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HERBCICIDE GALLS ON LOBLOLLY PINE SEEDLINGS

by
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INTRODUCTION

Spurge (*Chamaesyce maculate*) is a troublesome weed in southern pine nurseries and under some conditions can stunt seedling growth (South and Hill 2008). Oxyfluorfen (e.g. Goal®) provides some level of preemergence control, but once spurge seeds germinate and become established, the weed is difficult to control with most selective herbicides. Trials with metsulfuron methyl provided excellent control of emerged prostrate spurge (South and Hill 2007), but this herbicide can cause stunting, especially when applied to very young seedlings.

Preliminary trials with the herbicide pendimethalin produced excellent control of spurge at the Pine Hill Nursery in Alabama (South and Hill 2007; 2008). In 2008, testing was expanded to include nurseries in Elberta, Alabama and Jesup, Georgia. The objective of this study was to determine if this herbicide could be applied at nurseries with higher sand content and still obtain weed control without seedling injury.

METHODOLOGY

Four studies were installed during the 2008 growing season. Plot size was one seedling bed wide (4 ft) and 10-feet long. Pendimethalin (Pendulum-Aquacap®) was applied either once (e.g. May) or twice (May and again in June). Each treatment was replicated five times along the nursery bed. Treatments (a total of seven) were applied using a CO_2-backpack sprayer calibrated to apply 22

gallons per acre. The rate applied for each application was 68 ounces per acre (2 pounds a.i./acre/application). A fifth study (only two replications) was also installed at the Trenton Nursery in South Carolina where three rates of pendimethalin were applied in May.

Seedling densities (i.e. number of seedlings per square meter) were recorded using a 1'x 4' counting frame. Seedling samples were hand-lifted from the center of each plot and were transported to Auburn for analysis. Seeding shoot height and root-collar diameter were measured on 25 seedlings per plot. Oven-dry weights of shoots and roots were recorded for each 25-seedling sample. Seedlings at the Camden Nursery were also examined for knots (i.e. swellings, knots, bumps, galls) in September and then in February, they were examined again for herbicide galls at the groundline. At the other nurseries, only herbicide galls were recorded. Data were subjected to ANOVA and treatment effects were compared using orthogonal contrasts.

RESULTS

Soil texture at the Camden Nursery was classified a sandy loam with about 17% clay while soils at the Trenton and Jesup Nurseries contained less than 10% clay (Table 1). Seed were sown in April and at three nurseries, the first application of pendimethalin was applied in May. At the Elberta Nursery, the first application was made in mid-July (Table 2).

A single application of 2 lb a.i./acre had no effect on height, root weight, shoot weight or stocking at the Pine Hill Nursery (Table 3-4) but reduced seeding height slightly at the Elberta Nursery (Table 5-6). No reductions in either height, or biomass were observed at Jesup (Table 7-8) or the Trenton nurseries (Table 9-10). This rate of pendimethaline increased seeding diameter at the root-collar at the Trenton Nursery (Table 10).

The double application of pendimethalin (2 + 2 lb a.i./acre) did not affect height, diameter, root weight, shoot weight, or stocking levels when compared to the untreated control. However, this treatment did increase the average shoot weight at the Pine Hill Nursery (Table 4). Applying 4 or 6 lb a.i./acre did not have any effect on seedling morphology at the Trenton Nursery (Table 11-12).

The presence of herbicide galls (Figure 1) occurred at all four nurseries. At the 2 lb ai/acre rate, the amount of galls varied from almost 0% (1 out of 175 seedlings) at Trenton (Tables 10 and 12) to 28% at Jesup. The second application increased the amount of galls at the Jesup Nursery (Table 9) but not at the Camden or Elberta Nurseries (Table 5, 7). At the Trenton Nursery (Table 11-12), the herbicide produce 18 to 30% galls when seedlings were treated with 4 to 6 lbs a.i./a in May. At some sites, the galls resulted in larger stem diameters (Tables 4, 10).

Some "knots" on the stem between the groundline and the cotyledons were also observed at the Pine Hill Nursery. However, these were not of the same type as that found at other nurseries. These were related to location with 7% occurring in block 1 and 18% in block two.

MANAGEMENT IMPLICATIONS

These findings indicate that an application of pendimethalin (2 lb a.i./acre) in late May or mid-July

has no observable effect on seedbed density, but might either increase or decrease average height by 1 cm. However, at some nurseries this treatment will cause galls to appear at the groundline (Figure 1). The reason why galls occur at some nurseries but not at others is unknown. It was initially assumed that clay content might explain why herbicide galls were not observed at the Pine Hill Nursery but were observed at the Jesup Nursery. However, galls were not observed on plots receiving a double application (May + June) at the Trenton Nursery.

Genetics might explain the variable response among nurseries. The number of pendimethalin induced herbicide galls in soybeans (*Glycine max*) depends on genotype. Stem breakage may vary from 24 to 82%, depending upon genotype (Glover and Schapaugh 2002). If genetics also plays a role in formation of herbicide galls, then it will be difficult to predict when it is safe to apply pendimetalin to young loblolly pine seedlings.

This study indicates that at some nurseries, pendimethalin can produce herbicide galls at the groundline. The percentage of galls produced depends, in part, on the herbicide rate.

REFERENCES

Glover, D.G. and W.T. Schapaugh Jr. 2002. Inheritance of resistance to pendimethalin herbicide induced stem damage in soybean. Euphytica 125: 433-437.

South, D.B. and T. Hill. 2007. A spurge trial in Alabama. Auburn University Southern Forest Nursery Management Cooperative. Research Report 07-1. 3 p

South, D.B. and T. Hill. 2008. Spurge reduces seedling growth. Auburn University Southern Forest Nursery Management Cooperative. Research Report 08-7. 4 p

Table 1. Soil texture, organic matter (OM) and soil acidity of the loblolly pine nurseries.

Nursery	Texture	Sand	Silt	Clay	OM	pH
		---------- (%) ----------				
Camden, AL	sandy loam	66	17	17	1.0	4.9
Elberta, AL	sandy loam	72	14	14	1.5	5.2
Jesup, GA	sandy loam	77	15	8	2.3	5.2
Trenton, SC	loamy sand	80	11	9	1.5	5.1

Table2. Sowing date, mulch type, application dates and lifting dates for studies in 2008.

Nursery	Sow date	Mulch	First	Second	Lift date
Pine Hill	4/24	Agrilock	5/22	6/19	9/23
Elberta	4/30	Agrilock	7/16	8/13	11/22
Jesup	4/19	Agrilock+bark	5/28	7/1	11/18
Trenton	4/16	Agrilock	5/19	6/24	10/15

Table 3. Analysis of Variance for loblolly pine seedlings as affected by herbicides at the Pine Hill Nursery.

Source	df	Density	RCD	Height	Root	Shoot	Knots	Galls
		----Probability of a greater F-value----						
Replication	4	0.0452	0.8078	0.0352	0.1127	0.2881	0.0391	0.1903
Treatment	6	0.2468	0.0112	0.0003	0.0917	0.0265	0.6050	0.2193
Control vs. 1 application	(1)	0.8595	0.1526	0.1372	0.9870	0.1408	0.8714	0.3203
Control vs. 2 applications	(1)	0.4288	0.0057	0.0512	0.2579	0.0148	0.6281	0.1886
Error	24							

Table 4. Morphological characteristics for loblolly pine seedlings at the Pine Hill Nursery.

Treatment	rate	Density (#/m^2)	RCD (mm)	Height (cm)	Root (g)	Shoot (g)	Knots (%)	Galls (%)
Control	0	218	2.8	19.9	0.159	1.28	10	0
pendimethalin	2	216	3.0	21.9	0.130	1.38	11	2
pendimethalin	2+2	206	3.2	22.6	0.159	1.56	13	3
(LSD)		*33.1*	*0.28*	*2.78*	*0.034*	*0.30*	*10*	*5*

Table 5. Analysis of Variance for loblolly pine seedlings as affected by herbicides at the Elberta Nursery.

Source	df	Density	RCD	Height	Shoot	Root	Galls
		--------- Probability of a greater F-value ---------					
Replication	4	0.3857	0.3085	0.2072	0.6233	0.1794	0.2393
Treatment	6	0.9340	0.2312	0.3417	0.4884	0.6325	0.0080
Control vs. 1 application	(1)	0.7115	0.6402	0.0308	0.1004	0.5300	0.0089
Control vs. 2 applications	(1)	0.9018	0.1466	0.4287	0.8366	0.3422	0.0068
Error	24						

Table 6. Morphological characteristics for loblolly pine seedlings at the Elberta Nursery.

Treatment	rate	Density (#/m^2)	RCD (mm)	Height (cm)	Shoot (g)	Root (g)	Galls (%)
Control	0	181	4.6	28.8	3.89	0.37	4
pendimethalin	2	186	4.5	27.3	3.43	0.35	23
pendimethalin	2+2	182	4.8	28.3	3.84	0.39	24
(LSD)		*26.7*	*0.29*	*1.37*	*0.56*	*0.05*	*14*

Table 7. Analysis of Variance for loblolly pine seedlings as affected by herbicides at the Jesup Nursery.

Source	df	Density	RCD	Height	Shoot	Root	Galls
		---Probability of a greater F-value---					
Replication	4	0.2827	0.0079	0.0427	0.0339	0.1549	0.1483
Treatment	6	0.0018	0.2154	0.0617	0.8531	0.4486	0.0001
Control vs. 1 application	(1)	0.3789	0.2771	0.0560	0.6097	0.6292	0.0001
Control vs. 2 applications	(1)	0.3300	0.5051	0.6983	0.8121	0.4828	0.0001
Error	22						

Table 8. Morphological characteristics for loblolly pine seedlings at the Jesup Nursery.

Treatment	rate	Density (#/m^2)	RCD (mm)	Height (cm)	Shoot (g)	Root (g)	Galls (%)
Control	0	198	4.9	29.1	3.99	0.75	0
pendimethalin	2	190	5.1	32.8	4.14	0.72	28
pendimethalin	2+2	190	5.1	30.2	3.97	0.72	100
(LSD)		*19.6*	*0.39*	*3.92*	*0.63*	*0.14*	*12*

Table 9. Analysis of Variance for loblolly pine seedlings as affected by herbicides at the Trenton Nursery.

Source	df	Density	RCD	Height	Shoot	Root
		------- Probability of a greater F-value -------				
Replication	1	0.0143	0.0238	0.0095	0.2532	0.0852
Treatment	7	0.0603	0.0001	0.0315	0.1519	0.0104
Control vs. 1 application	(1)	0.0147	0.0001	0.0795	0.3028	0.0973
Control vs. 2 applications	(1)	0.6039	0.0001	0.0833	0.0871	0.2063
Error	24					

Table 10. Morphological characteristics for loblolly pine seedlings at the Trenton Nursery.

Treatment	rate	Density (#/m^2)	RCD (mm)	Height (cm)	Shoot (g)	Root (g)	Galls (%)
Control	0	168	4.1	20.5	3.07	0.51	0
pendimethalin	2	161	4.8	22.3	3.34	0.56	0
pendimethalin	2+2	178	4.9	22.3	3.53	0.55	0
(LSD)		*25.3*	*0.25*	*2.04*	*0.53*	*0.06*	-

Table 11. Analysis of Variance for pendimethalin applied in May at 3 rates at the Trenton Nursery.

Source	df	Density	RCD	Height	Shoot	Root	Galls
		---Probability of a greater F-value---					
Replication	1	0.8101	0.5008	0.1555	0.7399	0.7399	0.4015
Treatment	7	0.0442	0.0577	0.2457	0.1857	0.1857	0.0002
Control vs. 2 lbs.	(1)	0.6342	0.9607	0.9264	0.0460	0.0631	0.5704
Control vs. 4 lbs.	(1)	0.1347	0.4374	0.6322	0.3858	0.6211	0.0011
Control vs. 6 lbs.	(1)	0.4005	0.7793	0.5239	0.5602	0.7837	0.0001
Error	7						

Table 12. Morphological characteristics of loblolly pine seedlings at the rate study at the Trenton Nursery.

Treatment	rate	Density (#/m^2)	RCD (mm)	Height (cm)	Shoot (g)	Root (g)	Galls (%)
Control	0	144	4.6	26.0	3.72	0.58	0
pendimethalin	2	151	4.6	25.9	4.06	0.62	2
pendimethalin	4	167	4.8	25.1	3.94	0.56	18
pendimethalin	6	132	4.5	24.8	3.62	0.49	30
(LSD)		*31.9*	*0.55*	*4.44*	*0.87*	*0.17*	*8*

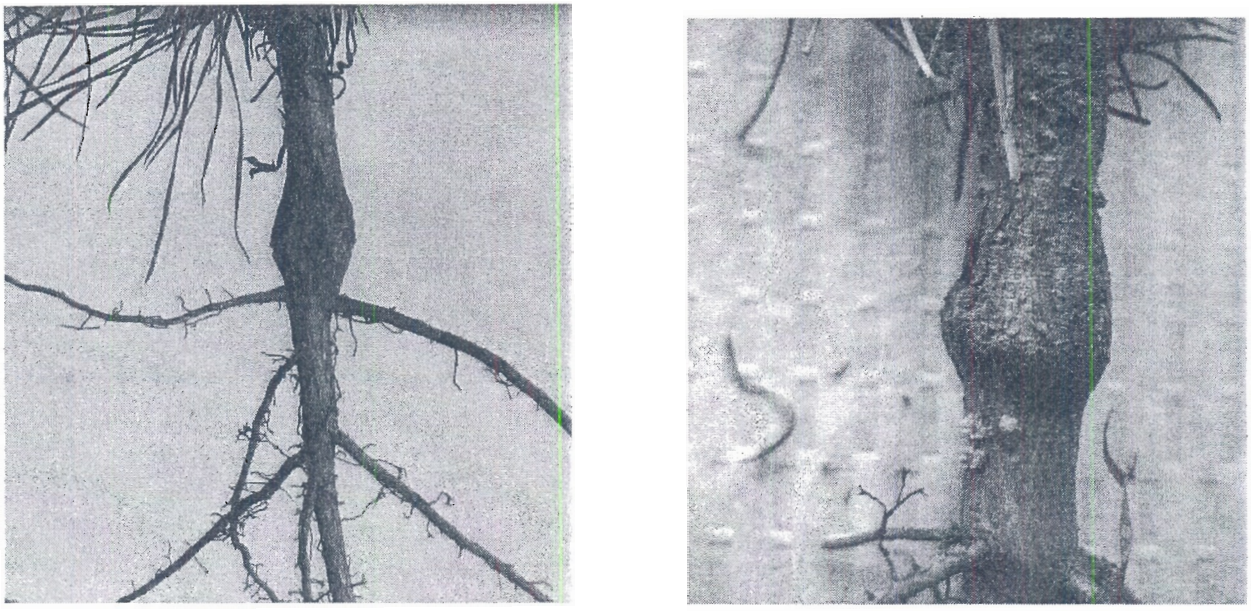

Figure 1. Herbicide galls at the Elberta Nursery (left) and Jesup Nursery (right).