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CULTIVATION IN COTTONWOOD PLANTATIONS-- PRACTICES AND EQUIPMENT

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Abstract.--Thorough first-year cultivation in cottonwood plantations is mandatory to ensure optimum survival and growth. Poor cultivation can reduce growth and may kill trees. Some plantation managers feel that only first-year cultivation is necessary, while others routinely disk for 2, 3, or even 4 years. Chemical weed control shows promise but has not been adequately researched. The equipment most often used consists of tractors of approximately 100 horsepower equipped either with a wide front-mounted cultivator that can straddle one row and cover the area between rows or with a small front-mounted cultivator that straddles the row as well as a disk or spring-tooth harrow drawn behind to cover the area between rows. Equipment should be kept well adjusted and tree damage during cultivation held to a minimum.

Additional keywords: Tillage, Populus deltoides, soil working, weed control, disking.

Intensive cultural methods have enabled land managers to grow cottonwood (Populus deltoides Bartr.) commercially. Cottonwood is highly marketable for a wide range of products including pulp, plywood, and furniture. Because young cottonwood tolerates little competition for light and moisture, weeds and grasses must be kept away from the trees during the early life of a plantation. Intensive cultivation during the first growing season greatly improves survival and can more than double the growth obtainable with minimal weed control (McKnight 1970). Cultivation appears to benefit young poplars by reducing competition for moisture, nutrients, and light and by changing soil oxygen and carbon dioxide content (Aird 1962, Byrnes and Merritt 1967). This paper describes practices and equipment currently used for cultivating cottonwood plantations.

Duration of cultivation.--Intensive cultivation throughout the first growing season is imperative. Extensive mechanical weed control greatly increases survival and may double or even triple growth obtained when only minimal control is attempted (McKnight 1970). During the first growing season, trees need to be cultivated mechanically five to seven times. Cultivation should begin early in the growing season (March or April) to minimize damage

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to young plants and to keep weed size manageable. Some hand hoeing may be necessary to control vines that are too close to the trees to be removed mechanically (McKnight and Biesterfeldt 1968, McKnight 1970). If not controlled the vines will quickly climb the young trees, bend them over, and damage them considerably.

The benefits of cultivation after the first year have not been completely ascertained. Some timber growers cultivate only during the first year, while others routinely cultivate during the second and even the third growing seasons. After intensive cultivation of a portion of a 55-acre cottonwood plantation during the second year, Alford (1971) found no differences in survival for trees cultivated for 2 years as opposed to those cultivated for only 1 year. However, second-year cultivation increased dbh by more than 61 percent and height by more than 31 percent. In this study, analyses of leaf samples for nitrogen content showed that second-year cultivation nearly tripled the amount of nitrogen per leaf over 1-year cultivation. This increase was almost as great as that noted in several nitrogen fertilizer studies conducted at the same time in the area.

In a study testing 1-, 2-, and 3-year cultivation, Alford (1972b) found no differences in survival after extended cultivation, but 2 years of cultivation increased height by 60 percent and diameter by 92 percent over measurements obtained after first-year cultivation only. Three years of cultivation was not significantly better than 2 years. In contrast, Vermillion (1974) found that third-year cultivation had an economically significant impact on average tree height, cubic foot volume per acre, and dollar value per acre. On the basis of minimal assumptions about future growth and with the assumption of a 5 dollar-per-acre cost for cultivation during the third year, he concluded that the additional cultivation was feasible both silviculturally and economically.

When Alford (1972a) compared first- and second-year cultivation only to first-year cultivation with various combinations of nitrogen, phosphorus, and lime, cultivation through the second year was as good as or better than any of the other treatments. First-year cultivation without any other treatment was poorest.

The benefits of extended cultivation may be related to the site and the condition of trees after one growing season. Improved growth and survival might occur after second- and third-year cultivation on sites where weed infestation is heavy and trees are small; but these benefits might not occur at other sites or in years when weeds are no problem.

Sekawin and Prevosto (1973) tested the influence of tillage (cultivation) with and without intercropping on a poplar stand. Maize was planted between the trees during the first year and mixed leguminous crops during the next 3 years. After 6 years, there were no growth differences caused by intercropping. Tillage was effective through the fourth year. Uncultivated stands brought ground rent about half that of stands cultivated for 4 years. Stands with and without intercropping were more valuable when cultivation was stopped after the fifth year, an indication that cultivation beyond the fifth year is detrimental.

Chemical weed control.--Carter and White (1971) administered several chemical cultural treatments to cottonwood plantations. They obtained best results with amizine--a contact and a preemergence herbicide--applied in a 4- to 5-foot band when the weeds were 2 to 3 inches tall. They used shields to protect foliage. Ten pounds a.i. per acre of amizine gave satisfactory weed control throughout the first growing season on Alabama sites, but on Delta soils--which are more fertile than those in Alabama--luxuriant weed growth may necessitate repeated applications in mid-summer.

Merritt (1964) attempted chemical weed control in cottonwood seed-source plantings during the second year with plantations that had already received 1 year of conventional cultivation with disk-harrows. Simazine at 1.6 and 3.2 pounds active ingredient (a.i.) per acre and amizine at 4.2 pounds a.i. per acre were carefully metered onto square mil-acre plots surrounding each tree. Analyses of height growth were made at the end of one and two growing seasons after chemical treatment. At the end of one growing season, height growth was better on all chemically treated plots than on untreated plots; amizine gave significantly better growth than simazine; and there were no growth differences between trees receiving the two simazine rates. At the end of two growing seasons, chemically treated plots continued to show better growth than untreated plots; however, plots receiving the heavier rate of simazine showed significantly better growth than those given the lower rate, and there was no difference between plots receiving amizine and the heavier rate of simazine.

Research at Stoneville, Mississippi, has not been conclusive, as results have been erratic. No chemical has been found to give satisfactory weed control throughout the first growing season. Since success of chemical weed control depends on soil, climatic conditions, weed species, stage of growth, and other conditions present at time of application, no unqualified recommendations can be given at this time.

Equipment and maintenance.--Although there are many types of equipment available for cultivating cottonwood, most foresters prefer tractors of about 100 horsepower, a size large enough for clearing, fallowing, and planting, but small enough for cultivating. One tractor per 200 acres is required for adequate results. Most commercial planters are straddle cultivating one row at a time with conventional front-mounted farm cultivators until the trees are about 2 feet tall. Front-mounted cultivators allow the driver to have better visibility and control and therefore cause less damage to the trees than do rear-mounted cultivators. Cultivators equipped with chisel- or shovel-type plows allow tillage close to the young trees but do not damage them appreciably. The equipment most frequently used consists of: (1) large, front-mounted cultivators with 19 to 21 shanks that will straddle one row while covering the space within the rows, or (2) offset front-mounted cultivators equipped with five or six shanks that straddle the row while covering a small area on each side; with this system, a disk or spring-tooth harrow drawn behind the tractor covers the area between rows. The unit in a cultivation operation therefore consists of a tractor plus either a large cultivator or a small cultivator with a disk or a harrow. When the trees are too tall to straddle, the cultivators are removed, and tillage between rows is accomplished with a disk or harrow.

After a manager has decided which tractors, cultivators, and disks best fit his needs, he should consistently utilize the same type of equipment to keep his parts inventory small and the parts interchangeable.

Proper maintenance of equipment is mandatory to minimize down-time; such maintenance depends on the availability of both a repair shop and an adequate parts inventory. One way managers can reduce repairs is by allowing an operator to use the same tractor at all times; familiarity with a particular machine may enable the operator to detect malfunctions early; thus, minor rather than major repairs may result.

Cultivation practices.--To ensure the best results from cultivation, the cottonwood plantation site should be as free as possible of stumps, roots, and other debris to minimize tree damage and equipment breakage. The cultivator shanks that straddle the trees should be set to plow 3 to 4 inches deep to within 3 to 4 inches on each side of the tree. The area between rows should be plowed to a depth of 4 to 6 inches. Cultivation to these depths will probably cut some of the roots that lie in the top 8 inches of soil, but some researchers believe that cutting causes root proliferation and is therefore beneficial because it increases the absorptive surface.

Disking patterns should be alternated during cultivation; that is, a row cultivated in a north-south direction during the first trip in a row should be cultivated from south to north during the next trip. If tandem disks are used, the front blades should be set to throw soil toward the trees and the rear ones to throw the soil away from the trees. The disk blades should be about 20 to 24 inches in diameter. The width of the disk or harrow would be determined by tree spacing but would be 2 to 3 feet narrower than the spacing to allow plowing to within 12 to 18 inches of the trees.

Cultivation should probably be postponed during extremely wet weather to avoid soil compaction, damage to tree roots, and equipment damage.

Careful cultivation to avoid breaking or covering sprouts is extremely important. When we compared survival and growth of carefully cultivated cottonwoods to that of trees damaged during cultivation (Kennedy 1975), survival with proper cultivation was 90 percent. For cuttings covered or broken during cultivation, survival ranged from 20 to 60 percent. Well-cultivated cuttings grew 30 to 35 percent better than those covered before sprouting and almost 100 percent better than covered cuttings whose sprouts were broken.

SUMMARY AND CONCLUSIONS

Adequate first-year cultivation in cottonwood plantations is a necessity to ensure optimum survival and growth. Some forest managers feel that extended cultivation through the second, third, or even the fourth growing season is beneficial.

The most frequently used tractors are about 100 horsepower and are equipped with either a wide front-mounted cultivator that can both straddle the row and cover the space within rows or with small front-mounted cultivators that

can straddle the row and cover a small area on each side, while a disk or spring tooth harrow drawn behind covers the area within rows. This equipment should be kept well-adjusted. Tractor operators should avoid disking so close or driving so fast as to damage the cutting or cover it with soil since poor cultivation reduces growth and may kill the trees.

Chemical weed control shows promise, but recommendations cannot be made about methods of chemical control without further research.

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