Burning Logging Residue Improves Site for Cottonwood Plantations

by

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With the current trend of establishing large plantations of eastern cottonwood *(Populus delloides* Bartr.) for pulpwood production, it has become evident that considerable effort must be made to provide optimal site conditions to fully realize the gains in growth rate expected from planting selected clones and intensifying management practices.

A major problem encountered in establishing cottonwood in cleared bottomlands throughout the South is the inherent acidity (low pH) and low fertility of the soils on many sites. The pH of bottomland soils commonly ranges from 5.0-6.0. but numerous studies have shown that cottonwood grows best on soils with a neutral or slightly alkaline (pH 7.0-8.0) reaction. A low pH also directly influences plant nutrition because nutrient elements, especially phosphorus, are not readily available to plants in acid soils even if they are present in optimal or near-optimal concentrations.

Soil pH and mineral nutrient levels may be improved by liming and fertilization, but these operations are costly and often are impeded by weather conditions and inaccessibility of the site due to high water. These practices may be necessary and economical under certain conditions, of course, but a recent study' has shown that site conditions can be significantly improved by burning logging residue and incorporating the ash into the soil.

Our study was conducted during the winter of 1972.73 in a 2-year-old cottonwood plantation near Bordelonville, La., owned by the Roy O. Martin Lumber Company, Alexandria. La. The unaltered soil on this 500-acre plantation is fairly uniform-a silty clay loam derived from recent sediments of the Red River. The area is subject to seasonal flooding by Bayou Natchitoches, a backwater drainage of the Red River.

Originally, the plantation site was a mixed bottomland hardwood stand which was clearcut in the winter of 1969-70. The logging residue was piled in several random locations throughout the area and burned. In the spring of 1970. the site was planted with *Sorghum bicolor.* which was harvested in the fall. The cottonwood plantation was established in February 1971 with unrooted cuttings derived from 17 selected clones developed and released by the USDA Forest Service laboratory at Stoneville, Miss. The cuttings were planted in randomized, replicated clonal row plots.

During an evaluation of the plantation in the fall of 1972, differences in growth rates approaching 100 percent were observed among certain groups of trees in the same clonal plots (fig. 1). The areas on which these striking differences occurred were scattered randomly throughout the plantation and, upon inspection, it was apparent that the faster growing trees were located on areas where logging slash had been piled and burned. Since all of the trees in each clone were grown from cuttings derived from the same original selected parent tree and were therefore genetically identical, the accelerated growth rate of those on the burned areas was obviously the result of an alteration of the soil properties on the burned sites.

To determine the extent of soil modification on the burned areas, soil samples were obtained from adjacent burned and unburned areas at various locations throughout the plantation.

1Leach, C. P. 1973. Variation in morphological characteristics of seven selected clones of eastern cottonwood *(Popular deltoides*Bartr.) planted in central Louisiana. MM.S. Thesis, Louisiana State Univ.. Baton Rouge. 59 p.

These were analyzed for levels of extractable nutrients, soil reaction (pH) and organic matter content by the Soil Testing Laboratory of the Louisiana Agricultural Experiment Station. Height and diameter were measured on trees of the same clone growing on the areas from which soil samples were obtained.

Statistical analysis of the data showed highly significant increases in levels of phosphorus, potassium, calcium, and magnesium, and also a significant increase in growth rate of trees growing on the burns. All of the four clones used in this study responded positively to the increased nutrient levels and more alkaline pH on the burned areas. The results are summarized in table 1.

The residual ash from burning the logging residue contributed large amounts of phosphorus. calcium. potassium, and magnesium to the soil. Increased calcium and magnesium content undoubtedly caused the marked increase in pH on the burns, providing the same effect as would liming the soil. The increase in pH would tend to make all elements present in the soil (except iron) more readily available to the trees, thereby improving the general level of nutrition on the burns. The slight increase in organic content on burned areas is probably the result of increased growth of annual plants which were observed to be more heavily concentrated in the understory of the burned areas, again as a result of improved mineral nutrition. It should be emphasized that these striking differences in soil chemistry were evident 3 years after burning.

Figure 1—Profile of cottonwood clonal row plot illustrating marked growth differences. Trees in center of photograph are growing on a site where logging slash was burned.

The overall effects of changes in the soil chemistry on the growth of cottonwood are obvious - a mean increase of almost 50 percent in height growth and 100 percent in diameter growth on the burned areas.

The incorporation of ash from burned logging residue apparently provides a potential for significant soil improvement and should be included in site preparation whenever possible. In practice, however, it would he impossible to distribute slash uniformly throughout the field and provide enough fuel for a sustained hot fire on the entire site, given the moisture condition prevalent in bottomland areas. A much more practical solution would be to pile the slash at intervals throughout the site. burn the windrows or piles, and then distribute the ash over the area by pushing or dragging it with tractors or other vehicles.

Distributing the ash over the entire area would obviously reduce the concentration of elements to levels below those found in our study where observations were based on areas with a high ash content. Therefore, growth increases of the level reported here could probably not be expected. However, it is certain that some level of improvement in pH and nutrient availability will result, and slight increases in the growth of all trees in the plantation may well produce a highly significant gain in volume per acre.

TABLE 1.—Means of extractable nutrients, soil pH, percent organic matter (O.M.), and growth of trees growing on burned and unburned areas

Treatment	P	K	Ca	Mg	O.M	pH	Height	Dbh
	ppm.				Percent		Feet	Inches
Burned ..	327	550	4000	1000+	2.75	7.55	16.9	2.54
Unburned	66	211	2735	750	2.40	6.20	11.3	1.27