United States Department of Agriculture

Forest Service

Southern Forest Experiment Station

Research Note

SO-381
September 1995

Controlling Herbaceous Competition in Pasture Planted with Loblolly Pine Seedlings

James D. Haywood

SUMMARY

Three treatments designed to control herbaceous vegetation competing with loblolly pine (*Pinus taeda* L.) seedlings planted in grazed and ungrazed pasture were tested. Effects of the treatments on seedling survival and growth during the first 3 years after planting were determined. The treatments were directed application of herbicides (glyphosate in the first 2 years and hexazinone in the third year), rotary mowing, and mulching with pine straw around individual pine seedlings.

After 3 years, the herbicide and mulching treatments increased the groundline diameter and total height of loblolly pine seedlings. Grazing apparently reduced pine survival and height growth. However, the observed treatment effects are not sufficient basis for a recommendation that a particular cultural practice be applied. Landowners who want to continue grazing cattle as pastures convert to pine will have to accept a reduction in pine survival and less seedling height growth.

INTRODUCTION

Many pastures and idle fields in loblolly pine (*Pinus taeda* L.), shortleaf pine (*P. echinata* Mill.), and hardwood forest areas of the Southern United States are being planted to pines (Yeiser and others 1987). Herbaceous vegetation on pastures and idle fields can impede the establishment and growth of pine seedlings by competing with the pine seedlings for water and nutrients (Bacon and Zedaker 1987, Haywood 1994, Tiarks and Haywood 1986, Zutter and others 1986). Several herbicides are labeled for controlling herbaceous vegetation in pine plantings. Mowing is an alternative that may appeal to landowners who already have the necessary equipment (Schmidtling 1984).

The use of tractors to apply herbicides and mow in pine plantations presents difficulties: planting spacings must be based on mechanical constraints, terrain is a factor, late winter and spring rains can cause unstable soil conditions that interfere with operations, and soils may be compacted (Yeiser and others 1987). It is possible that applying mulch around the seedlings at the time of planting would prevent these problems. Although mulching is labor intensive, it may be practical where landowners with limited budgets are converting pasture or idle fields to pines. Farmers all around the world use mulches and crop residues to control weeds in field and horticultural crops, but mulches and crop residues are used less often in forestry (Buller and Gibbs 1952, Dao 1987, Gale and others 1993, Ghadiri and others 1984, Gupta 1991, Mahajan and Kanwar 1993, Mayhead 1992, McDonald and Helgerson 1990, Sanderson and Cutcliffe 1991, Schroth and others 1992, Shekour and others 1987, Sood and Sharma 1985, Walker and McLaughlin 1989, Zuzel and Pikul 1993).

An experiment was performed to determine the effects of various competition-control treatments on the survival and growth of planted loblolly pine seedlings in grazed and ungrazed pastures. Only effects during the first 3 years after planting were considered, because loblolly pines are large enough to tolerate cattle pressure after 3 years. It was assumed that rural property owners would have access to agricultural chemicals, tractors, mowers, or a supply of pine mulch, and that most owners would select one technique for managing vegetation rather than a combination of the three techniques evaluated in this study.

METHODS

The field work was done in central Louisiana. The study area was located within a direct-seeded slash pine (t? *elliottii* Engelm. var *elliottii*) stand on a Beauregard-

Southern Forest Experiment Station/T-10210 U.S. Postal Services Bldg., 701 Loyola Avenue, New Orleans, La. 70113
Forest Service, U.S. Department of Agriculture.
Serving Alabama, Arkansas, Louisiana, Mississippi, E. Oklahoma, Tennessee, E. Texas, Puerto Rico, U.S. Virgin Islands.

Guyton association, of deep, medium textured, and slowly permeable soils. In October 1980, a 1 O-acre area within the slash pine stand was clearcut harvested, stumped, burned to remove woody debris, disked, and then treated with 1,620 lb/acre of dolomitic limestone, 4.5 lb/acre of sulphur, 36 lb/acre of phosphorus (as P_2O_5), and 68 lb/acre of potassium (as K_2O) (Pearson and Baldwin 1993). A cattle management program was begun, and this included yearly top dressing with 21 lb/acre of phosphorus (as P_2O_5) and 39 lb/acre of potassium (as K_2O), cattle grazing, and applications of glyphosate herbicide.

In January 1991, the original cattle management study ceased, and five areas within the 1 O-acre site were selected as blocks for this experimental work. The five blocks were all in open pasture.Three of the blocks were fenced to exclude cattle, and grazing continued on the other two. The five blocks were as follows:

(1) Ungrazed Kentucky fescue-Kentucky31 fescue (*Festuca arundinacea* Schreb.) and Florida bahiagrass (*Paspalum notatum* Flügge) were the primary grasses.
(2) Ungrazed ryegrass and clover-Gulf Coast ryegrass (*Lolium perenne* L.) and seeded Mt. Barker or Woogenellup subterranean clover (*Trifolium subterraneum* L.) .
(3) Ungrazed ryegrass only.
(4) Grazed ryegrass that had been disked in 1990.
(5) Grazed subterranean clover that had been disked in 1990.

Cattle were grazed in blocks 4 and 5 after January 1991. Otherwise, no effort was made to maintain the pasture vegetation present at the beginning of the study. A randomized complete block design was employed. There were four treatment plots in each of the five blocks. In January 1991, each 64- by 64-ft plot was planted with sixty-four 28-week-old container grown loblolly pine seedlings spaced 8 by 8 ft apart. The seedlings were of uniform quality and size at planting.

Each of the following four treatments was randomly assigned to one plot in each block:

(1) Check: No more cultural treatments.
(2) Herbicides': A l-percent solution of glyphosate in water was applied as a directed spray in April 1991 and April 1992, and the seedlings were shielded during both applications. In April 1993, hexazinone was broadcast at the rate of 1 lb active ingredient/acre.
(3) Rotary mowing: The plots were rotary mowed three times each growing season from 1991 through 1993.
(4) Mulching: In April 1991, 11 lb of air-dried (moisture content about 15 percent) pine straw (principally *P. palustris* Mill.) was placed around each seedling. Up to 5 lb of air-dried pine straw was added to individual seedlings in 1992 if needed to control weeds.

Because cattle grazing was still practical in these pastures, neither rotary mowing nor use of herbicide was intended to eliminate the nonpine vegetation. Rather, mowing and herbicide applications were meant to keep established pasture vegetation from overtopping and suppressing the pine seedlings. Glyphosate was used to determine whether control of the established cover followed by revegetation from seed would be sufficient to stimulate young pine growth. Hexazinone provides longer residual control than glyphosate does, and the seedlings were large enough by the third year in the field to tolerate hexazinone. The loblolly pine seedlings were not visibly injured by the herbicide treatments.

The central 16 pine seedlings on each plot served as the measurement trees. After the first growing season, herbaceous plant standing crop was determined by clipping and weighing the aboveground biomass in eight randomly selected 1 0^{-4}-acre subplots within each study plot. Nonpine plants were inventoried and heights and groundline diameters of the loblolly pine seedlings were measured after three growing seasons.

Analysis of variance (alpha=0.05) was used to determine whether there were any significant treatment effects on herbaceous standing crop or loblolly pine survival, total height, and groundline diameter. Where treatment effects were significant, Duncan's Multiple Range Tests were used to separate the treatment means.

RESULTS AND DISCUSSION

Treatments that could be employed on small landholdings were used to convert grazed and abandoned pastures to planted pine. Owners of rural property may have access to agricultural chemicals, tractors and rotary mowers, or straw mulch. Each cultural practice has its own set of associated problems, but none of the treatments tested presents exceptional difficulties. Block effects are discussed because the effects of grazing on pine survival and growth are a concern to landowners who would like to graze cattle on lands they have planted to pine.

[1]The chemical names of the herbicides are as follows: glyphosate (N-[phosphonomethyl] glycine) as Roundupe and hexazinone (3-cyclohexyl-6-[dimethylamino]-1-methyl-l, 3, 5-triazine-2, 4 [1H, 3H]-dione) as Velpar®L.

James D. Haywood is a silviculturist at the Alexandria Forestry Center, U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station, Pineville, LA 71360.

Loblolly Pine

Loblolly pine survival was not significantly affected by treatment, but survival was slightly lower when herbicides were used (table 1). Damage caused by cattle killed some pine seedlings, and pine survival averaged 70 percent on the two grazed blocks and 83 percent on the three ungrazed blocks after three growing seasons. However, the difference between survival in the grazed and ungrazed blocks did not seem great enough to justify excluding cattle from planted areas.

Groundline diameters of 3-year-old loblolly pines that received herbicide treatments were greater than those of 3-year-old loblolly pines in the check and rotary mowing plots (table 1). Loblolly pines that were mulched were significantly taller than those on the check and rotary mowing plots. Groundline diameters and total heights of pines that were mulched were comparable to those of pines that received herbicide treatments.

Grazing apparently did not affect the groundline diameter of the loblolly pines. Pine diameter averaged 2.0 in on the grazed blocks and 2.2 in on the ungrazed blocks (table 1). However, cattle broke the leaders of some trees and bent some trees over. As a result, pines in the grazed blocks averaged 4.9 ft tall and those in the ungrazed blocks averaged 8.3 ft tall.

Herbaceous Standing Crop

After one growing season, herbaceous plant production was not significantly affected by treatment (table 1). Rotary mowing produced the least herbage. The rotary mowing plots were cut three times each year, so rotary mowing affected standing crop much as grazing did. After the first growing season, herbaceous production averaged 938 lb/acre in the grazed blocks and 1,804 lb/acre in the ungrazed blocks. The pine straw mulch was placed around individual seedlings, so mulching did not influence herbaceous production in all areas of the mulched plot. Glyphosate controlled the herbaceous vegetation initially, but new vegetation developed by the time the herbaceous samples were collected.

Grazing and cultural treatments influenced which plant species were most common on the plots. Three years after grazing ceased in the Kentucky fescue pasture, mowing and herbicide applications increased Florida bahiagrass cover and reduced Kentucky fescue cover. In the ungrazed ryegrass and clover pasture, blackberry (*Rubus* spp.) was the most common plant on the check and mulched plots. The use of herbicides resulted in the replacement of ryegrass and clover by hairy crabgrass, *Digitaria sanguinalis* (L.) Scop.; blue waxweed, *Cuphea carthagensis* (Jacq.) Macbr.; and dogfennel, *Eupatorium capillifolium* (Lam.) Small, whereas mowing increased Florida bahiagrass; vasseygrass, *Paspalum urvillei* Steud.; and common carpetgrass, *Axonopus affinis* Chase. The ungrazed ryegrass pasture became dominated by common carpetgrass regardless of treatment. The check and herbicide plots in the grazed and disked ryegrass pasture were dominated by dogfennel, common carpetgrass, and vasseygrass, but dogfennel was uncommon in the mowed and mulched plots. Blackberry dominated the check and mulched plots in the grazed and disked clover pasture. On the mowing plot, the most

Table 1 .-*Survival, groundline diameter and height of 3-year-old loblolly pines (*Pinus taeda *L.) planted in pasture and the herbaceous p/ant standing crop production after the first growing season*

Treatments and blocks	Loblolly pine			Competing plant biomass
	Survival	Groundline diameter	Total height	
	Percent	*Inches*	*Feet*	*Lb/acre*
Treatments				
Check	78a*	1.8b	6.4b	1,900a
Herbicides	70a	2.4a	7.2ab	1,397a
Rotary mowing	81a	2.0b	6.4b	773a
Mulching	83a	2.2ab	7.6a	1,760a
Mean	78	2.1	6.9	1,458
Blocks				
Ungrazed Kentucky fescue	86	1.7	7.0	2,677
Ungrazed ryegrass and clover	73	2.5	9.1	1,106
Ungrazed ryegrass	91	2.4	8.7	1,629
Grazed and disked ryegrass	78	1.8	4.5	1,096
Grazed and disked clover	61	2.1	5.3	780
Mean	78	2.1	6.9	1,458

'Treatment means within columns followed by the same letter are not significantly different based on Duncan's Multiple Range Test (alpha=0.05).

common plant was Florida bahiagrass. On the herbicide plot, blue waxweed, hairy crabgrass, and dogfennel were most common.

CONCLUSIONS

Loblolly pine growth differed among treatments, but the range in treatment responses did not justify a recommendation that herbicides, rotary mowing, or mulching treatments be applied to increase seedling growth during the critical early years after planting. Other herbicides or treatments not used in this research might be more effective in controlling competitors. For example, postplanting weed control with soil active herbicides in the first and second growing seasons or disking might give good results (Haywood 1994). However, cattle grazing would have to be curtailed if the forage were almost eliminated.

Damage caused by cattle killed some loblolly pine seedlings and reduced the height growth of other seedlings over the 3-year period. The 13-percent reduction in survival and 3-ft loss in height growth would have to be acceptable costs to landowners who want to continue grazing cattle as pastures convert to pine.

LITERATURE CITED

Bacon, Catherine G.; Zedaker, Shepard M. 1987. Third-year growth response of loblolly pine to eight levels of competition control. Southern Journal of Applied Forestry. 11: 91-95.

Buller, George B.; Gibbs, J.A. 1952. Planted loblolly pines respond to mulching. Journal of Forestry. 50: 317318.

Dao, Thanh H. 1987. Crop residues and management of annual grass weeds in continuous no-till wheat (*Triticum* aestivum). Weed Science. 35: 395-400.

Gale, William J.; McColl, R.W.; Fang, Xie. 1993. Sandy fields traditional farming for water conservation in China. Journal of Soil and Water Conservation. 48: 474-477.

Ghadiri, Hossein; Shea, Patrick J.; Wicks, Gail A. 1984. Interception and retention of atrazine by wheat (*Triticum* aestivum) stubble. Weed Science. 32: 24-27.

Gupta, G.N. 1991. Effects of mulching and fertilizer application on initial development of some tree species. Forest Ecology and Management. 44: 211-221.

Haywood, James D. 1994. Tenth-year results of herbaceous weed control in a loblolly pine plantation. Southern Journal of Applied Forestry. 18: 105-l 09.

Mahajan, K.K.; Kanwar, B.B. 1993. Effect of pine (*Pinus* species)-needle mulch on maize (Zea *mays*)-wheat (*Triticum aestivum)* cropping system. Indian Journal of Agronomy. 38: 515518.

Mayhead, G.J. 1992. Some alternatives to herbicides in British forestry. Quarterly Journal of Forestry. 86: 105–112.

McDonald, Philip M.; Helgerson, Ole T. 1990. Mulches aid in regenerating California and Oregon forests: past, present, and future. Gen. Tech. Rep. PSW-123. Berkeley, CA: US. Department of Agriculture, Forest Service, Pacific Southwest Research Station. 19 p.

Pearson, H.A.; Baldwin, V.C. 1993. Agroforestry: southern pines and subterranean clover cultural treatments. Agroforestry Systems. 22: 49-58.

Sanderson, K.R.; Cutcliffe, J.A. 1991. Effect of sawdust mulch on yields of select clones of lowbush blueberry. Canadian Journal of Plant Science. 71: 1263-1266.

Schmidtling, R.C. 1984. Early intensive culture affects long-term growth of loblolly pine trees. Forest Science. 30: 491-498.

Schroth, Götz; Zech, Wolfgang; Heimann, Günter. 1992. Mulch decomposition under agroforestry conditions in a sub-humid tropical savanna processes and influence of perennial plants. Plant and Soil.147: l-l 1.

Shekour, G.M.; Brathwaite, R.A.I.; McDavid, C.R. 1987. Dry season sweet corn response to mulching and antitranspirants. Agronomy Journal. 79: 629-631.

Sood, MC.; Sharma, R.C. 1985. Effect of pine needle mulch on tuber yield and fertilizer economy of potato in Simla Hill soil. Journal of the Indian Society of Soil Science. 33: 141-l 44.

Tiarks, Allan E.; Haywood, James D. 1986. *Pinus taeda* L. response to fertilization, herbaceous plant control, and woody plant control. Forest Ecology and Management. 14: 103-l 12.

Walker, R.F.; McLaughlin, S.B. 1989. Black polyethylene mulch improves growth of plantation-grown loblolly pine and yellow-poplar. New Forests. 3: 265-274.

Yeiser, J.L.; Sundell, E.; Boyd, J.W. 1987. Preplant and postplant treatments for weed control in newly planted pine. Bulletin 902. Fayetteville, AK: Arkansas Agriculture Experiment Station, University of Arkansas Division of Agriculture. 10 p.

Zutter, B.R.; Glover, G.R.; Gjerstad, D.H. 1986. Effects of herbaceous weed control using herbicides on a young loblolly pine plantation. Forest Science. 32: 882-899.

Zuzel, John F.; Pikul, J.L., Jr. 1993. Effects of straw mulch on runoff and erosion from small agricultural plots in northeastern Oregon. Soil Science. 156: 11 l-l 17.

The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

This publication reports research involving pesticides. It does not contain recommendations for their use, nor does it imply that the uses discussed here have been registered. All uses of pesticides must be registered by appropriate State and/or Federal agencies before they can be recommended.

CAUTION: Pesticides can be injurious to humans, domestic animals, desirable plants, and fish or other wildlife-if they are not handled or applied properly Use all herbicides selectively and carefully. Follow recommended practices for the disposal of surplus pesticides and their containers.

United States
Department of Agriculture

Forest Service

Southern Forest
Experiment Station
701 Loyola Ave., Rm.T-10210
New Orleans, LA 70113-1920

OFFICIAL BUSINESS
Penalty for Private Use $300