PLANTING METHODS FOR BLACK WALNUT ON CUMBERLAND PLATEAU SITES

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Planting black walnut by the bar-slit method was as effective as the more expensive mattock center-hole method. Pruning tops and roots of seedlings to facilitate handling and planting did not reduce survival or growth.

Over a century of high grading has almost eliminated black walnut from the easily accessible forests on the Cumberland Plateau. For many stands, planting is the only way to reestablish this high-value species. Dependable planting techniques will also be needed to introduce genetically superior seedlings when such stock becomes available.

This study was made to determine if black walnut could be planted successfully in cutover Cumberland Plateau forests. Objectives were to evaluate effects of planting method, root pruning, top clipping, and seed source on early survival and growth of 1-0, bare-rooted seedlings.

Study Areas

Two plantations were established near Sewanee, Tenn., one on an excellent hardwood site and one on a fair site.

The first plantation is on a steep northwest-facing slope of the plateau escarpment-areas referred to locally as "coves". Plots were located on a bench where slope is only 5 percent. Soils here are developed in deep, bouldery colluvium from the sandstone and shale caprocks of the plateau top. Between the stones, soil is a dark, friable loam with good drainage and with organic matter incorporated to well below planting depth. Before logging, this area supported high-quality yellow-poplar, northern red oak, white basswood, yellow-buckeye, and several miscellaneous species. The understory was mainly sugar maple and dogwood, plus advance reproduction of the overstory species.

The second plantation is on a nearly level area on top of the Cumberland Plateau. Soils are well-drained Hartsells and Linkerfine sandy loams, averaging 32 inches to bedrock and with an A horizon of 7 inches. Before planting, this area had a stand of oak and hickory poles with a moderately dense understory of hardwood reproduction and shrubs. Although better than average for the plateau top, it is doubtful that this site is suitable for black walnut because soils are relatively infertile. This area was selected, however, because we wanted to insure a good test of planting variables even if a series of unusually wet summers masked effects of treatments on the cove site.

Planting Methods

On each site, bar-slit planting was compared to the mattock center-hole method. For both methods, seedlings were set with their root collars flush with the soil surface. Mattock planting holes were dug deep enough and wide enough to accommodate the root system without deforming it. When refilling the mattock holes, we carefully firmed soil around the roots.

Immediately before planting, roots were pruned to either 5 or 8 inches in length. Nursery-run stock with taproots averaging 10 inches provided the check for root-pruning treatments. Leaders of top-clipped seedlings were cut back to 6 inches; unclipped seedlings provided a check on top-clipping.

To check possible interactions between geographic origin of the seedlings and planting treatments, we included two seed sources in the study. A local source was taken from the Cumberland Plateau in Franklin County, Tenn. Walnuts for a western source came from the Highland Rim in Robertson County, about 100 miles away. Seedlots for these putative races were composited from six trees each. Stock was grown in the Tennessee Valley Authority's nursery near Clinton, Tenn. Before top clipping, seedlings averaged 12/32-inch in diameter, 1 inch above the root collar, and 1.5 feet in height.

In late May, seedlings were planted on each site in a randomized block design with three replications, each consisting of a row of 15 seedlings. Hardwoods larger than 1 inch in diameter were deadened by tree injection, and smaller stems were cut before planting. During the next two

growing seasons, a few sprouts that overtopped the planted walnuts were cut. At the start of the fourth growing season, all unwanted hardwoods, brush, and vines were cut. No attempt was made to control herbaceous competition.

Differences in survival and growth for each site were evaluated at the 0.01 level by analysis of variance.

Results

Survival. Fifth-year survival in the cove averaged 74 percent and was about the same for both seed sources. On the plateau top, survival of the eastern source was 73 percent and was significantly better than the 60 percent obtained with the western source. Survival was not affected by method of planting, root pruning, or top clipping on either site.

A few seedlings were girdled by mice or voles, but animal depredations were unimportant on both sites. We could seldom determine a definite cause of mortality, but most seedlings that died were below average in size and vigor, and probably succumbed to competition.

Height Growth. Top-clipped seedlings grew significantly better than unclipped seedlings for the first 3 years after planting on both sites (table 1). Growth in the fourth and fifth years was not improved much by clipping. Perhaps because the second and third summers after planting were unusually dry the leaders of many seedlings on the plateau site died back. Mean growth of unclipped seedlings was negative in the second year and only 0.10 feet in the third year. During these dry years top-clipped seedlings grew almost five times faster than unclipped seedlings. Although a few seedlings in the cove died back, average heights of both clipped and unclipped seedlings increased in both dry years. For the entire 5 years, growth of clipped seedlings averaged 6.13 feet in the cove and 2.29 feet on the plateau-top site. Growth of unclipped seedlings averaged 4.55 feet and 1.09 feet, respectively.

Overall, seedlings planted in carefully prepared mattock holes grew no better than those that were slit planted. Pruning roots to either 5 or 8 inches did not affect annual or cumulative growth on the plateau site. In the cove, root pruning improved first-year growth of slit planted seedlings, but growth in mattock holes was slightly better where roots were left unpruned. No other main effects or interactions between methods of planting, root pruning, top clipping, or seed sources were significant.

Table 1.—*Height growth of planted black walnut seedlings on cove and on plateau-top sites*

Site and clipping treatment	Annual growth since planting (years)					Total Growth (Height) (5 years)	
	One	Two	Three	Four	Five		
	(feet)						
Cove							
Top-clipped	0.47	0.76	1.58	1.73' a	1.59 a	6.13	6.6 a
Unclipped	0.29	0.33	1.12	1.56 a	1.25 a	4.55	6.0 a
Both treatments	0.38	0.54	1.35	1.64	1.42	5.33	6.3
Plateau							
Top-clipped	0.26	0.40	0.48	0.55 a	0.60 a	2.29	2.8 a
Unclipped	0.15	-0.10	0.10	0.44 a	0.50 a	1.09	2.6 a
Both treatments	0.20	0.15	0.29	0.50	0.55	1.69	2.7

[1] Means of top-clipped and unclipped seedlings followed by the same letter do not differ significantly at the 0.01 level.

The small differences that top clipping caused in early growth hardly affected final performance. Fifth-year total heights in the cove ranged from 4.7 to 7.9 feet and averaged 6.3 feet (table 1). On the plateau top, seedlings averaged 2.7 feet and ranged from 2.1 to 3.6 feet in height among planting treatments. Differences in fifth-year total heights were not statistically significant on either site.

Discussion

This study shows that black walnut can be established on forested Cumberland Plateau sites by bar-slit planting. Careful, center-hole planting offers no advantages in survival or growth. If tops and roots have not been pruned sufficiently at the nursery for easy handling and planting, they can be shortened in the field. Within 5 years, the faster early growth of top-clipped seedlings should overcome the initial loss of height caused by pruning. Pruning roots to about 8 inches is especially helpful for bar planting in stony soils and, in any soil, keeps the taproot from curling when the seedling is inserted in the planting slit. Even though pruning roots back to 5 inches did no apparent damage in this study, such severe pruning is not needed for planting black walnut.

The better survival on the plateau top of seedlings from the eastern origin indicates that seed source can influence performance of walnut plantations. However, results are too limited to justify firm conclusions as to seed collection zones for planting in Tennessee. Unless experience indicates the superiority of a specific, nonlocal source, seed should be obtained from a source as near the planting site as possible.

With respect to planting techniques, these Tennessee observations confirm research in southern Indiana where Williams (2) concluded that any planting method compatible with type of stock is suitable for black walnut.

Recent research in the Central States shows that virtually complete control of competition, and especially herbaceous vegetation, is needed for best growth of walnut planted on cutover sites (1). In our study, small hardwoods were only partially controlled and herbaceous weeds were not controlled. Even so, growth was satisfactory in the cove. Planted walnuts should grow even better on these good sites if herbaceous competition is also controlled thoroughly. Growth on the plateau top was poor by any standard. Considering the low fertility of the site, more intensive competition control probably would not have greatly improved growth. Planting black walnut on the plateau top cannot be recommended until we can better identify suitable soils or learn to overcome the inherent limitations of most plateau-top soils.

Literature Cited

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