Auburn University Southern Forest Nursery Management Cooperative

RESEARCH REPORT 04 - 4

TRIALS WITH A NEW FORMULATION OF OXYFLUORFEN

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INTRODUCTION

The herbicide oxyfluorfen (Goal®) is registered for use in pine seedbeds and field-grown deciduous trees. Formulations used in seedbed include 1.6 EC and 2 XL. The 1.6 EC formulation contains 9 to 10% xylene and a 2XL formulation might contain 54 to 59% petroleum naphtha. These additives help to provide good contact activity on weeds but they also cause cosmetic "speckling" to occur on newly emerged needles (South 1984). For this reason, the 2XL label indicates that the first postemergence application should be delayed until 5 weeks after emergence. When emergence occurs 3 weeks from sowing, this means there can be a gap of 8 weeks from sowing till the first postemergence application.

A new formulation is now being marketed by Dow AgroSciences that does not contain either xylene, naphthalene or any aromatic solvent. Goal® 4F is a water based 4 lb ai/gallon that is an SC (suspension concentrate) formulation. The 4F formulation has less contact activity than the XL formulation because the new formulation lacks an aromatic solvent. In addition, the particles of oxyfluorfen in suspension are approximately of 1.8 μm in diameter and are not taken up as efficiently by the plant leaves. As a result, contact activity on weeds is less with the 4F product than with formulations containing aromatic solvents. The cost per acre of the 4F product will be higher than the 2XL product. The main advantage of the 4F formulation is the toxicity to newly emerged pines is less than with formulations that contain aromatic solvents. To determine phytotoxicity, trials with the 4F formulation were conducted at two loblolly pine (*Pinus taeda*) nurseries and at one nursery that produced shortleaf pine (*Pinus echinata*). Soils varied from a sand to a loam (Table 1).

METHODOLOGY

Five studies were installed during the 2003 growing season (four with loblolly pine and one with shortleaf pine). A timing study at the Elberta Nursery involved 3 studies (each applied at a different date). Loblolly pine seeds were sown in April and seedlings were treated 3, 5 and 7 weeks after sowing. Additional tests (involving a single application date) were conducted at the Shubuta Nursery and at the Delano Nursery (shortleaf pine). Each study was installed as a randomized complete block design with five replications. Plot size was 10-feet long and one bed wide. Each study involved three herbicide treatments plus an untreated control. Herbicides were applied using a CO_2-backpack sprayer calibrated to apply 28.4 gallons per acre. Treatments included rates of 0.5, 1 and 2 quarts of product/acre. This is equivalent to 0.5, 1.0 and 2.0 lbs of oxyfluorfen per acre. Seedling densities (i.e. number of seedlings per square foot) were recorded in the Fall 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. Heights and root-collar diameters were measured on 25 seedlings per plot. Oven-dry weights of shoots and roots were recorded for each 25-seedling sample. Treatment effects were compared using linear and quadratic contrasts.

RESULTS

Treating loblolly pine seedlings three weeks after sowing did not affect RCD, height, and dry weight (Table 2). No cosmetic speckling occurred and no forking occurred. However, the 2 lbs a.i./acre rate did reduce stand density as indicated by a significant quadratic relationship. This suggests that applying the herbicide at a rate of 16 times normal might have an effect on germinating seed. Seedling biomass per area was also less than when treated at 1 lb a.i./acre.

When applied five weeks after sowing, only positive effects were observed (Table 3). The herbicide treatment resulted in greater RCD, height and shoot weight (as indicted by a significant linear effect). There was no significant effect on either stand density or total biomass production per area with this treatment

When the herbicide was applied seven weeks after sowing, there were no significant effects on stand density, RCD, height, shoot weight, or biomass per area (Table 4). However, there was a significant linear relationship for root dry weight. Seedlings treated with oxyfluorfen had less root mass than the controls.

Soil texture at the Shubuta Nursery is classified as a sand with an organic matter content of 1% (Table 1). At this nursery the herbicide treatments had no significant effect on stand density or seedling development (Table 5). Similar results were observed on shortleaf pine at the Delano Nursery (Table 6).

MANAGEMENT IMPLICATIONS

Typically, young pine seedlings are treated with only 0.125 lb a.i./acre (equivalent to 4 fluid ounces of Goal® 4F). We tested rates 4 to 16 times higher to see if any toxicity would occur at the higher rates. No injury was observed on seedlings when treated with 8 times the normal rate. *Although the 4F label reads the same as the 2XL label (both say to wait a minimum of 5 weeks after emergence), our trials indicate the 4F formulation can be applied safely 5 weeks after sowing.*

One problem nursery managers sometimes have is that weeds develop 4 or 5 weeks after sowing but to avoid injuring young plants, they delay applying Goal® 2XL until 8 weeks after sowing (e.g. 5 weeks from emergence). A two month interval between herbicide applications often allows time for weeds to develop. However, for the best weed control, applications of oxyfluorfen should be made prior to weed germination (South and Gjerstad 1980). Therefore, some managers apply lactofen (Cobra® 2L) six or seven weeks after sowing. Although lactofen can cause some necrosis to new tissue, the amount is less than with the 2XL formulation of oxyfluorfen. *From our limited experience, we did not see any visual phytotoxicity with the 4F formulation. Some nursery managers may switch from using lactofen on young pine seedlings to using Goal® 4F. However, lactofen is likely better on prostrate spurge than an equivalent rate of oxyfluorfen.*

There is another benefit from using the 4F formulation. Occasionally, weather conditions at a nursery will be conducive to codistillation of the oxyfluorfen applied as a 2XL formulation. For example, one nursery produced container-grown hardwoods near seedbeds of pine. The 2XL formulation was applied to large blocks of pine seedbeds and codistillation occurred. The chemical then drifted in the direction of the hardwoods and typical oxyfluorfen injury occurred along the margins of the new hardwood leaves. There should be less codistillation (or "reach-back") activity with the 4F formulation. *Nursery managers who use the 4F formulation should see less injury to sensitive crops that are growing near pine seedbeds.*

REFERENCES

South, D.B. 1984. Response of loblolly pine and sweetgum seedlings to oxyfluorfen. Canadian Journal of Forest Research 14:601-604.

South, D.B. and D.H. Gjerstad. 1980. Oxyfluorfen: an effective herbicide for southern pine nurseries. Southern Journal of Applied Forestry 4:36-39.

Table 1. Sowing date, treatment dates, soil texture, organic matter (OM) and soil acidity of the herbicide tests.

Nursery	Sowing	Treatment	Texture	Sand	Silt	Clay	OM	pH
				----------(%)----------				
Delano	4/4	6/4	loam	46	41	13	1.9	4.9
Elberta	5/5	5/27;6/10;6/24	loamy sand	79	12	9	1.0	5.7
Shubuta	4/14	5/28	sand	89	8	3	1.2	4.5

Table 2: Morphological characteristics for loblolly pine seedlings lifted on September 23 at the Elberta Nursery (seedlings treated 3 weeks after sowing).

Oxyfluorfen Rate lbs. Ai/acre	Density (#/sq ft)	RCD (mm)	Height (cm)	Root (g)	Shoot (g)	Total dry weight (g/sq ft)
0	16.2	3.4	24.8	0.17	1.79	31.53
0.5	16.9	3.3	24.7	0.17	1.73	32.01
1.0	18.0	3.4	25.4	0.16	1.75	34.07
2.0	14.6	3.4	25.0	0.16	1.79	27.79
lsd	*2.749*	*0.208*	*1.079*	*0.044*	*0.278*	*4.170*
P > F-value	0.103	0.833	0.492	0.890	0.934	0.042
Linear	0.366	0.873	0.435	0.457	0.936	0.156
Quadratic	0.038	0.385	0.564	0.881	0.552	0.028
Lack-of-fit	0.257	0.877	0.236	0.931	0.850	0.127

Table 3: Morphological characteristics for loblolly pine seedlings lifted on October 21 at the Elberta Nursery (seedlings treated 5 weeks after sowing).

Oxyfluorfen Rate lbs. Ai/acre	Density (#/sq ft)	RCD (mm)	Height (cm)	Root (g)	Shoot (g)	Total dry weight (g/sq ft)
0	18.3	3.9	29.5	0.28	2.64	52.87
0.5	17.8	4.0	29.3	0.31	2.70	53.83
1.0	17.0	4.1	30.5	0.30	2.81	52.84
2.0	16.7	4.1	30.4	0.31	2.84	52.64
lsd	*3.217*	*0.140*	*1.038*	*0.060*	*0.188*	*10.400*
P > F-value	0.718	0.171	0.058	0.630	0.109	0.994
Linear	0.270	0.045	0.024	0.427	0.020	0.913
Quadratic	0.925	0.384	0.963	0.654	0.775	0.867
Lack-of-fit	0.883	0.729	0.098	0.361	0.648	0.858

Table 4: Morphological characteristics for loblolly pine seedlings lifted on November 11 at the Elberta Nursery (seedlings treated 7 weeks after sowing).

Oxyfluorfen Rate lbs. Ai/acre	Density (#/sq ft)	RCD (mm)	Height (cm)	Root (g)	Shoot (g)	Total dry weight (g/sq ft)
0	16.8	4.8	30.9	0.83	4.16	84.32
0.5	16.8	4.6	30.2	0.72	3.64	72.78
1.0	16.8	4.7	30.4	0.73	4.00	79.62
2.0	17.6	4.6	31.2	0.71	3.90	80.73
lsd	*2.168*	*0.211*	*1.054*	*0.098*	*0.408*	*13.560*
P > F-value	0.826	0.377	0.166	0.069	0.092	0.351
Linear	0.479	0.238	0.422	0.027	0.476	0.845
Quadratic	0.580	0.749	0.040	0.195	0.145	0.177
Lack-of-fit	0.852	0.213	0.850	0.331	0.042	0.244

Table 5: Morphological characteristics for loblolly pine seedlings lifted on December 1 at the Shubuta Nursery (seedlings treated 6 weeks after sowing).

Oxyfluorfen Rate lbs. Ai/acre	Density (#/sq ft)	RCD (mm)	Height (cm)	Root (g)	Shoot (g)	Total dry weight (g/sq ft)
0	18.2	5.4	33.5	1.85	5.26	124.64
0.5	19.3	5.4	33.7	1.88	5.43	137.28
1.0	19.6	5.2	34.0	1.78	5.13	132.55
2.0	9.5	5.2	33.7	1.76	5.09	132.87
lsd	*3.825*	*0.299*	*0.819*	*0.193*	*0.558*	*21.970*
P > F-value	0.851	0.203	0.587	0.527	0.557	0.661
Linear	0.480	0.065	0.506	0.226	0.334	0.543
Quadratic	0.624	0.653	0.355	0.713	0.564	0.404
Lack-of-fit	0.951	0.332	0.450	0.464	0.386	0.495

Table 6: Morphological characteristics for loblolly pine seedlings lifted on November 12 at the Delano Nursery (seedlings treated 8.5 weeks after sowing).

Oxyfluorfen Rate lbs. Ai/acre	Density (#/sq ft)	RCD (mm)	Height (cm)	Root (g)	Shoot (g)	Total dry weight (g/sq ft)
0	14.9	5.5	23.4	1.42	4.52	87.87
0.5	14.2	5.4	23.2	1.34	4.46	83.84
1.0	15.6	5.5	22.9	1.37	4.82	95.87
2.0	12.3	5.7	23.2	1.45	5.20	80.30
lsd	*2.496*	*0.467*	*1.397*	*0.200*	*0.792*	*17.820*
P > F-value	0.065	0.519	0.841	0.631	0.214	0.308
Linear	0.105	0.315	0.578	0.680	0.060	0.687
Quadratic	0.128	0.284	0.532	0.240	0.401	0.339
Lack-of-fit	0.079	0.859	0.772	0.790	0.742	0.117