

HARDWOOD CULTURE IN THE EASTERN UNITED STATES

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ABSTRACT

Many hardwood plantations are being established in the East. Populus deltoides, Platanus occidentalis, Liquidambar styraciflua, and Juglans nigra are the species that have been planted and studied most.

Introduction

This paper describes hardwood management in the eastern United States where natural stands account for over 99 percent of the hardwood production. Today, however, between 100,000 and 150,000 acres are in plantations; and the acreage is increasing.

Research on planting of southern hardwoods has been conducted by the Forest Service, U.S. Department of Agriculture, at the Southern Hardwoods Laboratory at Stoneville, Mississippi, for over 30 years. Initial efforts began with cottonwood in the 1940's and were greatly accelerated with the advent of commercial plantations in the 1960's. The Forest Service has two other units working with intensive plantation culture of hardwoods in the East. One is at Carbondale, Illinois, where research is being conducted on black walnut (*Juglans nigra* L.), and the other is at Rhinelander, Wisconsin.

The Trend Toward Plantation Culture

Eastern hardwood forests contain many species and grow on a wide range of sites. The biological diversity among species represents a challenge to silviculturists whose primary tool in the natural forest is stand manipulation. Evenaged management has been applied to many natural stands during the past 25 years which led, in the 1960's, to clearcutting as the primary silvicultural system. During the past 5 years, more consideration has been given to unevenaged management, partly because of public reaction to clearcutting.

By creating, through cutting or deadening, conditions that are conducive to the establishment and growth of hardwoods, silviculturists have been able to favor selected species in many different hardwood timber types. For example, forest openings of 1 acre or more usually favor the development

of intolerant species if a seed source is present; smaller openings, particularly those under 1/2 acre, favor tolerant species (10).

In southern bottomlands, natural succession and diameter-limit cuts have resulted in many stands of relatively low value on sites of potentially high productivity. Such stands offer few opportunities for manipulation. It is in some of these areas that hardwood culture has been undergoing a slow but significant change to intensively managed plantations during the past 15 years.

A prime example of this change is in the broad bottomlands of the lower Mississippi River. Unlike many areas where eastern hardwoods grow, these sites are well adapted to intensive culture. Terrain is nearly flat and easily negotiated by heavy equipment. Many commercial species grow well, including the extremely fast-growing eastern cottonwood (*Populus deltoides* Bartr.); and natural stands are producing much less than their potential.

History of Eastern Hardwood Plantations

Commercial planting of hardwoods began in the South in 1960 when Crown Zellerbach Corporation purchased a 15,000-acre cattle-cotton plantation in the Mississippi Delta. The whole area was planted in cottonwood at the rate of 2 to 3 thousand acres per year. As this was the first large-scale hardwood planting in the South using agronomic-like practices, many problems were encountered. Among the problems were source and care of planting stock, quantity and disposition of equipment, spacing, estimates of site quality, and yield predictions. Nevertheless, within 5 years of Crown Zellerbach's original plantings, at least six other companies began commercial planting of cottonwood.

Research and experience have solved many of the problems of planting cottonwood and other hardwoods (methods are similar to those used by farmers in growing corn, soybeans, and cotton). Today, at least two more companies and several private landowners are growing cottonwood and other hardwood species. Other species being planted are black walnut, American sycamore (*Platanus occidentalis* L.), and sweetgum (*Liquidambar styraciflua* L.) which, with cottonwood, account for about three-fourths of the total hardwood plantation acreage in the East.

Plantation Establishment

SITE EVALUATION AND PREPARATION

Areas considered for planting are first evaluated for potential productivity. Frequently, identification of soil series is adequate (2). Species planted on unsuitable sites have poor survival, slow growth, and are highly susceptible to attack by insects and diseases.

Site preparation is the most costly step in establishing hardwood plantations in southern bottomlands. In 1976, contract clearing, raking, windrowing, burning, and when needed, disking cost about \$150 per acre. Such intensive site preparation is required because trees are straddle cultivated until they are about 3 feet tall. Straddle cultivation is essential to achieve nearly complete control of competing vines, weeds, natural sprouts, or seedlings.

In the past a number of hardwood plantings have failed because of inadequate weed control, but some species are affected much more than others by competition. Cottonwood, for example, cannot tolerate weeds, but yellow-poplar (*Liriodendron tulipifera* L.), sycamore, and green ash (*Fraxinus pennsylvanica* Marsh.) can often survive and grow above weeds and natural regeneration. None of the hardwoods, however, do well where vines and natural regeneration combine to compete with the planted trees. There are strong indications that with most intolerant hardwoods, trees that grow well early continue to grow better than those that start slowly--another good reason for weed control. Nearly complete weed control is essential for only 1 year in cottonwood but for up to 3 years among slower-growing species such as the oaks. After trees reach 6 to 8 feet tall, one or two diskings during the growing season are usually adequate to keep plantings growing until crown closure.

Unlike hardwood plantings in the Midsouth, walnut plantations in the Central States are small, averaging perhaps 8 to 10 acres. Sites are mostly old fields, usually in bottomlands. Weeds are controlled for at least 2 years with chemicals. Most planting and weed control is done by hand rather than with large agricultural-type equipment.

PLANTING STOCK

Quality planting stock should be used. Five select cottonwood clones developed by Stoneville researchers are available for purchase from the nurseries of six southern States. On most sites, 20-inch long cuttings are used when planting cottonwood. For most other species being planted commercially, seedlings are used. Best results are from seedlings 3/8 inch or larger in diameter at the rootcollar (11). Such seedlings are frequently difficult to obtain from 1-0 stock unless they have been custom grown. Large seedlings are worth additional effort because of better growth and survival in the field and because they may not require straddle cultivation.

SPACING AND YIELDS

Most planters use spacings in the range of 10 by 10 to 12 by 12 feet. Wide spacing is preferred because it allows farm equipment to be used for mechanical weed control, and it enables most trees to develop into minimum commercial size, 5.1-inch d.b.h. or larger, without thinning. Wide spacings, however, may require artificial pruning to produce high-quality sawlogs. Crown to total height ratios, which for most species should be 40 or 50 percent, can be regulated through thinnings. When thinning is delayed too long, some species such as cottonwood will not respond to the additional

growing space, and growth is below potential. First and even second thinnings can be mechanized by removing alternate rows, but later thinnings are selective.

Merchantable yields from cottonwood plantations have ranged between 3 and 3-1/2 cords per acre per year over 10 years (6). Early results with other species indicate that plantation trees grow significantly better than the same species in natural stands.

Recent Work

Sycamore, black walnut, sweetgum, and *Populus* spp. have received the most attention for planting in the East, but current work at Stoneville involves nine other hardwood species, including five oaks. Considerable progress has been made with cottonwood on site selection (1), plantation establishment and management (7), and insect and disease identification and control (8). The most recent work with cottonwood involves 8- to 10-foot tall planting stock to eliminate the need for straddle cultivation, to reduce cost of site preparation, and to establish trees above competing weeds and deer (9). Basic work is also being done in nutrient cycling to guide foresters on selection of rotation lengths and the need for species mixtures.

The concept of growing hardwoods at spacings as close as 4 by 6 feet in short rotations (4 to 6 years) followed by whole tree chipping and coppice regeneration is receiving attention. Predicted yields from sycamore grown under this system are high but so are costs (4). Initially, the short-rotation, close-spacing work done in the southeast at Athens, Georgia, was for fiber production (5). But during the last 2 years, such systems have been envisioned for fuel. At the Forest Service Laboratory in Rhinelander, Wisconsin, hybrid poplars are planted at very close spacings (to 9 by 9 inches), irrigated, and fertilized to achieve maximum yields of fiber in a short time (3).

Although planting acreages of eastern cottonwood and black walnut appear to have stabilized, other hardwoods are being more widely planted than in the past. The basic technology for planting most hardwoods is either available or soon will be; the future is in refinements and cost-cutting techniques. Although methods of establishment and management may vary by species and localities, plantations of eastern hardwood species most surely will increase as the demand for hardwood products increases.

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