THE EFFECT OF HERBACEOUS WEED CONTROL ON PLANTED LOBLOLLY PINE DURING A DROUGHT

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Abstract-- Seedling survival in loblolly pine (*Pinus taeda* L.) plantation establishment is often mentioned as a justification for herbaceous weed control (HWC). However, the effects of HWC treatment during drought have been difficult to find. Sometimes this research was proprietary in nature. Also, since weather patterns vary from year to year, drought may not have coincided with a research study.In the spring of 2007, a demonstration for a HWC comparison was installed on retired pasture at the North Branch Station near Holly Springs, MS. Second-generation loblolly seedlings from Weyerhaeuser were planted using a 10- by 10-foot spacing on March 27. Approximately half the area received HWC, and the other half did not (control). Broadcast HWC was simulated with a two-pass operation approximately 1 month after planting. The first pass was a 4-ounces Arsenal AC® plus 2-ounces Oust® mix sprayed at 15 gallons per acre (GPA) in a 5-foot band over the seedlings. The second pass was 32 ounces glyphosate in 15 GPA sprayed between the rows. Three measurement plots of one-tenth acre were randomly located on each treatment: control (no treatment) versus broadcast HWC. Initial measurements were taken August 14, 2007. Average survival on control plots was 84.4 percent, and 83.9 percent on treated plots. There was a late summer drought that growing season, so the study was measured again in mid-February 2008. Average stocking on control plots was 230 trees per acre, and survival was 37.1 percent. Treated plots, on the other hand, had an average 433 trees per acre and 74.7 percent survival. Broadcast HWC can affect survival of young pine plantations during drought years.

INTRODUCTION

The literature on vegetation management in loblolly pine (*Pinus taeda* L.) plantations is quite extensive. The Competition Omission Monitoring Project (COMP) evaluated different levels of weed and brush control during plantation development across the southeastern United States (Miller and others 1991; Miller and others 1995a, 1995b; Shiver and others 1991; Zutter and Miller 1998). This region-wide study evaluated the effects of herbaceous, woody, and complete versus no vegetation control on the development of loblolly pine plantations.

The advantages of HWC during plantation establishment included improved growth. However, documentation of the effects of HWC on pine seedling survival is rare. HWC treatment was shown to improve survival, but its effects varied by site, treatment area, and weather conditions (Dougherty and Lowery 1991, Miller and others 1991). The coincidence of drought during study establishment, and the proprietary nature of herbicide research partly explain this gap in the literature. This study compared survival effects of HWC treatment on loblolly plantation establishment during an actual drought in northern Mississippi.

METHODS

The study site was on the North Branch Station of the Mississippi Agriculture and Forestry Experiment Stations near Holly Springs, which has been described in detail by Kushla (2009). The site was retired Bermuda-grass bermudagrass [*Cynodon dactylon* (L.) Pers.] and tall fescue [*Schedonorus arudinaceus* (Schreb.) Dumort., nom. cons.] pasture from a former dairy operation. The fields were gently undulating hills (2 to 5 percent slope) consisting predominantly of Loring silt loam. The area comprised approximately 30 acres with a small drainage bisecting the site.

Planting was completed March 21, 2007 on a 10- by 10-foot spacing to demonstrate wildlife habitat early in plantation establishment. Broadcast HWC was added as a further comparison. The southern side of the drainage was sprayed, and the northern side was not. Since this was a demonstration, no statistical design was used.

Broadcast HWC treatment was simulated with a two-pass operation. Approximately 1 month after planting, a tank mix of 4-ounces Arsenal AC® plus 2-ounces Oust® mix was sprayed at 15 gallons-per-acre (GPA) over the top of planted seedlings in a 5-foot band over the seedlings. Afterward, 32 ounces glyphosate was sprayed in 15 GPA between rows.

On August 14, 2007, initial measurements were taken. Three one-tenth-acre measurement plots

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were randomly located in each treatment area (broadcast HWC or control). Initial measurements were for survival and stocking.

Subsequent measurements on the same plots were taken in mid-February 2008. These measurements included groundline diameter (GLD), total seedling height (HT), stocking, and survival. Weather data including temperature, precipitation, and growing season evaporation were collected on a daily basis according to standard procedures by an on-site National Weather Service/ National Oceanic and Atmospheric Administration weather station.

RESULTS

Initial stocking and survival measurements appear in table 1. While 10- by 10-foot spacing was the target, average actual stocking was a little higher on both treatment areas. As shown, average stocking and survival were comparable on both treatment areas in August 2007.

Table 1--Average initial loblolly stocking and survival measurements taken August 14, 2007

Treatment	Average stocking	Average survival
	trees/acre	*percent*
Broadcast HWC	486	83.9
Control	523	84.4

Average air and soil temperatures are presented in figure 1, which included actual temperatures with their historical 40-year average. Average monthly air temperatures tracked very closely to their respective 40-year averages. However, average monthly soil temperatures were well above their 40-year average. Through examination of the average maximum air temperatures, an explanation was found. Daytime maximum air temperatures during the summer of 2007 were considerably hotter than their 40-year average, despite the fact that average air temperatures appeared normal.

Monthly precipitation and evaporation are presented in figure 2, including the historical 80-year average monthly precipitation. For the most part, the spring and early summer were dry by historical standards, with the exception of July. The station experienced two significant rain events on July 11 and 13, totaling just over 5 inches of precipitation. After July 13, however, drought conditions were encountered. For 10 weeks thereafter, weekly rainfall was below 1 inch. In fact, there was no recordable rainfall during 4 of those weeks. Total rainfall for July through September was 10.01 inches, while evaporation that same period was -22.3 inches. Consequently, the drought coincided with a time of unseasonably high maximum temperatures on an historical basis.

First-year seedling GLD, HT, stocking, and survival measurements were taken during mid-February 2008 and are summarized in table 2. There were notable differences in average seedling GLD, HT, stocking, and survival between treatment areas. Seedlings receiving broadcast HWC on average were bigger and survived better than control seedlings. Although average survival was only 75 percent in the treated area, the average stocking of 433 trees per acre was very close to the original target stocking for a 10-by 10-foot spacing. Conversely, seedlings without HWC treatment were on average smaller and survived drought poorly (only 37 percent survival). The average stocking of 230 trees per acre would have required re-planting.

DISCUSSION AND MANAGEMENT IMPLICATIONS

Although just an operational comparison, broadcast HWC appeared effective in this study. Treated loblolly seedlings were larger and survived a severe drought. As the COMP and other studies showed, grass is very competitive to newly planted loblolly seedlings (Dougherty and Lowery 1991; Miller and others 1991; Miller and others 1995a , 1995b; Zutter and Miller 1998).

The difference in survival and stocking between treated and non-treated seedlings meant the difference between plantation establishment and failure. Despite the lack of statistical design, the evidence is very compelling that broadcast HWC is effective to assure plantation survival during drought.

With increasing concern for the effects of climate change on forested ecosystems, there are opportunities to continue vegetation control research in southern pine plantation establishment. Increasing maximum temperatures and occurrence of localized

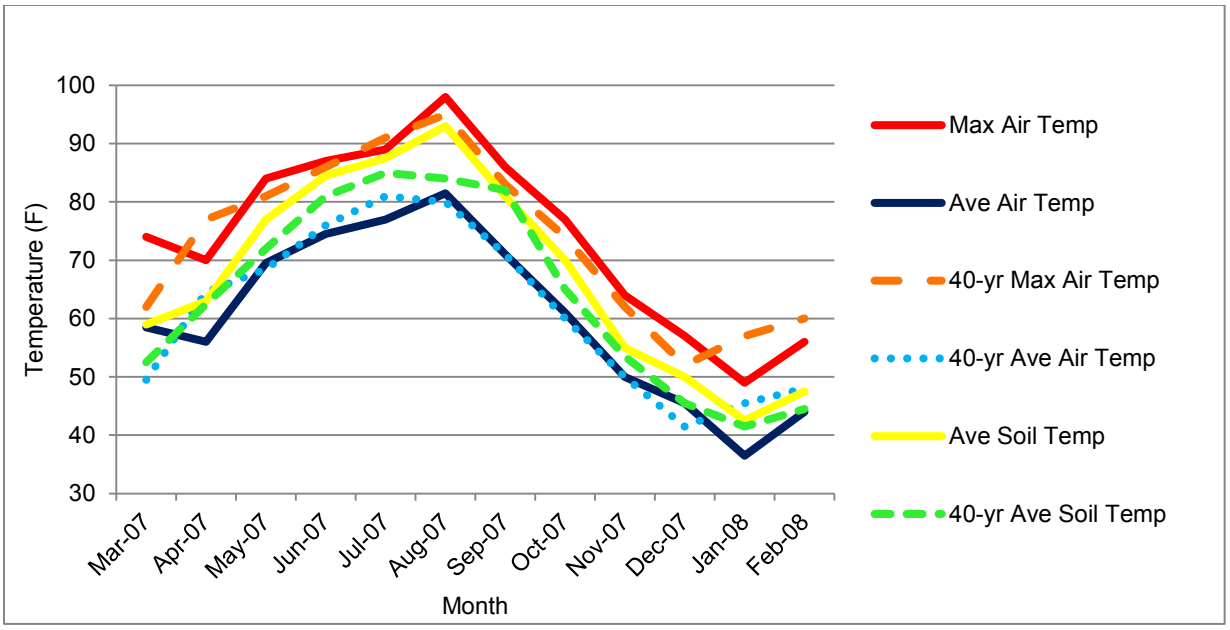

Figure 1--Monthly average temperatures March 2007 through February 2008, Holly Springs, MS.

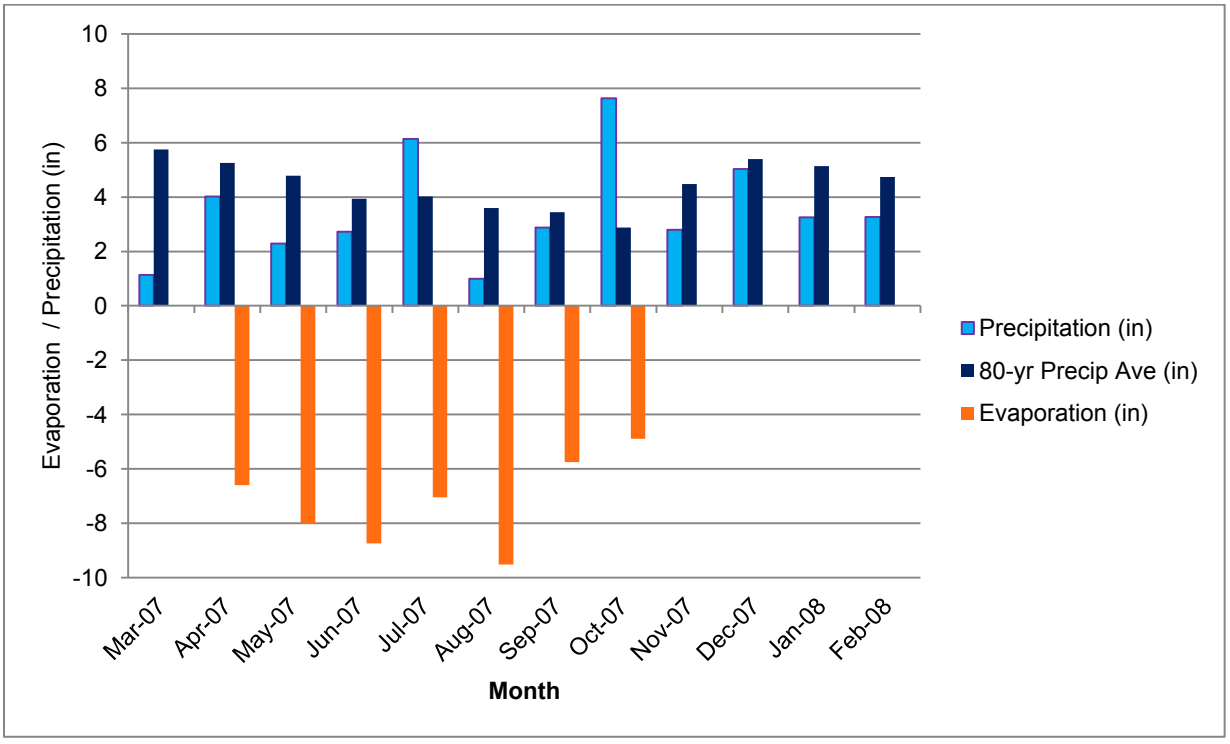

Figure 2--Monthly evaporation and precipitation March 2007 through February 2008, Holly Springs, MS.

Table 2--First-year loblolly seedling average measurements

	Average			
Treatment	GLD	Height	Stocking	Survival
	inches (mm)	*inches (cm)*	*trees/acre*	*percent*
Broadcast HWC	0.347 (8.82)	18.6 (47.2)	433	74.7
Control	0.232 (5.89)	11.5 (29.3)	230	37.1

droughts could have profound effects on plantation establishment in retired pastures.

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