HERBACEOUS WEED CONTROL IN LOBLOLLY PINE PLANTATIONS USING FLAZASULFURON

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Abstract--A total of 13 treatments were applied at four sites (two in Mississippi and two in Texas) to evaluate the efficacy of flazasulfuron applied alone or in mixtures for providing control of herbaceous weeds. All sites were newly established loblolly pine (*Pinus taeda* L.) plantations. Plots were evaluated monthly until 180 days after treatment. No phytotoxicity on pine seedlings was observed. Overall, flazasulfuron has potential for use in forestry herbaceous weed control applications but only in mixtures with other products.

INTRODUCTION

The benefits of herbaceous weed control (HWC) in recently planted pine plantations are well established. For more than 20 years, different herbicides have been evaluated for such applications. While there is no "silver bullet" which will provide complete control on every site, the combination of biological control and economics have narrowed the operational applications across the South to a relatively few choices of tank mixtures. These applications are all highly cost effective and therefore make it difficult for new products to enter the market. Combined with the established applications is the fact that very few new products are proposed for use in forestry applications. Thus, when a new product is proposed for use in forestry, it is worthwhile to conduct a thorough evaluation.

OBJECTIVES

The objectives of this study were as follows: (1) to evaluate the efficacy of flazasulfuron for herbaceous weed control in first-year loblolly pine (*Pinus taeda* L.) plantations; and (2) to evaluate the crop tolerance of loblolly pine seedlings to applications of Flazasulfuron.

STUDY SITES

Two study sites were utilized in Mississippi and in Texas. In each state, one site received all treatments with non-ionic surfactant added (0.25 percent v/v), and one site had treatments with no surfactant. In Mississippi, the first site was on forest industry land with Prentiss silt loam soil (pH = 5.3). The site was harvested April 2009, received a shear/combination plow treatment in August 2010, and was hand planted January 2011. The second site in Mississippi was on forest industry land with Smithdale-Ruston sandy clay loam soil (pH = 5.0). The area had been harvested June 2010, subsoiled August 2010, received chemical site preparation treatment September 2010, and was hand planted in January 2011.

In Texas, the first site was near the town of St. Augustine. It had clay soils and had been machine planted in winter 2011. The second site was near Forest, Texas, had sandy loam soils, and had been machine planted in winter 2011.

TREATMENTS

A complete list of treatments is provided in table 1. While the addition of non-ionic surfactant is presented in the table, it was included for treatments on only one site per state as noted earlier. The SL-160 listed in the table is flazasulfuron.

Treatments were applied on March 16 (without surfactant) and March 21, 2011 (with surfactant) in Mississippi. Treatments were applied on March 17 (without surfactant) and April 2, 2011 (with surfactant) in Texas. All treatments were applied as a 5-foot swath over the top of the planted seedlings using a CO_2-powered backpack sprayer and hand-held wand.

Each treatment was replicated four times at each site. A completely randomized design or randomized complete block design was utilized depending on site conditions. Each plot (replication) consisted of 100 linear feet of the planted row with the 5-foot spray swath.

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Table 1--List of treatments in 2011 ISK field trials using SL-160 (flazasulfuron) and non-ionic surfactant (NIS)

Treatment number	Herbicides (rates of product/A)
1	Untreated check
2	SL-160 (3 oz) + NIS (0.25% v/v)
3	SL-160 (6 oz) + NIS (0.25% v/v)
4	SL-160 (9 oz) + NIS (0.25% v/v)
5	Oust (2 oz) + NIS (0.25% v/v)
6	SL-160 (6 oz) + Arsenal AC (4 oz) + NIS (0.25% v/v)
7	SL-160 (9 oz) + Arsenal AC (4 oz) + NIS (0.25% v/v)
8	SL-160 (6 oz) + Velpar L (32 oz) + NIS (0.25% v/v)
9	SL-160 (9 oz) + Velpar L (32 oz) + NIS (0.25% v/v)
10	Oust (2 oz) + Arsenal AC (4 oz) + NIS (0.25% v/v)
11	Oust (2 oz) + Velar L (32 oz) + NIS (0.25% v/v)
12	Oust Extra (3 oz) + NIS (0.25% v/v)
13	SL-160 (6 oz) + Escort (1.07 oz) + NIS (0.25%)

EVALUATIONS

Plots were evaluated at 30, 60, 90, 120, 150, and 180 days after treatment (DAT). For each evaluation, an ocular estimate of ground cover was recorded by vegetation type of either grasses, broadleaf forbs, or vines. Loblolly pine seedlings were also evaluated for phytotoxic symptoms at each timing.

Data were analyzed using ANOVA procedures. Means were separated using Duncan's New Multiple Range Test (DNMRT).

RESULTS

No phytotoxic symptoms were observed on any seedlings at any evaluation timing in either state. Flazasulfuron is safe to use over loblolly pines at the rates tested in this study.

Mississippi--Differences were observed between sites in Mississippi. These are attributed to variation in site preparation and the ensuing weed complex which occupied each site. As might be expected, coverage by grasses and forbs was appreciably lower on the site which had received chemical site preparation.

On the site with no surfactant, grass coverage in untreated plots decreased through the growing season as forb coverage increased (tables 2 and 3). Grass control in treatments with flazasulfuron alone (treatments 2, 3, and 4) was not as good as areas treated with mixtures of flazasulfuron plus Arsenal AC® or Velpar L® (treatments 6, 7, 8, and 9). The best control was provided by treatment 10 (Arsenal AC® + Oust XP®) and 11 (Oust XP® + Velpar L®), but these treatments were not significantly different from the flazasulfuron tank mixes.

Forb pressure on this site was strong (table 3). Again, the flazasulfuron applied alone did not provide desirable levels of control (treatments 2, 3, and 4). Oust XP® applied alone provided the best control (treatment 5). This treatment and the Arsenal AC® + Oust XP® (treatment 10) provided the best forb control.

On the Mississippi site with surfactant added, there was very little grass coverage (table 4) which is attributed to the chemical site preparation. With this lack of competition, there were no significant differences in any of the treatments. Forb coverage on this site varied through the growing season as winter annuals gave way to warm season species (table 5). Overall, the high rate of flazasulfuron applied alone and the mixes with both Arsenal AC® and Velpar L® provided comparable control to the "standards" of Arsenal AC® + Oust XP® or Oust XP® + Velpar L®.

Texas--Texas endured the worst drought in their history of recorded weather conditions during 2011. In essence, the lack of moisture compromised the response to treatments. There was an effect of treatments (tables 6, 7, 8, and 9) evidenced by a comparison of untreated

Table 2--Average percent grass coverage In Mississippi flazasulfuron field trials without surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment					
	30	60	90	120	150	180
	percent					
1	80.0b	71.3c	72.5d	45.0c	38.8b	37.3b
2	13.0a	26.3b	55.0c	38.8b	36.3b	37.3b
3	12.5a	26.3b	51.3c	31.3b	28.8b	27.8b
4	7.3a	15.0ab	36.3bc	30.0b	31.3b	33.3b
5	6.0a	15.0ab	26.3b	37.5b	35.0b	33.3b
6	6.5a	7.0a	36.3bc	25.0ab	25.0ab	25.0ab
7	14.8a	5.0a	16.8ab	23.8ab	25.0ab	25.0ab
8	6.8a	11.3a	23.8b	26.3ab	26.3ab	25.0ab
9	6.3a	9.3a	26.8b	18.8a	21.3a	20.0a
10	10.8a	1.8a	6.8a	11.3a	12.5a	13.3a
11	7.0a	4.3a	8.0a	16.3a	16.3a	16.3a
12	4.5a	8.0a	20.0b	41.3bc	38.8b	37.3b
13	11.3a	23.8b	60.0c	51.3c	47.5c	45.0c

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 3--Average percent broadleaf coverage in Mississippi flazasulfuron field trials without surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment					
	30	60	90	120	150	180
	percent					
1	12.0b	38.0c	45.0b	62.5d	70.0e	75.0d
2	2.0a	20.0b	35.0b	48.8c	63.8d	65.8d
3	2.0a	12.5ab	27.5ab	30.0ab	41.3bc	45.0bc
4	1.5a	6.3a	26.3ab	35.0b	48.8c	50.8c
5	1.3a	6.3a	43.8b	35.0b	12.5a	18.8a
6	1.0a	4.5a	30.0ab	35.0b	46.3c	50.0c
7	0.8a	3.5a	22.5a	23.8a	32.5b	35.0b
8	2.5a	8.8a	22.5a	28.8a	40.0bc	41.3b
9	1.0a	4.5a	26.3ab	35.0b	42.5bc	42.5b
10	1.0a	1.5a	15.0a	21.3a	28.8b	33.3ab
11	1.3a	3.3a	40.0b	51.3c	61.3d	70.0d
12	0.5a	3.5a	30.0ab	42.5c	50.0c	56.8c
13	1.3a	3.3a	18.8a	32.5b	31.5b	37.8b

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 4--Average percent grass coverage in Mississippi flazasulfuron field trials with surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment					
	30	60	90	120	150	180
	percent					
1	0.0a	0.8a	3.8b	2.0ab	4.0b	7.5c
2	0.0a	0.3a	0.3a	0.5a	1.8a	3.3ab
3	0.0a	0.0a	0.5a	0.3a	1.3a	3.0ab
4	0.0a	0.3a	0.5a	0.3a	0.3a	3.0ab
5	0.0a	0.0a	0.3a	0.0a	0.5a	1.0a
6	0.0a	0.0a	0.0a	0.0a	0.5a	1.0a
7	0.0a	0.0a	0.0a	0.0a	0.8a	1.0a
8	0.0a	0.5a	0.5a	0.0a	0.3a	0.5a
9	0.0a	0.3a	0.3a	0.3a	0.5a	0.5a
10	0.0a	0.0a	0.0a	0.0a	0.5a	0.5a
11	0.0a	0.3a	0.3a	0.3a	0.5a	1.0a
12	0.0a	0.3a	0.0a	0.0a	0.0a	1.0a
13	0.0a	0.0a	0.3a	0.8a	1.8a	3.0ab

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 5--Average percent broadleaf coverage in Mississippi flazasulfuron field trials with surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment					
	30	60	90	120	150	180
	percent					
1	45.0c	41.3d	41.3b	57.5c	66.3c	70.0c
2	20.0b	28.8c	6.8a	27.5b	33.8b	35.3b
3	10.3b	12.8b	8.0a	25.0b	32.5b	37.3b
4	6.3a	33.8c	6.3a	16.3a	22.5ab	25.0a
5	9.3ab	19.0bc	5.0a	23.8ab	32.5b	34.3b
6	4.5a	17.0b	4.5a	20.0ab	25.0ab	30.0ab
7	9.5ab	19.0bc	4.0a	14.3a	18.8a	21.3a
8	3.0a	1.5a	3.5a	10.0a	17.5a	20.0a
9	3.0a	5.5a	3.0a	10.0a	15.5a	18.3a
10	8.8ab	2.0a	3.3a	12.5a	17.5a	20.3a
11	2.3a	3.3a	2.8a	9.5a	16.3a	18.8a
12	3.0a	12.8b	2.0a	10.0a	15.0a	18.8a
13	4.3a	12.8b	5.0a	15.0a	21.3a	25.0a

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 6--Average percent grass coverage in Texas flazasulfuron field trials with surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment				
	30	60	90	120	150
	percent				
1	9.0a	15.0a	32.5a	37.5a	37.5a
2	6.0ab	8.3b	25.0ab	22.5b	20.0bc
3	2.3b	4.8bc	18.3bc	20.8b	23.3b
4	1.5b	2.0c	10.3cde	13.3bcd	13.3cd
5	2.5b	7.3b	17.5bcd	20.0bc	27.5b
6	2.0b	4.3bc	10.8cde	6.5d	9.0d
7	2.0b	1.5c	6.3e	3.8d	3.8d
8	1.3b	2.0c	5.8e	5.8d	10.0cd
9	1.7b	4.3bc	8.5de	11.0cd	6.0d
10	3.3b	1.5c	2.5e	4.3d	6.0d
11	0.8b	1.8c	4.0e	4.0d	3.5d
12	1.7b	2.0c	8.5de	13.3bcd	12.5cd
13	3.3b	1.5c	6.0e	6.0d	8.5d

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 7--Average percent broadleaf coverage in Texas flazasulfuron field trials with surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment				
	30	60	90	120	150
	percent				
1	1.5a	9.5a	17.5a	27.5a	27.5a
2	1.0ab	2.0b	9.0b	11.5bc	15.8b
3	0.3b	1.0b	5.3bcd	7.8cd	7.8bc
4	0.5ab	1.0b	3.8bcd	4.8cd	4.8cd
5	1.0ab	1.5b	8.3bc	17.5b	15.0b
6	0.8ab	0.8b	1.3cd	1.8d	2.0c
7	0.5ab	1.0b	1.5cd	1.0d	2.0c
8	0.3b	0.5b	1.3cd	1.8d	1.8c
9	0.0b	0.3b	0.5d	1.5d	0.8c
10	0.5ab	0.8b	1.0d	2.0d	2.5c
11	0.3b	0.8b	1.3cd	1.3d	1.8c
12	0.8ab	0.8b	2.0cd	4.3cd	4.8c
13	0.5ab	1.0b	1.5cd	2.0d	2.0c

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 8--Average percent grass coverage in Texas flazasulfuron field trials without surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment				
	30	60	90	120	150
	percent				
1	1.0a	4.3a	8.3a	25.0abc	37.5ab
2	1.5a	4.3a	15.0a	27.5ab	37.5ab
3	1.5a	4.3a	7.3a	25.0abc	35.0ab
4	1.0a	4.3a	12.5a	22.5abc	37.5ab
5	1.5a	4.3a	7.3a	22.5abc	32.5ab
6	1.0a	2.5a	4.3a	15.0bc	27.5ab
7	1.0a	1.0a	26.0a	17.5bc	27.5ab
8	1.5a	2.0a	4.8a	12.5c	25.0b
9	1.5a	3.8a	6.8a	17.5bc	27.5ab
10	1.0a	1.5a	6.0a	15.0bc	30.0ab
11	1.5a	4.3a	10.8a	32.5a	45.0a
12	1.0a	2.0a	4.3a	17.5bc	30.0ab
13	1.3a	4.8a	6.5a	17.8bc	40.0ab

[a]Values in a column followed by the same letter do not differ at α = 0.05.

Table 9--Average percent broadleaf coverage in Texas flazasulfuron field trials without surfactant. Values are averages of all replications[a]

Treatment number	Days after treatment				
	30	60	90	120	150
	percent				
1	1.0a	2.5a	4.8ab	20.0ab	30.0ab
2	1.5a	3.8a	10.8a	20.0ab	35.0ab
3	1.5a	3.8a	7.3ab	20.0ab	32.5ab
4	1.0a	2.0a	10.0ab	20.0ab	35.0ab
5	1.5a	3.8a	7.3ab	15.0ab	30.0ab
6	0.8a	1.0a	2.5b	9.0b	20.0b
7	0.8a	1.0a	2.5b	13.3ab	25.0ab
8	1.0a	1.0a	4.3ab	12.5ab	20.0b
9	1.5a	3.8a	6.8ab	15.8ab	27.5ab
10	1.0a	1.5a	4.3ab	12.5ab	27.5ab
11	1.5a	4.3a	8.5ab	25.0a	42.5a
12	1.0a	1.0a	3.8ab	15.0ab	30.0ab
13	1.3a	4.5a	6.5ab	17.8ab	42.5a

[a]Values in a column followed by the same letter do not differ at α = 0.05.

areas (treatment 1) to treated plots (treatments 2 through13). However, the ability to separate treatments at either site was greatly impacted by the harsh weather conditions. Differences in weed pressure between the two sites are attributed to a difference in the species complex and the ability to endure the drought.

SUMMARY

The treatments in this study did not control *Andropogon* spp., johnsongrass [*Sorghum halpense* (L.) Pers.], or bermudagrass [*Cynodon dactylon* (L.) Pers.]. That is not unexpected as very few HWC treatments control these species, and the treatments commonly used in pine

plantations are not expected to control these species. Flazasulfuron applied alone did not provide desirable levels of grass control on the sites used in this study. The mixtures with Arsenal AC® and Velpar L® worked well and compared favorably to the operational applications currently used most widely in the South.

In forb control, the treatments did not control wooly croton (*Croton capitatus* Michx.), Virginia buttonweed (*Diodia virginiana* L.), horse nettle (*Solanum carolinense* L.), or purple cudweed [*Gamochaeta purpurea* (L.) Cabrera] very well. Of this group, only the wooly croton poses a serious threat to loblolly pine seedlings.

Flazasulfuron applied alone did not provide overall desirable levels of forb control on these sites. Again, mixtures with Arsenal AC® or Velpar L® did provide control of the forbs at levels comparable to HWC operational applications currently used in the South.

Overall, flazasulfuron has potential for use in forestry HWC applications. Based on results of this study, this material would not be applied alone, but mixtures with Arsenal AC® or Velpar L® could be effective.