PINE FAILURES ON FORMER AGRICULTURAL SITES

A Brief Summary of Two years of Field Investigations

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INTRODUCTION

The Conservation Reserve Program (CRP) resulted in vast acreage being converted from traditional agricultural row crops to forest trees. The Southeast was by far the dominant participant in tree planting within this program, and loblolly pine was the most frequently planted tree. Certainly the program and its influence on forest regeneration has been positive; however, some problems were uncovered by this massive regeneration effort.

One particularly frustrating problem was the complete or nearly complete failure of loblolly pine observed on a number of sites; replanting these sites also resulted in failure. We are familiar with several sites in Georgia that were planted three to five times without obtaining sufficient stocking. Although there were many suggestions as to what was causing the excessive mortality, such speculative causes could not be rigorously evaluated because of lack of data.

Our work focused on several factors that may explain the observed mortality. Specifically we tested whether or not Oust herbicide may influence survival on these sites, particularly as soil pH increased. The solubility of Oust increases exponentially with increasing soil pH (Cantrell 1985). Secondly, we examined the influence of herbicide residuals from previous crop production on pine survival. Lastly, we tested the role that Furadan and ripping may play in ameliorating the conditions which resulted in pine mortality.

Oust Herbicide Study. Five sites scattered throughout the Coastal Plain region of Georgia were selected on the basis of soil pH. Mean soil pH across the sites ranged from 4.8 -6.5. All sites were approved for tree planting in the CRP; four of the sites had been in soybean production and the final site had been in peanut production. Two of the sites had been planted in trees the year before and failed. One of the failed sites was ripped before this study was initiated.

At each site, plots were established in four randomized complete blocks. The three treatments were Oust applications at 0, 4, and 8 oz of product per acre applied in a three-foot band. Fifty loblolly pine seedlings obtained from the Flint River Nursery were planted in each treatment plot at the beginning of March 1988.

In addition to mortality, pine phytotoxicity assessments were estimated visually three months after planting. Also, periodically throughout the first growing season fungi associated with the root systems were isolated, cultured, and identified. Data regarding nematode frequency and presence of root-feeding insects also were collected.

Herbicide Residual Study. In July, 1988 a study was established to test the influence of soybean herbicide residuals on pine mortality. The study was established as randomized complete blocks with four replicate plots. Herbicides tested included: Prowl, Treflan, Basagran, Blazer and Scepter (a non-treated control was also included). Prowl and Treflan herbicides were soil incorporated immediately after application. All herbicides were applied at 1, 2 and 4 times their labeled rate. Seedlings were planted in December 1988 in a manner similar

to the previous study. Fifty pine seedlings were planted per plot. Each herbicide-treated plot was split and Oust herbicide at 4 oz per acre was applied over the top of newly-planted seedlings on one-half of each plot. Seedling survival was assessed several times during the first growing season, and roots were excavated in the 4X treatments of the soil-incorporated herbicides to determine biomass.

Furadan - Ripping Study. Data from the Oust study suggested that root-feeding insects and/or nematodes may be responsible for seedling mortality. Also, circumstantial evidence that plow pans may exacerbate mortality problems on such sites led us to develop a study which tested effects of Furadan applications and ripping on seedling mortality. The three sites selected for this study had been approved for tree planting in the CRP, and had failed at least three times prior to the initiation of this study. In addition, an undisturbed, well- developed plow pan was present at each site. The study design, randomized complete blocks with four replicates, was similar to the previous two studies; fifty trees were planted per replicate plot. Treatments were Furadan or no Furadan on plots that were ripped or plots without a ripping treatment. In addition to seedling mortality, assessments were made throughout the first growing season of associated root fungi and populations of soil nematodes and root-feeding insects.

RESULTS

Oust Study. Applications of Oust increased survival in all sites regardless of soil pH. However, increasing rates of Oust also increased pine phytotoxicity symptoms. Such symptoms can be misleading on Oust-treated sites where mortality

due to other causes occurs. In such cases, it would not be unreasonable, without further information, to suspect that the phytotoxic response observed prior to the seedlings death contributed in some manner to the mortality. Visual symptoms of Oust phytotoxicity can be quite severe (88 % of all seedlings showed moderate to severe chlorosis), yet pine survival actually was increased compared with a no Oust treatment. Thus, we conclude that Oust toxicity is not factor in pine mortality problems observed on the CRP regeneration sites.

Other data from these studies indicate several potentially important factors. Firstly, of the five test sites, the one with excessive mortality was the only site that had an undisturbed, well-developed plow pan. A similar site that had failed the year prior to this study but was ripped before planting had a survival greater than 90%. In addition, the operationally-planted area surrounding the experiment experienced reasonably good survival (more than 500 trees per acre surviving after the first year).

The only plots which had significant populations of dagger, stunt, and ring nematodes were at the failed site. Furthermore, the failed site was the only one in which white fringe beetle larvae were found. Lastly, numerous cultures of Fusarium subglutinans, Fusarium spp. and Macrophomina spp. were isolated from seedling roots taken from these plots. These same fungi were isolated from roots across all sites with similar frequency, which raises questions concerning their roles in seedling mortality. In fact, the frequency that these fungi were isolated from root systems did not differ between dead, sickly, or healthy seedlings. It could not be determined whether these fungi were pathogenic, epiphytic, or saprophytic. Nevertheless, the frequent occurrence of these potential pine pathogens suggests that further work be done to clarify their role in pine mortality on these sites.

Herbicide Residual Study. Pine survival was not influenced by any of the herbicides tested or at any of the rates used. However, rainfall patterns were nearly ideal for seedling establishment, and even if root growth had been inhibited mortality would be expected to be less what would occur had a summer drought occurred. Root growth was inhibited by Oust and by Prowl at the 4X rate.

Furadan - Ripping Study. Furadan decreased by one-half the number of seedlings that died; ripping had no effect on survival. However, it should again be stated that rainfall patterns provided nearly ideal conditions for seedling establishment. Root-feeding insects were present on all of the sites and most of the dead seedlings in the'no Furadan treatment showed severe root feeding and decortication symptoms. White fringe beetle larvae were found on all three sites, and on two of the sites various species of white grubs were observed. Nematodes were found on all sites, and fungi were isolated from root samples in a frequency similar to that of the Oust study. However, in this study roots were subjected to a more stringent disinfestation procedure to reduce the chance of isolating superficial fungi. Also, seedlings were collected monthly, thus reducing time for saprophytic fungi to colonize the dead tissue.

CONCLUSIONS

Herbicides, specifically Oust and residual soybean herbicides are not important causes for pine mortality on CRP sites. Over the two-year study, every site that failed had populations of root-feeding insects, and most of the dead seedlings showed symptoms similar to those caused by white grubs and white fringe

beetle larvae. Also, potential pathogenic fungi were frequently isolated from root systems of seedlings grown on these sites. In fact, it has been reported that F. subglutinans can colonize and survive on dead stem segments of soybean plants (Bolkan et al., 1979). The cosmopolitan nature of the fungi found suggests that if they play a role in mortality on these sites other factors such as wounding agents, environmental conditions, etc. are likely to be important. F. subglutinans requires a wound to gain entrance (Barrows and Dwinell 1983), and root-feeding insects and/or nematodes may provide suitable infection courts (Ruehle 1973). Although no effect of ripping was observed in this study, it may prove to have greater benefits in years with significant drought events. Furthermore, ripping may be justified on the basis of its effect on seedling growth, regardless of its effects on mortality.

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