

FNR-149

**Purdue University
Cooperative Extension Service
West Lafayette, IN 47907**

Important Information About Planting Black Walnut in Indiana

*Scott D. Roberts, Assistant Professor
Walter F. Beineke, Associate Professor
Department of Forestry and Natural Resources*

Introduction

Black walnut is the most valuable individual tree in Indiana based solely on the dollar value of the wood produced. This is primarily due to the very high value of walnut veneer; but considerable value also exists in walnut sawtimber, as well as the production of nuts.

Because of the inherent value of the species, there has been considerable interest in the planting of black walnut in Indiana. Plantations are established for a variety of reasons, including long-term investments, establishment of legacies for children or grandchildren, or the enjoyment of planting and tending trees with the recognition of future economic returns. Properly planned and managed, a black walnut plantation can be a sound economic investment while also providing aesthetic and environmental benefits.

Before proceeding with plans for a black walnut plantation, there are several important factors you should consider. Is your land suitable for black walnut? What type of planting stock should you use? What management techniques will be employed? How long will it take the plantation to mature? These are factors that will help you decide if establishing a walnut plantation is appropriate for meeting your objectives. This bulletin introduces some basic information concerning black walnut, and points out where additional information and assistance can be found.

Site Requirements

Choosing an appropriate site is the most important step in the successful establishment of a black walnut plantation. Black walnut will survive on a wide range of sites; however, to achieve best growth, walnut requires

high-quality sites. Failure to select a proper site will lead to poor tree performance, if not outright plantation failure.

Black walnut grows best on moist, well- drained soils that are deep and fertile. Ideally, soils should be at least 36 inches deep and high in organic matter. Loams or sandy loams provide the best combination of moisture holding capacity and drainage. Black walnut does not tolerate flooded or saturated soil conditions well, nor does it perform well on dry south or southwest facing slopes, or on ridgetops where soils are commonly thin. Black walnut often performs best on moist bottomland sites where drainage is adequate to prevent soil saturation.

Planting Stock Options

Various types of black walnut planting stock are available for you to select from. They differ in growth performance, as well as in price. The choice of which planting stock to use in your plantation should be based on careful consideration of the costs and benefits of each type of stock relative to your short- and long-term objectives.

Superior Grafted Stock

Since the late 1960s, scientists at Purdue University and elsewhere have been working on selecting for genetically superior black walnut trees, as well as developing techniques of tree grafting which allow reliable and economical production of genetically superior planting stock. This work has culminated in several patented superior strains of walnut, a few of which are available commercially.

The superior strains of walnut have been selected primarily for stem straightness and rapid height and diameter growth. On good sites, with proper cultural treatments, these trees will perform better, on average, than common black walnut trees. Tests have shown that over the first 15-20 years, average stem straightness was improved by over 20 percent, average height growth was increased 25-35 percent, and average diameter growth was 15-30 percent greater. It is still too soon to tell whether these improvements will hold up over the entire life of the stand. These tests were all performed in Indiana, and care should be taken in extending the results of these tests to other states where conditions may be quite different. Also, actual growth performance will depend on site quality, plantation care, and intensity of management.

The primary benefit of the superior grafts is that, with proper management, they will typically produce a given sized tree in a shorter length of time. These trees also will likely have better stem form and, therefore, be more valuable, particularly for lumber. There are still some questions yet to be answered concerning the impact that faster growth rates will have on the veneer qualities of these trees.

The primary drawback of the superior planting stock is currently the high cost per tree. In 1995, the cost is approximately \$25 per tree, although this will likely change over time as availability and demand changes. The high cost per tree is partially offset by planting fewer trees per acre; however, initial plantation establishment costs using superior grafts are substantially higher than they are when using nursery produced seedlings.

Seedlings from Genetically Superior Trees

A second black walnut planting stock option is to use seedlings produced from nuts collected from superior trees. With these trees, the "mother" tree is known to contain superior characteristics; but, the quality and characteristics of the "father" tree are unknown. Preliminary tests have shown that the growth performance of these trees is intermediate-the seedlings have more rapid growth and better form, on average, than common nursery stock, but do not perform as well as the superior grafts. The cost of these seedlings is considerably less than that of grafted stock, but still much higher than nursery stock.

Nursery Stock

Common black walnut nursery stock is available from the Indiana Division of Forestry state nurseries, or from several commercial nurseries in the region. Because few of these seedlings are produced using nuts collected from trees screened for quality, there is greater variability in the growth characteristics of nursery stock.

Black walnut nursery stock is very capable of producing high-value crop trees; though, on average, its growth will be somewhat slower and form somewhat poorer than that of genetically superior stock. With time, proper care, and selective thinning, however, these seedlings can produce quality black walnut trees. Planting more trees than needed, and then selecting the better trees to remain during a series of plantation "thinnings" can result in a successful plantation containing fast growing trees with excellent stem characteristics.

The main benefit of nursery stock is the low cost per seedling which, even at higher planting rates, will result in lower plantation establishment costs than planting with improved grafted stock. This benefit will be partially offset by the need for more intensive plantation management, especially pruning and thinning.

Planting Rates

Once you've decided upon an appropriate site and a type of planting stock, the next important decision is how many seedlings per acre should be planted. When seedlings are initially planted, they are free to grow without competition from other planted trees. As the trees get bigger, they require more room, and eventually they start competing with each other for growing space. The denser the initial plantation (closer tree spacing), the sooner the trees start competing. Competition slows down the diameter growth of the trees, although height growth is typically not affected. The fastest way to produce large diameter trees is to keep them well spaced so that they do not compete.

While wide spacing allows for rapid tree growth, it also allows room for weeds and other competing vegetation. When uncontrolled, this can reduce tree growth in the same way as if they were competing with other trees in the

Table 1. Recommended planting density, and resulting tree spacing, for different types of black walnut planting stock.

Planting Stock Type	Trees per Acre	Average Tree Spacing (ft)
Superior Grafted Stock	140	17-18 (plant 15'x20')
Superior Seedling Stock	200-300	12-15
Nursery Stock	400-500	9-10

plantation. Wide spacing also promotes the development of larger lateral branches, and does not help correct poor stem form the way closer spacing does. Finally, wide initial spacing in the plantation means you will have fewer trees to select from when thinning the plantation to favor the best trees.

The decision of how many trees to plant represents a trade-off. Wide initial spacing promotes rapid tree growth, but may increase costs associated with cultural treatments such as pruning. Closer spacing can lower these costs, but does so at the expense of individual tree growth rates and leads to longer rotation lengths.

The correct planting density will depend, in part, on your management objectives, the stock type planted, and the management practices you employ. Another important consideration is the type of equipment you will be using in your plantation. The spacing between rows should allow adequate room for you to move within the rows while mowing, pruning, or performing weed control.

In most cases where an investment is made in a black walnut plantation, one primary objective is to produce large, high-valued trees. This usually includes the production of veneer grade logs, but may also include production of both sawtimber and nuts. Under this objective, the goal is to get the trees to the minimum

merchantable sawtimber size, and then to the larger veneer grade sizes, as quickly as possible. This is best done by maintaining rapid individual tree growth, which is best accomplished by keeping the tree density below the point where trees are strongly competing with one another.

Given the objective of rapid production of high value trees, recommendations can be made for appropriate planting densities for different stock types. Realize, however, that these are only recommended target tree densities which may vary. For example, if nut production is also an objective, tree spacing might be increased slightly (i.e. lower density) to allow for the development of larger crowns. If an intercropping system is being considered, tree density may be even lower. If you're interested in minimizing the costs of certain cultural treatments, then density might be higher.

Another option to consider is to plant a lower density of walnuts and interplant other species. A common approach is to interplant with a "nurse" tree, such as European black alder or white pine, to help promote better stem form on the walnuts. Professional foresters commonly recommend planting a mixture of species in a plantation. Matching black walnut with another species of similar growth rate can provide better utilization of site resources and provide greater diversity which may lend itself better to multiple objectives.

Superior Grafted Stock

If using genetically superior grafted stock with the objective of producing high-quality sawtimber and veneer, a reasonable recommendation for planting density would be about 140 trees per acre (TPA) (Table 1). This equates to an initial tree spacing of 15 feet by 20 feet. From this starting point, a series of thinnings will periodically reduce tree density, each time selecting the largest and best formed trees to remain. A practical target is to try and have 90-100 TPA remaining when the average tree size in the plantation reaches 10-12 inches (21-22 foot average spacing between trees).

The final target number of trees per acre to manage for can vary, and will depend on the owners preferences. If your goal is to continue to maximize individual tree growth and shorten the rotation as much as possible, then a reasonable target would be to manage for 25-35 trees per acre when the average tree diameter has reached 18-20 inches (35-40 foot average spacing). A more conservative approach would be to manage for 50 to 75 trees per acre when average diameter is 18-20 inches (25-30 foot spacing). The higher density will result in a longer rotation as the trees take longer to reach the target size. but total stand volume will be greater and the slower tree growth may result in a higher quality veneer.

Superior Seedlings and Nursery Stock

Because there is greater variability in the performance of the seedling stock, more trees need to be planted to provide a greater selection when thinning to favor the best trees. A reasonable planting density for superior seedling stock is approximately 200 to 300 TPA (12-15 foot average spacing) (Table 1.). From this starting point, thinning targets are the same as grafted stock, although there may need to be additional thinnings early in the rotation to bring tree numbers down and reduce excessive competition between trees.

Because of the higher variability in common nursery stock, an even greater number of seedlings must be planted to provide adequate assurance that enough trees of suitable quality will be included in the plantation. Common recommendations call for planting at least 400-450 TPA (about a 10 foot spacing) (Table 1.). Again, this will provide for greater selectivity when thinning, and the tighter spacing may enhance tree form. The same thinning targets apply, but additional early thinnings will definitely be needed to reduce tree competition.

Plantation Care

In addition to controlling the density of trees through planting and thinnings, there are two primary concerns for taking care of your plantation. One is controlling weeds and other competing vegetation which slows down tree

growth. The other is controlling stem form and quality.

Weed Control

Weeds compete with trees for moisture and nutrients, thus reducing the growth rate of the trees. This competition is strongest when the trees are small, but may continue to some extent over the life of the plantation. It is imperative for weeds to be controlled, particularly for the first several years when the plantation is getting established.

The easiest way to control weeds in a plantation is with herbicides. Safe and effective herbicides, labeled for use in forest situations, are available for many plantation weed control needs. Other methods, such as using organic or plastic mulches also exist. While often more time consuming and labor intensive, they offer a choice for those not wishing to use chemical herbicides. Mowing is often used in conjunction with herbicides or mulches but is mostly cosmetic and should not be considered a weed control method.

A common misconception in hardwood plantation management is that control of broad-leaved weeds is adequate to ensure good tree growth. Numerous studies have indicated, however, that control of sod forming grasses may be more critical than controlling broad-leaved weeds.

All plantations should receive early weed control. Higher density plantations reduce weed control problems somewhat, but do so at cost of tree growth. In low density plantations, where complete crown coverage is not maintained, weed control, and particularly sod control, will likely provide benefits throughout the life of the stand. Whether the increased tree growth outweighs the costs of weed control over the life of the plantation is difficult to say. It will likely depend on the management practices used and the weed problems inherent to the site.

Controlling Stem Form and Quality

Two primary tools are used to improve stem form and quality-corrective pruning and lateral pruning.

Corrective pruning is the removal of multiple leaders or forks in the stem so that the tree maintains a single, straight stem. This is often necessary because black walnut is prone to producing multiple stems following injury to the terminal bud. Genetically superior stock has been selected for stem straightness, and therefore, requires less corrective pruning. Corrective pruning is done relatively early in the life of the tree; generally up to a tree height of about 17 feet.

Lateral pruning is the removal of branches along the main stem which allows the tree to produce wood without knots. This "clear" wood is more valuable and, in the case of veneer, is required. Lateral pruning should be started when trees reach 6-8 feet tall. A series of prunings gradually increases the length of clear stem on the tree. Each pruning should try and leave 40 to 50 percent of the tree height with a clear bole, but no more than 25 percent of the total length of the crown should be removed in any one pruning. Ideally, you want to prune up as high as practical. At a minimum, you should prune the lower 17-18 feet of the stem and, if possible, the lower 24-25 feet should be pruned. Before pruning, you should make sure you are familiar with proper pruning techniques. Improper pruning can sharply reduce the value of your trees.

Rotation Length

A frequently asked question is how long will it take until the plantation matures? This will depend greatly on the quality of the site, the type of growing stock used, the density of the plantation, and the management practices employed. Estimates can be made, however, of the approximate number of years it will take to grow trees to a given size under a given set of conditions.

With high-quality planting stock, grown on very good sites and managed for rapid individual tree growth, you can expect average tree diameter (at 4½ feet above the ground) to approach 14-15 inches in 30-40 years. Reaching the 18-20 inch diameter class, where higher veneer values are attained, will take longer, perhaps 45-55 years. Use of common nursery stock planted at 400-500 TPA and thinned regularly to select the highest quality trees will result in somewhat longer rotation lengths than attained using superior grafted stock. If you are planting on less desirable sites, or if you do not provide the recommended intensive management practices, then the time needed to produce large diameter trees can be increased significantly.

Rotation length can be an extremely important financial consideration. For example, if we assume a \$1,000 per-acre investment in the plantation, with a 50-year rotation you would need to generate \$19,936 per acre to realize a 6 percent return on your investment. To realize the same 6 percent return over a 60-year rotation would require \$36,271 in per acre revenue-an increase of nearly 82 percent! Extending rotation length can be desirable if it results in bigger trees and thus greater per acre value. However, extending the rotation length just to produce the same economic returns that could be produced in a shorter period under a different management approach will result in a decreased return on your investment.

Seeking Professional Assistance

Many attempts at establishing plantations in Indiana are unsuccessful due to poor decisions by the landowner. We strongly encourage anyone who is contemplating establishing a black walnut plantation seek the advice of a professional forester. A forester can help you decide if your site is appropriate for growing walnut, can provide advice on different types of growing stock, can let you know where you can purchase trees, and can help design a plantation management plan which best suits your objectives.

The Indiana Division of Forestry has district foresters located throughout the state which provide free advice to landowners on forestry matters. In addition, private consulting foresters provide a full range of services including tree planting, weed control, and eventually marketing of your trees. A list of certified consulting foresters is available from Purdue University, state district foresters, or the Indiana Forestry and Woodland Owners Association.

Additional Information Available

The Cooperative Extension Service at Purdue University has additional information that can help you decide if black walnut plantation management is something you may want to pursue further. Some of the relevant publications available include:

- FNR-76 W.F. Beineke. Corrective Pruning of Block Walnut for Timber Form (\$.50)
- FNR-105 W.F. Beineke. Grafting Black Walnut (\$.50)
- FNR-115 W.F. Beineke. Characteristics of Purdue University's Patented Block Walnut Trees (\$.50)
- FNR-119 W.F. Beineke. Block Walnut Plantation Management (\$1.50)
- FNR-134 J.R. Seifert. Planting Hardwood Seedlings
- FNR-135 J.R. Seifert. Weed Control for Tree and Shrub Seedlings
- FNR-148 W.L. Hoover. Predicting Block Walnut Prices (\$1.00)
- SB-562 F. Ponder, Jr., P. Johnson, and W.F. Beineke. Guide to Selecting Soils for Black Walnut Planting Sites in Indiana (\$5.00)

These publications are available through the Agricultural Media Distribution Center at Purdue University, 301 South 2nd Street, Lafayette, IN 47905-1092.

Additional information concerning black walnut management and marketing may be obtained from the Walnut Council, Inc. located at 260 South First Street, Suite 2, Zionsville, IN 46077-1602. Their phone number is (317) 873-8780. There is also a Walnut Council Hotline to answer specific questions. Their phone number is (618) 453-2318.

New 10/95

Cooperative Extension Work in Agriculture and Home Economics, State of Indiana, Purdue University and U.S. Department of Agriculture Cooperating. H.A. Wadsworth, Director, West Lafayette, IN. Issued in furtherance of the Acts of May 8 and June 30, 1914. It is the policy of the Cooperative Extension Service of Purdue University that all persons shall have equal opportunity and access to our programs and facilities.