EVALUATING SUBSOILING AND HERBACEOUS WEED CONTROL ON SHORTLEAF PINE PLANTED IN RETIRED FARM LAND[1]

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Abstract—In March 2005, shortleaf pine was planted on retired fields of the Mississippi Agriculture and Forestry Experiment Station in Holly Springs. The objectives were to evaluate subsoiling and herbaceous weed control on first year seedling stocking, survival, and size. First year seedling measurements were made on stocking, survival, and size. Only results for first year seedling survival will be reported here. Subsoil tillage, herbaceous weed control, and control treatments were completed. Treatments were replicated 3 times in a randomized complete block design. The subsoiling treatment was done in December of 2004. The herbaceous weed control treatment was 4 ounces Arsenal AC® + 2 ounces Oust XP® per sprayed acre applied in a 4-foot band over the row in April 2005. In addition, mowing was completed 3 times between rows during the first growing season. Measurements were conducted on a 0.1-acre plot within each treatment. Neither subsoiling nor herbaceous weed control had any significant effect on seedling survival the first year.

INTRODUCTION AND PROBLEM

Loblolly pine is the premier species of the southern pines. It has an extensive range across the southern United States and is very adaptable to a wide variety of soil and site conditions (Schultz 1997). Loblolly pine is relatively easy to regenerate, has been genetically improved for decades (McKeand and others 2003), and responds well to intensive management (Stanturf and others 2003a, 2003b).

Martin and Shiver (2002) reported that first generation improved loblolly contributed to 11-16 percent better volume growth on a Coastal Plain site and 12-19 percent better volume growth in the Piedmont. Early plantations were established primarily with mechanical site preparation and burning. With the increasing production of fertilizers in the mid twentieth century, forest research found that both loblolly and slash pines were very responsive to added nutrients. Diagnostic tools based on site (Kushla and Fisher 1980, Fisher and Garbett 1980) and foliar analyses were developed (Wells and Allen 1985). In addition to fertilizers, the application of herbicides to control competing vegetation had pronounced effects on loblolly plantation growth. Pine volumes at age 5 more than doubled with total herbaceous weed control and improved by 67 percent with total woody control (Miller and others 1995a, 1995b). However, beyond age 6, total woody control exerted greater influence on pine volume by age 11 on a Georgia site than herbaceous weed control (Zutter and Miller 1998). Furthermore, regional studies that evaluated the effects of total vegetation control and frequent fertilizer applications on loblolly plantation growth revealed additive effects. Volume growth responses were in the range of two to four times that of controls with repeated fertilizer and herbicide application (Borders and Bailey 2001, Jokela and others 2004, Martin and Jokela 2004). Meanwhile, tillage studies particularly subsoiling on Piedmont and Upper Coastal Plain soils have continued, but with mixed results. Wheeler and others (2002) found that tillage, including subsoiling, improved seedling survival and stand volume growth after 3 years.

By contrast, research with shortleaf pine has been eclipsed by loblolly. Much research on shortleaf pine has focused on management of natural stands (Baker and others 1996). Some research has been done evaluating responsiveness of natural shortleaf stands to thinning (Cain 1996) and vegetation control (Cain 1991). Yet given the very extensive range of shortleaf pine, and its tolerance to dry, infertile sites (Lawson 1990), shortleaf pine is a viable choice for plantation management in northern Mississippi. Here loblolly pine approaches the northern extent of its range, and is prone to ice damage from periodically severe winter storms (Baker and Langdon 1990). Further evaluation of shortleaf pine to intensive forest management including site preparation, vegetation control, and fertilizer application is warranted.

METHODS

Recently, shortleaf pine plantations were established on the Mississippi Agriculture and Forestry Experiment Station at Holly Springs, MS. Subsoil tillage treatments were done prior to planting in December 2004 using a 20-inch ripping shank pulled by a tractor on ten foot planting centers. Shortleaf pine was then planted on the retired farmland in March 2005 at a nominal density of 622 trees per acre.

The herbaceous weed control (HWC) treatment consisted of a combination of herbicide application and mowing for the first year. Herbicide was applied in April of 2005. A tank mix of 4 ounces Arsenal AC® and 2 ounces of Oust XP® per acre was applied over the planted trees in a four-foot band. In addition, row centers were mowed three times during the growing season on treated areas.

All treatments (tillage, herbaceous weed control, and control) were replicated three times in a randomized complete block design. First year measurements were taken January through March 2006. Seedling measurements included stocking, mortality, survival (as a percent), total height, and root collar diameter. Only results for survival are reported here. Measurements were done on 4, 1/40-acre subplots

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within each treatment and replication, and compiled into one measurement (for a 0.1-ac plot) for analysis.

RESULTS

First year seedling survival by treatment is presented in Table 1. Survival on the control treatment (no subsoil tillage or HWC) was 90.1 percent. Subsoil tillage improved first year survival about 1 percent, HWC improved survival about 3-4 percent. The best survival was on the combination of subsoil tilled and HWC at 94.4 percent. The analysis of variance is shown in Table 2. There were no significant ($\alpha = 0.05$) effects due to blocking, subsoil tillage, or HWC. There was a significant interaction between subsoil tillage and HWC.

DISCUSSION

Schilling and others (2004) found little improvement of loblolly growth on subsoiled Upper Coastal Plain and Piedmont sites. This may indicate that such treatments are more site-specific. Indeed, the retired farmland on which the shortleaf were planted was cropped, not grazed. In addition, the trees in this study were machine planted. The tree planter had a coulter shank nearly as long as the ripping shank. Finally, since ripping was done late in the year, the seedlings were not planted directly into the rip, but alongside. Occasionally, the tree planters did not closely follow the subsoil trenches.

The region wide competition studies with loblolly pine revealed that pine volumes at age 5 more than doubled with total herbaceous weed control (Miller and others 1995a, 1995b). However, given the previous cropping history to this site, grass competition was not uniform. Much of the planting sites were dominated by seasonal forbs, which apparently did not as severely impact seedling survival.

Further evaluations of this data will examine subsoiling and herbaceous weed control effects on seedling size (diameter and height). In addition, a second-year application of herbicide will be added as another factor level. Future research on these shortleaf plantations will entail their response to fertilizer applications and thinning.

Table 1—Response matrix of first year survival to subsoiling and herbaceous weed control

Average first year survival		
	Herbaceous weed control	
Subsoil tillage	Control	Treated
	- - - - - - - - - - - *percent*	- - - - - - - - - - -
Control	90.1	93.9
Treated	91.4	94.4

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Table 2—Analysis of variance for treatment effects

Source	d.f.	SS	MS	F
Total	11	152.069		
Block	2	44.662	22.331	1.931 NS
Subsoil	1	2.521	2.521	0.218 NS
Herbaceous Weed Control (HWC)	1	35.021	35.021	3.030 NS
Subsoil x HWC	1	0.521	0.521	0.045 NS
Error	6	69.345	11.558	

d.f.= degrees of freedom
SS = sum of squares
MS = mean square error
F = Fvalue
NS—not significant
*--significant at α=0.05

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