RESEARCH NOTE NC-118

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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GROWTH AND SURVIVAL OF INTERPLANTED HARDWOODS IN SOUTHERN WISCONSIN OAK CLEARCUTTINGS

ABSTRACT. — Four years after planting in oak clearcuttings, 1-1 white ash transplants had the best survival and growth of seven hardwood species. Other species tested were yellow-poplar, sugar maple, red maple, northern red oak, and American basswood. The relatively high success of white ash makes it the safest selection for Upper Mississippi Valley clearcut interplantings. However, large 1-1 transplants with about 2-foot tops are recommended, in addition to control of stump sprouting.

OXFORD: 235.6:221.1:176.1:77. KEY WORDS: regeneration, planting, white ash, yellow-poplar, northern red oak.

In the even-aged management of hardwoods, interplanting may be a reasonable alternative or supplement to natural regeneration on some sites. This conclusion is based on 4-year growth and survival of seven hardwood species planted in two southern Wisconsin oak clearcuttings.

METHODS

The study areas were two 20-acre clearcuttings, one on the Coulee Experimental Forest near La Crosse and another south of Madison near Albany. Before harvest cutting, the fully stocked Albany stand was dominated by 65-year-old black oak (*Quercus velutina* Lam.), with lesser amounts of white oak (*Q. alba* L.), northern red oak, black cherry (*Prunus serotina* Ehrh.), and American elm (*Ulmus americana* L.). The topography was nearly flat and the site index for black oak was 58 based on Schnur's[1] curves. Despite an attempt to control understory shrubs with an herbicide 2 years before harvest cutting, a moderately dense shrub layer persisted. These shrubs consisted mainly of briars (*Rubus* spp.), racemose dogwood (*Cornus racemosa* Lam.), and American hazel (*Corylus americana* Walt.).

The Coulee stand was also fully stocked prior to clearcutting with 100-year-old northern red oak predominating. Other species included white oak, American basswood, white ash, American elm, and butternut (*Juglans cinerea* L.). Site indices for northern red oak on similar sites typically range from 55 to 65. A moderately dense shrub understory of roundleaved dogwood (*Cornus rugosa* Lam.), briars, and American hazel was treated with an herbicide the summer before clearcutting and a good kill was obtained.

On both areas, hardwood species were planted the spring following cutting of all trees 2 inches d.b.h. and larger. The seedlings were planted in four randomly selected 1-acre-square plots within each study area. Each species was planted in a row at 6- to 10-foot spacing as logging debris permitted.

[1] *Schnur, G. Luther. Yield, stand, and volume tables for even-aged upland oak forests. U.S. Dep. Agr. Tech. Bull. 560, 88 p., illus. 1937.*

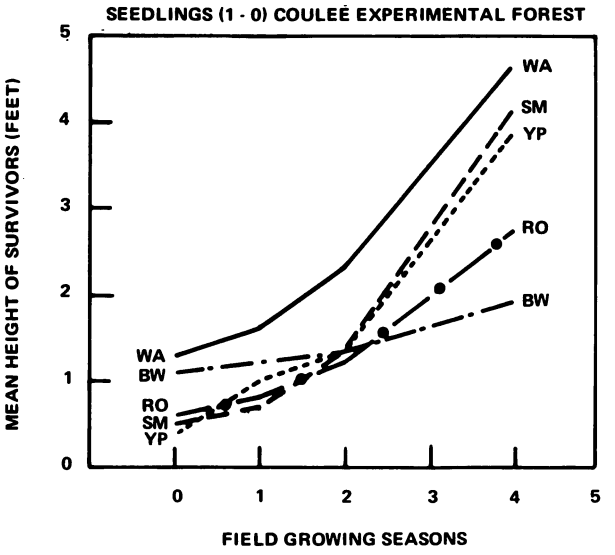
In the Albany area, 25 1-1 transplants of northern red oak (*Quercus rubra* L.), sugar maple (*Acer saccharum* Marsh.), red maple (*A. rubrum* L.), white ash (*Fraxinus americana* L.), yellow-poplar (*Liriodendron tulipifera* L.), and American basswood (*Tilia americana* L.) were planted in each plot in April 1966.

In the Coulee Experimental Forest, 50 1-0 seedlings of northern red oak, yellow-poplar, and black walnut (*Juglans nigra* L.), and 25 1-0 seedlings of sugar maple and white ash were planted in each plot in May 1967. Three of the four plots in this stand were on a steep (30- to 70-percent), concave, north-facing slope. The remaining plot was on a 20- to 30-percent southeast-facing slope.

RESULTS AND CONCLUSIONS

Any measure of planting success within clearcuttings must consider growth of competing vegetation. Extremely dense shrub cover characterizes most Upper Mississippi Valley clearcuttings; thus planted trees that did not grow into or above the upper shrub canopy after four growing seasons were categorized as "unsuccessful" even though alive. Because shrub canopies averaged about 5 feet in height 4 years after clearcutting, successful trees were defined as those that survived and grew into the 6-foot height class or beyond. It was assumed such trees would develop successfully, provided they were not immediately overtopped by clumps of rapidly growing stump sprouts or dense aspen clones.

Albany plots. — Transplants at Albany were about twice as tall as the Coulee seedlings after 4 years (fig. 1). White ash, yellow-poplar, and sugar maple had the best survival and growth (table 1). Considering only trees that survived, yellow-poplar exhibited the best average 4-year height (9.1 feet); 93 percent were above the mean shrub canopy. Nevertheless, white ash was more successful because of high (92 percent) survival. These survivors averaged 7.6 feet in height. The faster growth of yellow-poplar should be interpreted cautiously, because the planting site was 200 miles outside its natural range. Continued observations on the growth of this species will be required before reliable conclusions on its suitability for this region can be made.



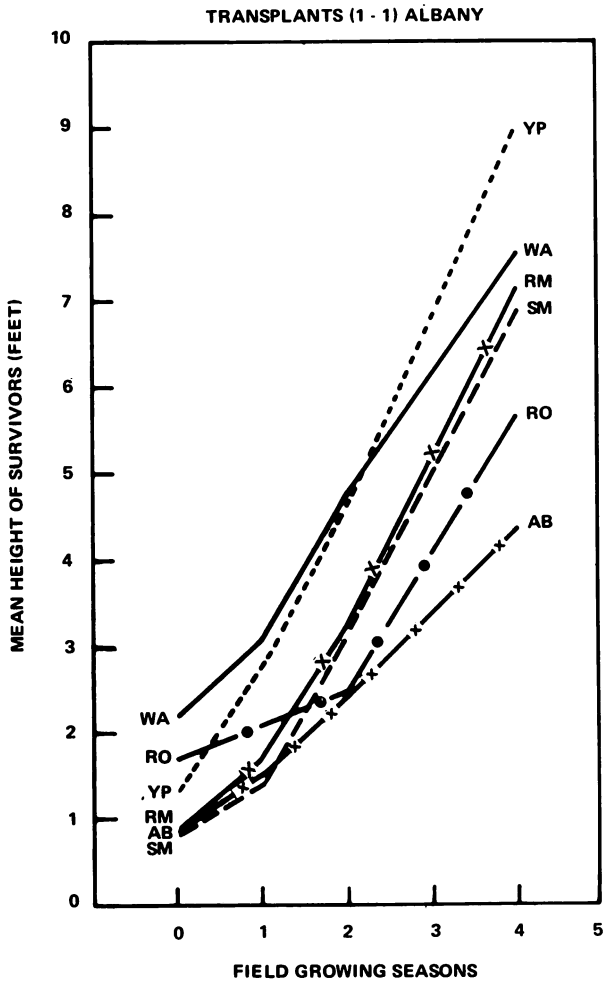


Figure 1. — *Height growth of interplanted hardwoods. (AB = American basswood; BW = black walnut; RM = red maple; RO = northern red oak; SM = sugar maple; WA = white ash; YP = yellow-poplar).*

Table 1. — *Fourth-year survival and success of interplanted hardwoods*

Species	Planting stock	Survival	Survivor success[1]	Total success[2]
Albany plots:				
White ash	1-1	92	79	73
Yellow-poplar	1-1	72	93	67
Sugar maple	1-1	75	76	57
Red maple	1-1	66	71	47
Northern red oak	1-1	51	65	33
American basswood	1-1	48	35	17
Coulee plots:				
White ash	1-0	99	28	28
Sugar maple	1-0	89	21	19
Yellow-poplar	1-0	74	17	13
Northern red oak	1-0	67	4	3
Black walnut	1-0	77	2	1

1/ Percent of fourth-year survivors 5.6 feet in height or taller.

2/ Percent of total planted trees surviving and reaching 5.6 feet in height or more after four growing seasons.

Of the remaining species, sugar maple was the most successful. Its survival was significantly better than that of red maple, even though height growth of the two species was nearly identical. Overall response of both northern red oak and American basswood transplants was very poor. Northern red oak showed fairly good height growth, but poor survival (table 1).

Coulee plots. — The white ash seedlings had the best survival (99 percent), average height growth (4.6 feet), and survivor success (28 percent) (table 1). Northern red oak and black walnut had the poorest overall success, even though survival was moderately good (67 and 77 percent, respectively). Poor height growth of both species resulted in nearly total suppression by competing vegetation. In general, 1-0 seedlings of all species were unable to stay ahead of the dense shrub canopy that redeveloped, despite the preharvest herbiciding.

Stump sprout competition. — Although high shrub densities were a threat to planted hardwoods, vigorous 1-1 planting stock of some hardwood species outgrew this competition. In contrast, even the most vigorous planted trees could not outgrow the stump sprouts. On the Coulee plots, for example, stump sprout clumps averaged about 150 per acre. These included both oak and non-oak[2] species. After four growing seasons, the non-oak sprouts averaged about 17 feet in height and 24 stems per clump; the oak averaged about 11 feet and 11 stems per clump. Such numbers and densities of stump sprouts influenced an inordinately large area. Observations in several 15- to 20-year-old clearcut oak stands on similar sites within the region have indicated that most seedling and seedling-sprout origin reproduction becomes totally suppressed by stump sprouts.

Thus, to ensure growth and survival of planted trees, stump sprout competition must be minimized by either reducing sprouting or avoiding areas with many sprouts. The latter alternative will be difficult in clearcuttings containing more than 70 to 80 non-oak stump sprouts per acre. Consequently, most stands will require a reduction of stump sprouts by either mechanical or chemical methods. The stump sprout problem will be particularly severe where there are many small-diameter stumps of non-oak species.

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[2] *Predominant non-oak species include boxelder* (Acer negundo *L.*), *American basswood, white ash, black cherry, elms* (Ulmus *spp.*), *and eastern hophornbean* (Ostrya virginiana (*Mill.*) *K. Koch.*).

The relatively fast growth, high survival, and adaptability of white ash transplants make them the safest selection for clearcut interplanting in the Upper Mississippi Valley. The large, 2-foot tops of the planting stock may have determined the success of this species. However, 1-1 sugar maple with 10-inch tops also did relatively well, and might also be a reasonable choice for clearcut interplanting. Planting of either species, however, should be limited to high-medium or better oak sites (upland oak site index 58+) during the first spring after harvest cutting.

Usually there will be some desirable hardwood reproduction following a complete clearcut. And studies in progress indicate that mixed stands with even moderate amounts of light-seeded species such as white ash and sugar maple before harvest cutting regenerate heavily to these species, and thus do not require any supplemental planting.

In contrast, most pure or nearly pure oak stands throughout the Upper Mississippi Valley contain a paucity of desirable reproduction after cutting. In such situations, proper hardwood interplanting should improve future stand composition and quality.

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1971

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