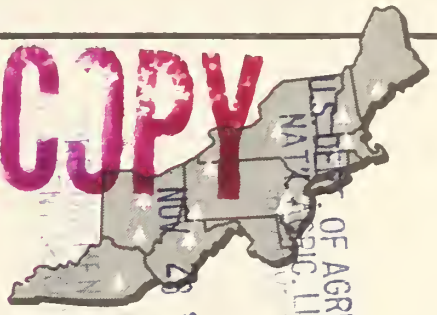
FOREST SERVICE RESEARCH NOTE NE-241
1977

Northeastern Forest Experiment Station



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ODC 232.4 + 228.0 547 + 561.1

INTRODUCTION OF BLACK WALNUT AND NORTHERN RED OAK SEEDLINGS IN AN UPLAND HARDWOOD FOREST IN SOUTHEASTERN OHIO

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Abstract.—Black walnut and northern red oak seedlings were planted on a clearcut area in 1964. Three cultural treatments were applied to seedlings to control competing trees. Average height and survival were analyzed 13 growing seasons after planting. Results indicated that black walnut seedlings can be effectively established on good sites if cultural treatments are applied. Red oak seedlings are difficult to establish, regardless of treatment or site.

Keywords: black walnut, red oak, planting, height growth.

The upland timber stands on many of southeastern Ohio's good sites contain few, if any, black walnut (*Juglans nigra* L.) or northern red oak (*Quercus rubra* L.) trees. Yet such sites are capable of growing high-quality timber at a rapid rate and could possibly be stocked with these high-value species. The most obvious way to introduce high-value species is to plant them after removing residual trees in a regeneration cutting.

The dense sprout and brush cover that develops on these sites after a regeneration cutting creates fierce competition for any seedlings planted there. Therefore the seedlings should be selected from superior stock, planted with great care, and helped along by release cuttings or other cultural measures as necessary. The high value of the species and the potential for rapid growth on these good sites may very well justify the costs of these intensive methods.

The purpose of this study was to evaluate several methods of establishing black walnut and northern red oak seedlings after clearcutting a hardwood stand on a good site where these species were scarce or absent.

The Study

Planting site.—A timber sale in an upland mixed oak stand on the Vinton Furnace Experimental Forest[1] in southeastern Ohio during the winter of 1963-64 created a convenient and suitable test area for this study. The 8-acre sale

[1]The Vinton Furnace Experimental Forest, located in southeastern Ohio, is managed cooperatively by the Northeastern Forest Experiment Station and the Mead Corporation.

area, located in a north-facing cove, was regenerated by a complete clearcutting. All trees and brush larger than 1.5 inches (3.8 cm) dbh were cut. The original stand contained a few northern red oak trees but no black walnut.

Northern red oak and black walnut seedlings were planted in the spring of 1964. The field layout consisted of four square blocks, 105.6 feet (32.19 m) on a side. Two of the blocks were on a noticeably better site. Each block contained 32 red oak seedlings and 32 black walnut seedlings, planted alternately in a checkerboard fashion, 13.2 feet (4.02 m) apart. The average height of all 256 seedlings at the time of planting was 1.2 feet (0.37 m) ± 1.6 percent.

Planting stock.—Red oak seedlings were selected from 1-year nursery-run stock. The black walnut seedlings were 1+0 surplus stock[2] from a walnut progeny study. The black walnut seedlings planted on the two blocks with lower site were from a selected parent tree located in Indiana, and the walnut seedlings on the two blocks with higher site came from a selected parent tree in Ohio. Results of other outplantings using these seed sources *(Funk 1972)* indicated that the progeny from the Indiana tree grew better than the progeny from the Ohio parent tree; the 9-year height growth averaged 13.5 feet (4.11 m) and 9.5 (2.90 m), respectively.

Cultural treatment.—Each seedling received one of three treatments:

Mulch: brush was cut from a 3-foot (0.91-m) radius around the seedlings, and a mulch of building paper was applied.

Rake: brush was cut from a 3-foot radius around the seedling, the soil was cultivated in an 18-inch (45.7-cm) radius, and herbicide spray was applied from 18 inches out to a 3-foot radius.

Spray: brush was cut from a 3-foot radius around the seedling and stubs were sprayed with herbicide.

On check seedlings, no cultural treatments were applied.

Treatments were assigned randomly to seedlings within the limits of a Latin square design. The rake and spray treatments were repeated four successive springs from 1964 to 1967. The mulch treatment was made in the spring of 1964 and repeated in 1966, using black polyethelene plastic instead of the paper mulch. Total heights were recorded for each tree in the summers after treatment. Both total height and dbh were recorded in August 1976, thirteen growing seasons after planting.

Natural reproduction competing with the planted seedlings included fast-growing species such as yellow-poplar, aspen, and cherry. Shrubs such as hazelnut, dogwood, sassafras, and serviceberry were prevalent. Other species, some of which were fast-growing sprouts with established root systems, included chestnut oak, red maple, and black oak.

Natural Disturbances

A drought in 1964 and a periodical cicada attack in 1965 were the two major natural disturbances during the experiment. The drought caused some damage, but the cicada attack caused damage to 60 percent of the red oak seedlings and 25 percent of the black walnut seedlings.

Since many of the leaders had been damaged by cicadas or had died back and sprouted, it was decided in the spring of 1966 to try cutting back some of the stems to the ground line and letting the new sprouts take over (coppicing). Forty-five damaged red oak seedlings, 10 uninjured red oak seedlings, and 24 uninjured black walnut seedlings were cut back. None of the damaged walnut seedlings were cut back. Those seedlings selected for coppicing had the least height growth. It was hoped that the new sprouts would grow faster and straighter than the original stems.

Results

The most recent height and dbh measurements recorded in 1976 were used in the analysis. Results indicated that site quality was a major factor affecting the establishment of the black walnut seedlings. Survival and average height were therefore determined for each species x site x treatment category (table 1). Planned statistical analyses were not performed because there were not enough surviving trees in some of the categories.

Suppression was the major cause of mortality. The drought and cicada attack undoubtedly increased the number of suppressed seedlings.

[2]Some of the walnut seedlings planted on the two blocks with lower site may have been 1+1 stock. Records are not clear on this point.

Damage by small mammals and local erosion accounted for the deaths of several seedlings.

Natural sprouting of planted seedlings occurred following dieback. Twenty-two percent of all live trees measured in 1976 originated from natural sprouts following dieback. Ninety percent of all seedlings coppiced in 1966 sprouted successfully. Although their average height had almost caught up to that of the uncut seedlings after only two growing seasons, they were still the shorter trees. Their competitive status relative to surrounding trees was not improved. Therefore, the primary effect of coppicing was to delay mortality due to suppression over the short run only. It did not significantly reduce mortality or increase height growth during the length of the experiment. Because of the amount of natural sprouting that occurred, inclusion of the coppiced seedlings in table 1 does not distort the results to any major degree.

Red oak.—Site apparently did not have much effect on the survival or height growth of the red oak seedlings (tables 1 and 2). Growth, mortality, and crown class of the seedlings were similar on all four blocks.

Forty-nine percent of the red oak seedlings on all four blocks survived the 13 growing seasons. However, the average height was only 16.0 feet (4.88 m), and the average diameter[3] was only 1.2 inches (3.0 cm). Most of the remaining red oaks are now well below the main crown canopy and

[3]Quadratic mean, breast height. The diameter of a tree of average basal area.

Table 1.—Survival and average height of trees, in feet, 13 growing seasons after planting, by treatment, species, and site

Site class	Check		Mulch		Rake		Spray		Average	
	Survival [a]	Average [b] height	Survival	Average height	Survival	Average height	Survival	Average height	Survival	Average height
	Pct.	*Ft.*	*Pct.*	*Ft.*	*Pct.*	*Ft.*	*Pct.*	*Ft.*	*Pct.*	*Ft.*
					NORTHERN RED OAK					
Good	38	13.1	63	17.9	50	15.6	63	15.5	53	15.8
Medium	44	16.7	56	16.8	50	16.5	31	14.6	45	16.3
					BLACK WALNUT					
Good	38	16.0	56	26.3	75	25.1	75	23.7	61	23.5
Medium	13	13.1	13	15.9	6	12.3	13	13.9	11	14.0

[a] There were 16 original seedlings planted in each species x site x treatment category.
[b] Height in meters = 0.3048 x height in feet.

Table 2.—Crown class distribution of surviving trees, 13 growing seasons after planting, by species and site, all treatments combined

Site class	Original number of seedlings	Dominant/ codominant		Intermediate		Suppressed		Total, all crown classes	
		Survival	Average height [a]	Survival	Average height	Survival	Average height	Survival	Average height
	No.	*No.*	*Ft.*	*No.*	*Ft.*	*No.*	*Ft.*	*No.*	*Ft.*
					NORTHERN RED OAK				
Good	64	2	27.9	8	21.8	24	12.8	34	15.8
Medium	64	9	21.5	8	16.5	12	12.4	29	16.3
					BLACK WALNUT				
Good	64	25	29.3	3	20.2	11	11.4	39	23.5
Medium	64	1	20.6	1	11.1	5	13.2	7	14.0

[a] Average height in meters = 0.3048 x height in feet.

do not look vigorous enough to last until rotation age. Only 11 of the original 128 seedlings are in the dominant-codominant crown class (table 2). Competing trees in the dominant-codominant crown class in 1976 included yellow-poplar, chestnut oak, cherry, aspen, and red maple.

None of the cultural treatments resulted in a dramatic increase in height growth compared to that of the check trees. Only the mulch treatment was consistently better than no treatment (table 1).

Black walnut.—Site apparently was a major factor influencing establishment of the black walnut seedlings (tables 1 and 2). Even though the sources of the planting stock were slightly different for the good and medium sites, the results indicated that the large differences between sites should probably be attributed mainly to site effects.

Only 11 percent of the original seedlings on the two blocks on the medium site survived. Only one of these remaining trees was in the dominant-codominant crown class (table 2). Intermediate and suppressed trees probably will not make it to rotation age. Average height of all surviving walnut trees on the lower site areas was 14.0 feet (4.2 m), and the average diameter was 1.1 inches (2.7 cm).

Sixty-one percent of the original seedlings on the two blocks on the good site survived. Twenty-five of these remaining trees were in the dominant-codominant crown class (table 2), and 17 were more than 25 feet tall. Average height of all trees on the good site areas was 23.5 feet (7.16 m), and average diameter was 3.1 inches (7.8 cm). The tallest walnut tree was 43.2 feet (13.17 m), and had a dbh of 4.7 inches (11.9 cm). Another of the larger walnut trees was already bearing fruit (fig. 1).

All cultural treatments showed a distinct advantage over the check trees on the good site areas, the mulch treatment having the best average height (table 1). Only 2 of the 25 trees in the dominant-codominant crown class were check trees (table 2). Differences were not as distinct on the medium site areas. Again though, there were too few surviving trees to make sound conclusions regarding treatment effects.

Figure 1.—Black walnut tree 35.5 feet (10.8 m) tall and 5.7 inches (14.5 cm) dbh, 13 growing seasons after planting. Original seedling received mulch treatment on good site area.

Discussion

Seedlings planted in a recently clearcut area must compete with fast-growing trees, shrubs, and sprouts that have established root systems. To establish valuable species such as red oak and black walnut, the planted seedlings must be kept free of competition through cultural treatments that are usually expensive to apply.

Krajicek *(1975)* found that, after seven growing seasons, survival of black walnut seedlings planted in cleared forest openings in Illinois did not differ by competition-control treatments. He also found that the trees grew somewhat larger where all competing vegetation was controlled, but almost as large when only herbaceous competition was controlled.

Although our study did not provide conclusive evidence, the results do warrant some general

observations. Northern red oak seems to be difficult to establish regardless of site quality or cultural treatment. However, the poor performance of red oak may be due to the severe cicada attack and the large number of seedlings that were coppiced. Black walnut also performed poorly on medium sites, regardless of cultural treatment; but on good sites walnut can be effectively established with cultural treatments. The fact that 39 percent of the original walnut seedlings planted on the good site are now in the dominant-codominant crown class and average 29.3 feet in height after only 13 growing seasons is very promising. I believe that survival and development of walnut would be even better if the treatment area were larger than a 3-foot (0.91-m) radius and if the treatments had been continued at 3- or 4-year intervals.

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MANUSCRIPT RECEIVED FOR PUBLICATION 17 FEBRUARY 1977