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HERBICIDE STUDIES WITH CLOPYRALID ON LOBLOLLY PINE SEEDBEDS

by
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INTRODUCTION

Clopyralid is sold in the U.S. under various brand names including Stinger®, Transline®, and Lontrel®. Stinger® and Transline® are labeled in the United States for use in cottonwood and Eucalyptus plantations. Lontrel® Turf and Ornamental herbicide can also be applied to established dogwood, sycamore, oak and maple in nurseries. Clopyralid has activity on legumes, including sicklepod. Skroch (1990) tested clopyralid in North Carolina and found that it did not injure longleaf pine or Virginia pine. Due in part to the successful use of this herbicide in North Carolina, the Auburn University Southern Forest Nursery Management Cooperative tested this herbicide in 1997 and 1998. The objective of this research was to determine the tolerance of southern pines to a postemergence application of clopyralid.

METHODOLOGY

Herbicide experiments were conducted at ten nurseries (Table 1). At most nurseries, a preemergence herbicide application (oxyfluorfen at 0.56 kg a.i./ha) was applied at sowing. Herbicide plots (6' by 10') were arranged in a randomized complete block design with four replications at each nursery. The herbicide was applied postemergence to young seedlings. Clopyralid was formulated as a salt [40.9% active ingredient is the same as 31% acid equivalent (a.e.)]. The herbicide was mixed with water (with no surfactant) and applied with a $C0_2$ powered sprayer. Rates of 1/2pint (1X), 1 pint (2X), 2 pints (4X) of product per acre were tested. Most applications were in May and June but eight were in July and one was made in April (Table 1). Irrigation was delayed for at least 24 hours after application. Data were collected in the fall and winter and were analyzed using an analysis of variance (ANOVA) procedure.

RESULTS AND DISCUSSION

In mid-July, epinasty (stem twisting) was noted at the Beauregard Nursery and at the Blenheim Nursery in 1998. At the Beauregard Nursery, this symptom occurred at all three herbicide rates on both loblolly pine and slash pine. This effect was ephemeral and seedlings appeared to be normal at lifting in October.

Loblolly pine was tolerant of rates ranging from 1/2 to 2 pints of per acre. In general, variation in the seedbeds (replication) caused greater differences in tree size than did the herbicide application (Table 2). Out of 89 ANOVAs, the herbicide factor was statistically significant in only 4 tests.

The high rate of 2 pint/acre rate (0.75 lb a.e./acre) did not cause a significant reduction in either seedling density or in seedling size (as compared to the control). However, a reduction in seedling number was noted with the ½ pint rate in one nursery in Alabama (Table 3). However, higher rates were not significantly different from the controls.

Shoot weight was not affected by clopyralid (Table 4) and root weight at the 4X rate was not significantly different than the control (Table 5). Again, in one test in Alabama, an intermediate rate was lower by 0.4 g.

In no study were the heights (Table 6) or root-collar diameters (Table 7) reduced by the use of clopyralid. In one case, seedlings treated with 2 pints of clopyralid per acre were larger than the controls.

MANAGEMENT IMPLICATIONS

It appears from these tests that young loblolly pine seedlings have some tolerance to clopyralid. Apparently, in some years epinasty will result but seedlings appear to grow out of this condition with time. As a result of this research, Stinger® was registered for use on loblolly pine seedbeds in 1999 in 10 southern states.

LITERATURE

Skroch, W,A. 1990. Clopyralid: a new herbicide for weed control in conifers. Southern Nursery Association Research Conference 35:246-249.

Table 1. Location, sowing date, sower, treatment date, mulch, and soil characteristics for 19 loblolly pine studies.

Location	State	Sowing Date	Sower	Application	Mulch	Soil Texture	pH	Organic matter
Verbena-1	AL	4/10/97	Weyer	4/25/97	Bark	Loamy sand	4.8	1.5
Verbena-2	AL	4/10/97	Weyer	5/26/97	Bark	Loamy sand	4.8	1.5
Verbena-3	AL	4/20/98	Weyer	5/26/98	Bark	Loamy sand	4.9	1.7
Chatsworth-1	GA	5/1/98	Whitfield	5/27/98	Pine bark	Sandy loam	5.0	2.5
Trenton-1	SC	4/21/98	Summit	5/28/98	Sawdust	Loamy sand	5.2	1.7
Blenheim-1	SC	4/13/98	Øjyord	5/28/98	Soil stabilizer	Sand	4.3	1.1
Byromville-1	GA	5/5/97	Summit	5/29/97	Pine bark	Loamy sand	4.9	0.7
Camden-1	AL	4/29/98	Summit	6/2/98	Hog fuel	Sandy loam	4.8	1.9
Ashburn-1	GA	5/7/98	Summit	6/3/98	Soil stabilizer + pine bark	Loamy sand	5.2	1.0
Beauregard-1	LA	4/17/98	Øjyord	6/9/98	Pine needles	Loamy sand	5.9	1.3
Byromville-2	GA	5/5/97	Summit	6/17/97	Pine bark	Loamy sand	4.9	0.7
Verbena-4	AL	4/20/98	Weyer	6/25/98	Bark	Loamy sand	4.9	1.7
Chatsworth-2	GA	5/1/98	Whitfield	6/29/98	Pine bark	Sandy loam	5.0	2.5
Trenton-2	SC	4/21/98	Summit	6/30/98	Sawdust	Loamy sand	5.2	1.7
Blenheim-2	SC	4/13/98	Øjyord	6/30/98	Soil stabilizer	Sand	4.3	1.1
Ashburn-2	GA	5/7/98	Summit	7/6/98	Soil stabilizer + pine bark	Loamy sand	5.2	1.0
Elberta-1	AL	5/12/97	Øjyord	7/9/97	Soil stabilizer	Loamy sand	4.9	1.2
Camden-2	AL	4/29/98	Summit	7/10/98	Hog fuel	Sandy loam	4.8	1.9
Beauregard-2	LA	4/17/98	Øjyord	714/98	Pine needles	Loamy sand	5.9	1.3

Table 2. Probability values (p > F) for replication and treatment effects on loblolly pine seedlings.

	Replication					Treatment				
Location	Number	Shoot weight	Root Weight	Height	RCD	Number	Shoot weight	Root Weight	Height	RCD
Verbena-1	0.25	0.27	0.23	**0.02**	0.39	0.10	0.42	0.14	0.38	0.40
Verbena-2	0.30	0.46	0.62	0.17	0.25	**0.04**	0.07	0.18	0.15	0.23
Verbena-3	0.26	0.06	**0.01**	**0.01**	0.82	0.97	0.17	0.71	0.13	0.76
Chatsworth-1	0.36	0.29	0.14	0.40	**0.02**	0.17	0.26	0.40	0.54	0.13
Trenton-1	**0.03**	**0.04**	**0.00**	0.48	**0.02**	0.25	0.10	0.86	0.54	0.13
Blenheim-1	0.46	0.55	0.39	0.36	0.95	0.32	0.22	0.08	0.29	0.99
Byromville-1	0.31	--	--	**0.05**	**0.03**	0.91	--	--	0.07	**0.01**
Camden-1	0.06	0.32	0.95	0.06	0.35	0.16	0.33	**0.04**	0.82	0.22
Ashburn-1	0.25	**0.02**	**0.05**	0.97	0.63	0.42	0.34	0.43	0.07	0.62
Beauregard-1	0.44	0.06	0.17	**0.03**	0.17	0.48	0.69	0.20	0.62	0.23
Byromville-2	0.37	--	--	0.93	0.20	0.92	--	--	0.09	0.37
Verbena-4	0.22	0.60	0.07	0.07	0.85	0.68	0.91	0.65	0.19	0.74
Chatsworth-2	0.18	0.56	0.50	0.87	0.84	0.43	0.45	0.33	0.99	0.35
Trenton-2	0.49	0.31	**0.03**	0.87	0.51	0.75	0.68	0.09	0.66	0.40
Blenheim-2	0.99	0.38	0.78	0.64	0.51	0.98	0.35	0.40	0.08	0.15
Ashburn-2	0.58	0.27	0.60	0.07	0.57	0.23	0.81	0.30	0.61	0.58
Elberta-1	--	0.56	0.50	--	0.97	--	0.66	0.38	--	0.72
Camden-2	0.27	0.83	0.06	0.35	**0.05**	0.29	0.56	0.21	0.85	0.96
Beauregard-2	0.17	0.10	0.27	0.12	0.25	0.24	0.12	0.75	**0.05**	0.47

Table 3. Effect of clopyralid on the number of loblolly pine seedlings per square meter.

Nursery location	Pints per acre			
	0	1/2	1	2
Verbena-1	248	280	266	245
Verbena-2	272a	**242b**	280a	264ab
Verbena-3	285	280	280	269
Chatsworth-1	280	266	258	261
Trenton-1	226	213	186	196
Blenheim-1	248	245	229	221
Byromville-1	223	239	245	237
Camden-1	234	215	239	207
Ashburn-1	145	161	140	137
Beauregard-1	218	194	207	210
Byromville-2	272	266	280	274
Verbena-4	269	264	264	266
Chatsworth-2	218	231	231	245
Trenton-2	181	161	173	186
Blenheim-2	285	283	280	283
Ashburn-2	167	186	132	148
Camden-2	242	223	226	231
Beauregard-2	215	210	231	215

Treatments highlighted in **BOLD** are significantly different from the control at the 5% level of probability according to Duncan's new multiple range test.

Table 4. Effect of clopyralid on shoot weight (g) of loblolly pine seedlings.

Nursery location	Pints per acre			
	0	1/2	1	2
Verbena-1	3.0	2.9	3.0	3.2
Verbena-2	2.7	3.3	2.8	2.8
Verbena-3	2.4	2.4	2.5	2.3
Chatsworth-1	2.1	2.3	2.2	2.1
Trenton-1	1.5	1.4	1.8	1.6
Blenheim-1	2.6	2.8	2.8	3.0
Camden-1	2.6	2.7	2.5	2.6
Ashburn-1	2.6	2.8	2.7	2.7
Beauregard-1	2.6	2.8	2.7	2.5
Verbena-4	2.3	2.4	2.2	2.2
Chatsworth-2	2.2	2.1	2.3	2.0
Trenton-2	1.4	1.4	1.4	1.3
Blenheim-2	2.4	2.2	2.5	2.3
Ashburn-2	2.6	2.5	2.4	2.5
Elberta-1	5.1	4.9	4.5	4.9
Camden-2	2.9	2.9	2.9	2.8
Beauregard-2	2.7	2.4	2.3	2.5

Treatments highlighted in **BOLD** are significantly different from the control at the 5% level of probability according to Duncan's new multiple range test.

Table 5. Effect of clopyralid on root weight (g) of loblolly pine seedlings.

Nursery location	Pints per acre			
	0	1/2	1	2
Verbena-1	0.39	0.33	0.34	3.6
Verbena-2	0.34	0.38	0.32	0.33
Verbena-3	0.28	0.28	0.28	0.25
Chatsworth-1	0.39	0.43	0.42	0.38
Trenton-1	0.25	0.24	0.25	0.25
Blenheim-1	0.47	0.48	0.55	0.52
Camden-1	0.35a	0.37a	**0.31b**	0.33ab
Ashburn-1	0.49	0.55	0.53	0.50
Beauregard-1	0.38	0.38	0.38	0.30
Verbena-4	0.28	0.27	0.28	0.27
Chatsworth-2	0.37	0.37	0.41	0.36
Trenton-2	0.27	0.25	0.24	0.23
Blenheim-2	0.45	0.39	0.50	0.41
Ashburn-2	0.53	0.47	0.47	0.45
Elberta-1	1.88	1.91	1.64	1.85
Camden-2	0.30	0.33	0.32	0.33
Beauregard-2	0.34	0.32	0.31	0.33

Treatments highlighted in **BOLD** are significantly different from the control at the 5% level of probability according to Duncan's new multiple range test.

Table 6. Effect of clopyralid on height (cm) of loblolly pine seedlings.

Nursery location	Pints per acre			
	0	1/2	1	2
Verbena-1	28.5	28.5	29.5	29.4
Verbena-2	27.0	29.0	29.0	28.2
Verbena-3	28.0	27.6	27.5	29.0
Chatsworth-1	23.8	24.4	24.2	24.9
Trenton-1	18.5	18.3	20.5	19.6
Blenheim-1	22.7	24.1	25.1	27.6
Byromville-1	22.7	22.7	21.1	22.0
Camden-1	32.2	33.4	33.3	33.2
Ashburn-1	26.4	25.6	23.0	23.5
Beauregard-1	28.9	28.2	27.7	27.7
Byromville-2	28.6	30.1	30.0	30.1
Verbena-4	30.1	29.3	30.3	30.9
Chatsworth-2	23.9	23.9	23.8	24.0
Trenton-2	16.7	17.5	17.8	17.6
Blenheim-2	24.6	23.4	25.6	22.7
Ashburn-2	24.3	25.3	24.1	24.4
Camden-2	36.2	36.8	36.7	37.3
Beauregard-2	27.8a	**25.5b**	27.7a	27.2ab

Treatments highlighted in **BOLD** are significantly different from the control at the 5% level of probability according to Duncan's new multiple range test.

Table 7. Effect of clopyralid on root-collar diameter (mm) of loblolly pine seedlings.

		Pints per acre			
Nursery location	State	0	1/2	1	2
Verbena-1	AL	4.3	4.2	4.6	4.4
Verbena-2	AL	4.2	4.9	4.5	4.3
Verbena-3	AL	4.0	4.0	4.0	3.9
Chatsworth-1	GA	4.2	4.5	4.5	4.3
Trenton-1	SC	3.2	3.1	3.2	3.2
Blenheim-1	SC	4.1	4.1	4.1	4.1
Byromville-1	GA	2.5b	2.7b	2.8b	**3.2a**
Camden-1	AL	3.7	3.8	3.7	3.6
Ashburn-1	GA	4.2	4.1	4.1	4.0
Beauregard-1	LA	3.5	3.6	3.4	3.4
Byromville-2	GA	3.6	3.8	3.8	3.9
Verbena-4	AL	4.0	3.8	4.0	3.9
Chatsworth-2	GA	4.2	4.2	4.0	4.1
Trenton-2	SC	3.0	3.1	3.1	3.0
Blenheim-2	SC	4.0	3.7	3.9	3.6
Ashburn-2	GA	4.0	3.9	4.0	3.9
Elberta-1	AL	6.7	6.7	6.4	6.6
Camden-2	AL	3.7	3.7	3.7	3.7
Beauregard-2	LA	3.3	3.3	3.4	3.3

Treatments highlighted in **BOLD** are significantly different from the control at the 5% level of probability according to Duncan's new multiple range test.