North Central Regional Extension Publication No. 605

Planting Oaks For Timber And Other Uses

by

Donald Dickmann and

Douglas Lantagne

Department of Forestry

Michigan State University

Planting Oaks For Timber and Other Uses

The nearly 50 million acres of oak-dominated woodlands in the North Central states are a common and economically important part of the landscape of this region. Red, black and white oaks are the principal species found in these woodlands, though several other oak species can be locally important. High-quality red and white oak sawlogs and veneer logs are in demand and sell for top prices. Oaks are considered one of the best fuel woods, and many trees are cut each year for home heating or for use as chips in industrial or institutional boilers. Smaller oak logs are used for pulpwood. Thus, oak wood will continue to be economically important in the future.

Oak forests are important for other reasons, too. They provide habitat for wild animals, and their acorns are an important food source for game species such as deer, turkeys and squirrels. Because they can grow to an old age, forests of oak provide long-term protection of soil from erosion. Oaks can act as a nurse crop for trees such as white pine, ash, sugar maple and red maple, which grow well in their shade, thus providing for the continuation of forest cover as the oaks die. Finally, because they attract wildlife, provide beauty in every season, and symbolize strength and longevity, oaks appeal to people's aesthetic sense-they are just nice to have around.

To foresters, however, oaks can be problematic. If they are cut for timber products or killed by the gypsy moth, oak wilt or fire, they do not consistently reproduce from natural seeding, though young trees that are cut or killed by fire will sprout from the stump. Typically, a forest that consisted primarily of large oak trees may naturally reproduce to become one in which oak is a minor component or absent altogether, and maples, cherry, ash, elm or other woody species take over. Because this reproduction problem is compounded by high grading, wide-scale death of oaks from gypsy moth defoliation and oak wilt, the acreage of oak forests is declining and will continue to do so in the future. Much research is being carried out by universities, state forest management agencies, the U.S. Forest Service and forest products companies to solve this problem, but progress has been slow.

An alternative to natural oak reproduction is planting. Though this alternative at first seems very attractive, it must be approached with caution and forethought. Oaks are difficult to plant successfully, perhaps more difficult than any other important forest tree. Yet research has shown that following certain rules greatly increases the chances for success. The purpose of this bulletin is to outline these principles of oak plantation establishment and early management.

The plantation establishment triangle (Fig. 1) is a good way to view the process of tree planting. Paying proper attention to the factors making up each side of this triangle makes it likely that a planting will be successful and fulfill the landowner's expectations. On the other hand, neglecting or ignoring any of the sides of the triangle means the planting likely will fail or fall short of expectations. No matter what the size of the planting project, it is essential to follow the plantation establishment triangle. We will discuss each side of the triangle as it pertains to planting oaks, but these principles apply to the planting of other trees as well.

Figure 1. The plantation establishment triangle.

Side l: Preparation

The elements that should be considered when preparing for any planting project are planning, site selection and site preparation. Only when these three elements have been fully considered and appropriate actions are taken can the project proceed to side 2 of the triangle, the actual planting stage.

Planning

The old adage "failing to plan is planning to fail" applies to tree planting. Just as buying a house or a car on a whim is a bad idea, so is putting in a plantation, especially a large plantation. Take some time to sit down and think about the steps needed to complete the anticipated planting project. Monetary issues are especially important. How much do you want to spend and what do you expect in return? Federal, state or local cost-share funds may be available to qualified landowners to help defray the costs of a plantation, and this factor may improve the economic outlook considerably. At the planning stage, it might be wise to talk to a consulting forester or someone with experience in tree planting. Then put your plan down on paper or on a computer word-processing file so it's there to refer to or to modify as necessary. As the project proceeds, supplement this plan with records of all plantation materials, activities and expenditures. A computer spreadsheet file could be set up for convenient record keeping.

Selecting and preparing the planting site

One or more species of oak can be found growing on just about any site in the North Central Region, from swampy ground to droughty uplands. Nonetheless, extreme sites should be avoided. For example, low areas or depressions into which cold air drains are a poor choice, because expanding oak buds are easily killed by late spring frosts. Likewise, oaks should not be planted on wet and poorly drained, mucky, shallow rocky or excessively drained sandy soils. Survival and growth under these conditions will be poor. Deep soils with good internal drainage and textures ranging from sandy loam to clay loam are best. Oaks are tough and, once established, they can grow well even if water and fertility are somewhat limiting. As with most trees, however, the better the soil, the better the growth of planted oaks.

Oaks can be planted in cleared fields or pastures, brushy or commercially cutover land, shelterwood forest stands (see below) or small openings in existing forests, depending on the land that is available and the landowner's objectives. However, the approach to site preparation will be different in each of these situations.

When preparing **cleared land for** oak seedlings, think of a tilled agricultural field just prior to seeding-this condition is ideal whether corn, beans or oaks are planted (Fig. 2). Two objectives are of paramount importance: controlling competing vegetation and improving the tilth of the soil. If established biennial or perennial weeds are abundant on the site, a broad-spectrum herbicide (one that controls both grasses and broadleaf weeds) l should be applied to the weed foliage in the late summer or early fall **prior to planting.** After the vegetation begins to brown, the site can be tilled, either by plowing and disking or by

Fig. 2. Cleared sites properly prepared for plantings oaks. Above: a site fitted for planting using conventional tillage; below: a no-till approach where strips of weeds have been killed with herbicides.

rototilling, then left fallow over winter. A cover crop could be planted to reduce erosion and retard weed reinvasion. On sites previously in field crops, subsoiling to break up the plow pan is beneficial. A no-till approach (using only herbicides) also will work (Fig. 2), but trees in the plantation often grow faster following tillage. Spraying and tilling in the spring just before planting is an option, but standing water and wet soil can delay site access and put the whole planting process behind schedule. It's better to plan ahead and do as much preparation as possible in the fall before planting.

Guidelines for preparing brushy or commercially cutover land are harder to prescribe because conditions can be quite variable. in general, tillage is not feasible or even necessary on these rough sites, so the major objective is to temporarily control the weeds and brush that will compete with newly planted oak seedlings. Oaks can be slow growing at first and need all the help they can get. Large, undesirable trees on the planting site can be double girdled or felled. The stumps of felled hardwood trees should be treated with a herbicide-stump sprouts are the most serious competitors with young oak seedlings. Standing trees can be injected with a herbicide and then left to decay slowly and break up. Small trees or shrubs with thin bark can be killed by spraying the basal portion of stems with a herbicide in a fuel oil carrier, which aids bark penetration. Several general-use or restricted-use herbicides are available on the market for these treatments. Herbicide treatments are most effective if applied during the growing season or winter **before planting.** Simply felling competing hardwood trees may make the problem worse than before because the vigorous stump or root sprouts that follow are intense competitors. To control herbaceous plants, grass and low-growing woody plants, several herbicides are available that can be applied to weed foliage using low pressure sprayers in the late summer or early fall before planting.

Mature forests can be converted to young stands containing a high oak component by planting oak seedlings under a shelterwood overstory. This shelterwood overstory is created by partially cutting an existing forest, leaving enough large, vigorous trees to partially shade planted oaks and giving the site a parklike appearance (Fig. 3). The crowns of the shelterwood should cover **50 to 70 percent of the ground,** with highest coverage only on sites where a dense under story already is established (Dey and Parker, 1996; Johnson and others, 1986). If large oaks are present in the preharvest stand, some should be left to supplement planted seedlings with natural reproduction from acorns. Other desirable trees, such as black walnut, white ash, black cherry or hard maple, can be left in the shelterwood if few or no oaks are present. This system is designed to create light partial shade and frost protection for planted seedlings until they become well established. (See "Side 3: Protection" below for further treatment of shelterwood stands.) Competing herbaceous and woody vegetation under shelterwood overstories must be controlled as described above for brushy sites. Competition control can occur before or after the partial cutting but before oak seedlings are planted. Depending on site conditions, competition control may have to be repeated for 3 to 5 years after planting.

Fig. 3 Oaks can be planted after a shelterwood harvest to supplement natural seeding. The overstory will protect seedlings from overheating during the summer and frost in the spring and fall.

A final alternative is to plant oaks in small clearings in mature forest stands. This system works well in pine plantations (Stroempl, 1987) because oaks often follow pine during natural forest succession. Called "group shelterwood" when applied in hardwood stands (Stroempl and Secker, 1995), this system will work if stump sprouting and other competition is controlled. Openings usually range from 1/10 acre to 1 acre, with larger openings preferred in older, taller stands. All existing trees in the openings should be cut. Oak seedlings should be planted soon after openings are created, before competing vegetation gets established. If competing herbaceous and woody vegetation already is present, it can be treated as described above for brushy sites. Do not plant oak seedlings right next to the forest edge-they will grow slowly and bend in towards the center of the opening.

Side 2: Planting

After the site is selected and prepared, the planting process begins. Some forethought and decision making are required at this stage, too. There are six major species in the white oak group and seven major species in the red oak group that grow naturally in some part of the North Central Region. Add to those numbers several minor oak species and exotic oaks imported from other countries, and selecting the species to plant becomes no simple matter. Furthermore, the characteristics and cost of the stock to be planted are of critical importance, as is the actual planting of this stock.

Species and stock selection

Depending on location in the region, sites available and objectives, a landowner may have to decide among several candidate oaks. Northern red oak most often has been the species of choice because it naturally occupies a wide range of sites throughout the region, its growth rate is rapid and red oak nursery stock is more widely available than that of any other oak species. Other native species can be planted, too, and the same rules apply to them as to red oak. Exotics such as English or sawtooth oaks should be planted only if a particular seed source has been shown to survive and grow well in a local area.

What about mixed plantings of several oak species or of oaks and other trees? Generally, mixed plantings are more difficult to establish successfully because species survive and grow differently, so one or another species eventually dominates the others. For example, if red and white oak are planted together, the red oak usually will outgrow the white oak and eventually overtop it. If a landowner is willing to let nature take its course, such an outcome is acceptable. In fact, slower growing trees may act as "trainers," forcing their faster growing cohorts to grow straight and the lower branches to die and naturally prune.

When planning a mixed plantation, choose tree species that naturally grow together. Plant oaks with other oaks or with hardwoods such as yellow (tulip) poplar, black walnut, white ash, basswood, black cherry or sugar maple. Among the conifers, red cedar is a good choice on calcareous soils, and white pine or red pine on sandy soils. In fact, planting a pine seedling within 2 feet of a planted oak has been shown to be very beneficial. The nitrogen-fixing shrub autumn olive can act as a trainer and stimulate growth when planted with oaks and other hardwoods. However, the seed of this exotic shrub is readily spread by birds and it aggressively colonizes open areas, so many people consider it a nuisance.

Planting stock can be purchased from commercial and state nurseries or local Natural Resources Conservation Service or Farm Service Agency offices. Catalogs of available planting stock may be available from these sources. Special orders for large numbers of seedlings can be made, but they must be placed well in advance. Make sure to specify species, seed source and size-quality characteristics (see below). To be absolutely sure of seed source, acorns from local trees can be supplied to a nursery for customized growing. Avoid buying stock from nurseries far to the north or south of the planting site- the seed sources used there may be unsuitable.

Acorns that show no signs of weevil or other damage should be collected in the fall, either directly from the tree (preferred) or from the ground. Unless other proven sources are available, **choose local trees** that are straight-growing and vigorous and show no signs of rot or pest problems. Note that white oak acorns will germinate immediately after they fall from the tree, so early collection is especially important. Collect only large acorns that are fully ripe-they will be dark brown and the caps will break away easily or will already have broken away. After collection, put the acorns in water for 24 hours and then **plant only acorns that sink** (Teclaw and Isebrands, 1986). After collection, keep acorns cool (but above freezing) and moist at all times.

An alternative to purchasing planting stock is to grow seedlings yourself. Acorns (sinkers only) should be sown **in the fall right after collection** in a well tilled seedbed and covered with a thin layer of firm soil. Beds may be mulched with straw or leaves and should be covered with hardware cloth or other material to protect them from rodents and deer. Space the acorns about 6 to 8 inches apart-the more room they have to grow, the bigger and more vigorous the seedlings will be. Keep beds weed free during the growing season, water them regularly and apply a balanced fertilizer as necessary. Red oak can be transplanted to the field after one year of nursery growth as a 1-0 seedling, but an additional year of growth to produce a 2-0 seedling is beneficial, especially in northern areas. If appropriate equipment is available, seedlings grown for more than one year in a nursery bed should be undercut to a

depth of 5 to 6 inches just after leaves have fully expanded on the first flush of growth during the second growing season (Johnson and others, 1986). Undercutting curtails deep taproot growth and promotes a dense, compact root system that is ideal for transplanting to the field.

One rule of thumb is paramount for planting stock: **plant the largest seedlings you can handle or afford!** Small, spindly seedlings will grow poorly, if they survive at all. Planting such seedlings is a waste of time and money!

Seedlings should be **no less than 3/8 inch in diameter at the base of the stem;** 1/2 inch is an even better lower limit. Stem thickness is a much more important quality characteristic than seedling height. Age is important, too. Even if they're similar in size, 2-0 seedlings survive and grow better than 1-0 seedlings. Transplant seedlings (1-1 or 2-1) offer little advantage over high-quality 2-0 seedlings and are more expensive.

Another trait of good planting stock is **an abundance of lateral roots** (1/8 inch diameter or greater) coming off of the taproot (Fig. 4). Seedlings with at least six to eight large lateral roots will grow and survive much better than those with few or spindly laterals. Seedlings with poor lateral root development should be culled out. Lateral roots (and the taproot, if undercutting was not done in the nursery) should be trimmed back just after they are lifted out of the nursery beds to form a ball not exceeding 8 inches in any dimension (Johnson and others, 1986).

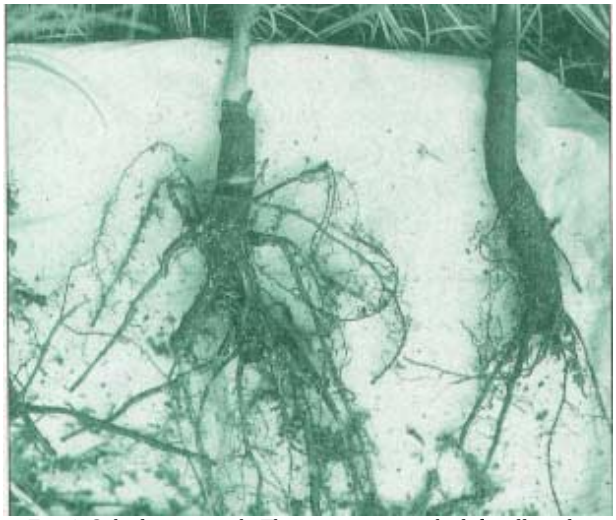

Fig. 4. Oak planting stock. The root system on the left will produce superior survival and growth because it has abundant lateral roots.

Planting stock is a major budget item in any planting project. High-quality seedlings will cost more to produce or to buy from a commercial nursery, but **low priced, poor-quality planting stock is no bargain.** What is saved here will be lost in marginal plantation performance or, in the worst case, outright failure. It's better to reduce the size of the plantation to curb costs than to purchase inferior seedlings. The best alternative is to shop around and find the best price for planting stock that meets the specifications discussed above. If stock that meets specifications is not available, special order it or, if feasible, grow it yourself. Finally, always grow or order more seedlings than you think you will need-some will inevitably have to be culled out and discarded because they do not meet specifications.

The planting process

Ideally, stock should be planted within a few days after it is lifted from the nursery. If seedlings must be stored for long periods, they should be kept cool and moist right up to the moment they are transplanted into the ground. Storage at 35 to 40 degrees F and high humidity is ideal. The tops of the seedlings can be pruned back to 8 inches above the root collar **just before they are shipped to the planting site** to ease handling; this will not adversely affect first-year height growth. At the planting site, keep seedlings shaded (cool) and moist. They can be killed or irreversibly harmed by overheating within minutes of exposure to direct sunlight, even if they are still in their shipping bags or bundles.

Seedlings can be planted by hand using a shovel, dibble or mattock (Fig. 5). Large stock is more easily planted with an auger or, on cleared land, a planting machine with a large shoe, e.g., one designed to plant fruit trees. The conventional tree planter configured to plant smaller conifer seedlings will not work very well. In any case, trees should be planted so that the roots are fully buried without being twisted or bent into a J shape, and the stems should be fully upright2. Seedlings usually are planted in the spring anytime after the frost leaves the ground. Planting in the fall is possible, provided that soil moisture is adequate.

What about planting acorns instead of seedlings? After all, this is nature's way. Successful plantations have come about from acorns, but the probability of success is lower than with seedlings. Not every acorn will germinate, and animal predation of acorns can be

Fig. 5. A vigorous young red oak seedling soon after planting free from weed competition.

Over 90 percent, so many more acorns should be planted than seedlings. Push the acorns into the ground or plant them in holes 1 to 2 inches deep. If competition is not completely controlled, the young seedlings that develop from planted acorns will grow poorly. This is the low-cost alternative, but expectations should be correspondingly low.

Spacing among trees will vary widely, depending on landowner objectives and the type of site planted, so there are no hard and fast rules. On cleared land a rectangular spacing-10 x 6 or 8 x 6 feet (densities of 726 or 1089 trees per acre, respectively)-works well (Fig. 6). The wider-between-rows-dimension should be sufficient to allow clear passage of a tractor with attached cultivation equipment or sprayer. Higher densities are advantageous for oaks because they promote straight growth, encourage natural pruning of branches and assure a fully stocked plantation, even if some trees die. But these advantages are offset by the higher costs of planting more seedlings. On brushy or clearcut land, spacing will not be as regular as on cleared land because of the need to deviate around stumps, slash, standing trees and other obstacles, but per-acre densities should be approximately the same.

Fig. 6. A rectangular spacing, with more distance between rows than within rows, allows for better equipment access.

A rule of thumb has been developed by U.S. Forest Service researchers in Missouri for determining seedling densities to plant under a shelterwood, though it probably can be applied to plantings on cleared land as well. The researchers determined how many planted trees are required, on the average, to produce one successful tree two years after removal of the shelterwood overstory. A successful tree is defined as one in a dominant or co-dominant position-i.e., a tree as tall or taller than those surrounding it. They found that the probability that a seedling will be successful depends on its stem diameter (Table 1).

Table 1. Number of planted 1-0 or 2-0 seedlings needed to obtain one successful tree 2 years after removal of a shelterwood overstory.

Seedling diameter at the stem base (inches)	No. of seedlings needed to get one successful tree
1/4	9.1
5/16	5.9
3/8	4.3
7/16	3.4
1/2	2.9
9/16	2.6
5/8	2.4

From Johnson and others (1986).

For example, if seedlings, on the average, have a basal stem diameter of 1/2 inch, it will take 2.9 seedlings to get one successful tree (Table 1). If the landowner's objective is 300 successful trees per acre, then 300 x 2.9 or 870 seedlings will have to be planted (a square spacing of approximately 7 feet between trees). To get the average basal stem diameter of a lot of seedlings, take a sample of 50 and measure their diameters to the nearest 1/16 inch.

Side 3: Protection

A newly established plantation represents a substantial investment in time and money. For this investment to pay off, the plantation must be protected from competing vegetation and animal pests. Although this is true for all tree plantations, this rule is unconditionally true for oaks and other hardwood trees. If the landowner walks away from newly planted oak seedlings and pays no further attention to them, the planting almost certainly will fail.

Control of competing vegetation

Protection from competing weeds begins with site preparation. But competition control must continue if oak seedlings are to grow into young dominant and codominant trees. Achieving 100 percent suppression of competing vegetation is impractical (Fig. 5), but the closer, the better, especially in the first few years. **Oaks are very sensitive to competition and will grow rapidly only if they do not share the site with weeds and brush.** Highly competitive plants include grasses (especially sod), woody sprouts and others trees that grow as fast or faster than oaks. The approach to competition control depends on the type of site planted and the nature of the competition.

Plantations on cleared land can be periodically cultivated with a disk or rototiller between the rows until the canopies of the oaks begin to close together, or for a minimum of 2 years. Cultivation should be shallow (less than 6 inches deep) to avoid undue injury to lateral oak roots, and care should be taken to avoid scraping or uprooting the seedlings. Cultivation should be avoided on steep ground where erosion is a problem, unless trees are planted on the contour.

Another way to suppress weeds is to use herbicides (von Althen, 1990). If site preparation has been adequate, a yearly broadcast or banded application of a pre-emergent herbicide in late fall or early spring will prevent weed reinvasion. Established weeds on cleared, brushy or cutover land, especially those within 3 feet of planted trees, can be controlled by directed sprays of foliar-applied herbicides or by basal sprays. Trees and shrubs can be cut with a brush saw, but they will resprout unless the stumps are treated with a herbicide. Plantations should be evaluated every two to three years. If the oaks are not maintaining dominant or co-dominant positions, competing plants need to be suppressed.

On shelterwood sites, the overstory should be left in place only long enough for the target number of seedlings to become well established as dominants or co-dominants. The large overstory trees will suppress seedling growth if left longer. Remove the entire shelterwood **during the winter dormant season** of the third or fourth year after planting (Johnson and others, 1986). Though a careful logging operation always is desirable, no particular protection of the oak seedlings is necessary. Even if they are broken off or bent over, well established seedlings will produce vigorous sprouts and often regain their original height in the first year of growth. After logging, cutting back or treating with herbicide each competing tree or shrub within a 6-foot circle centered on each planted oak can help maintain the oaks in a dominant or co-dominant position.

Protection from animals

The woodland creatures that we usually find so compelling can ruin young oak plantations. Deer will browse the tips of young oaks in the winter, reducing them to stunted bushes. Rubbing by bucks during the autumn rut can destroy young trees. Rabbits, hares, mice and voles can strip bark off the lower stems and branches of young trees and girdle them. Animal browsing can be so serious, especially in areas with high deer densities, that only two options are available to the landowner: keep animals away from the trees or don't plant. Solutions to serious animal problems can be labor intensive and very expensive.

Deer browsing and rubbing can be deterred by area fencing, but a deer-proof fence is very expensive. Deer have amazing jumping power, so a fence must consist

of **no less than 2 tiers of 4-foot woven wire fencing.** Stay wires in the fencing should be spaced no more than 6 inches apart to keep deer from crawling through. Adding a third tier of fencing or a strand or two of barbed wire will give added assurance against deer penetration. Any break in the fence is a door through which deer will enter. For most landowners, installing such an area fence is prohibitively expensive, even without considering the large amount of labor required. One alternative in a small planting is to surround individual trees with a single tier of woven wire fencing 5 to 6 feet in diameter.

Electric fencing is cheaper than woven wire fence, but it probably will not be 100 percent deer proof. Nonetheless, a properly constructed electric fence can bring most young oak trees through their susceptible early years with a minimum of damage. A five-strand fence, with the lowest strand 10 inches off the ground and the other strands 12 inches apart above it, has worked in some situations (Brenneman, 1982). An alternative is a "figure 4" fence, with two strands facing the interior of the plantation, one strand 15 inches off the ground and the other 28 inches above the first, and then a third strand 30 inches off the ground and 38 inches to the outside of the other two. If the plantation borders a wooded area, wire can be attached to tree trunks whenever possible. Regardless of the configuration, some deer eventually learn how to penetrate an electric fence, especially if animal densities are high.

Studying a large plantation area to learn the travel habits of deer can help in planning a fence, be it woven wire or electric. If an established deer trail goes through the plantation, construct the fence in two parts, leaving the trail as an open corridor. Though this requires more fencing, the result will be a more effective exclosure. Or simply plant and fence on one side of the trail and not on the other. Deer are creatures of habit-they move through an area on certain "highways" on their way toward food, water or cover. If a fence suddenly appears in the way, they will try to get through it, not so much to get at what's inside but simply to move through the area along their habitual route. Of course, once through the fence, they will browse or rub trees along the way.

Individual trees can be protected by using repellents (von Althen, 1983). Odor repellents such as tankage (a byproduct from meat packing plants), raw eggs blended with water, bone tar oil, moth balls, rosin and deodorant soap have been used against deer with vary ing degrees of success. The repellent is sprayed on trees or placed in small cloth bags or old nylon stockings and hung loosely in them. Small trees require only one bag, but it may take up to four bags to protect a larger tree.

Taste repellents are generally more effective than odor repellents and can be used to deter small mammals as well as deer. Several of these repellents are marketed commercially and are available from garden centers as well as forestry and horticultural suppliers. Homemade concoctions consisting of liberal additions of hot pepper sauce to thinned latex paint also have been tried. For maximum protection, these repellents should be sprayed or brushed on trees once or twice a year. For commercial products, follow the label instructions.

To minimize damage by small mammals during the growing season, control herbaceous weeds and grasses that provide these creatures with protective cover. Unfortunately, mice and voles often do their damage under cover of snow, so other approaches are necessary if this problem is severe. Taste repellents are one option. The lower portion of stems also can be encircled with plastic tree guards, tree wrapping or netting, all of which are available commercially. Chicken wire or hardware cloth also can be used. In all cases, protect the tree as high as possible-deep snow can give small animals access to the upper stem and branches. Mice and voles can be killed by placing homemade or commercial poison bait stations throughout the plantation at a density of about 10 per acre (von Althen, 1983), but non-target animals also may be affected.

Tree shelters are another alternative that deters damage by small animals and deer while stimulating tree growth (Lantagne, 1989). Tree shelters (also called "Tuley tubes" after their inventor, the British forester Graham Tuley) are translucent plastic tubes-round, triangular or square in cross-section and 2 to 4 feet tall-which are placed over individual tree seedlings (Fig. 7). Each shelter acts as a miniature greenhouse that increases temperature and humidity within the shelter while providing physical protection. Tree shelters come in a variety of shapes and sizes and can be purchased commercially or homemade. If deterring animal browsing is the primary consideration, shelters 2 feet tall may be sufficient for rabbits (unless the winter snow pack is deep), but 4- to 5-foot shelters are required for deer. The heavier the deer browsing pressure, the taller the shelter should be.

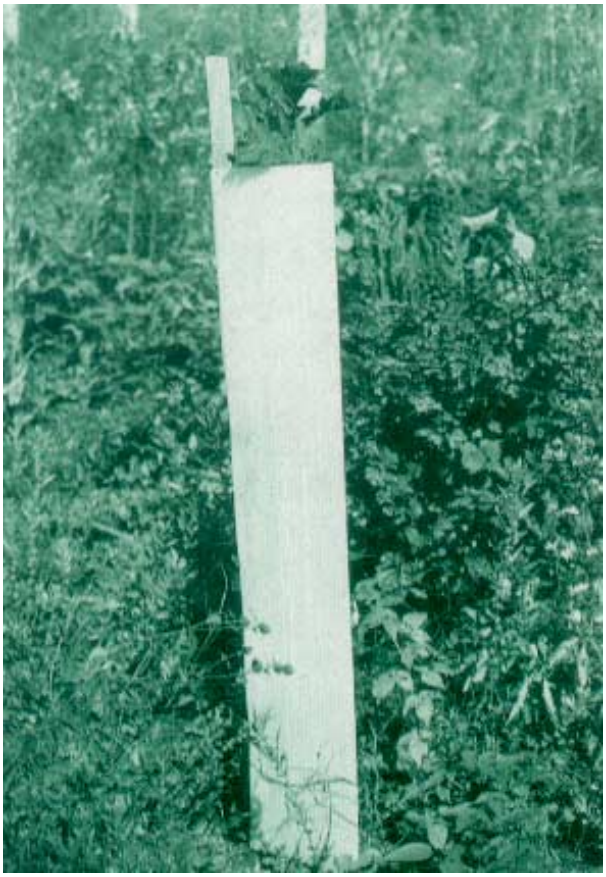

Fig. 7. Tree shelters, also known as Tuley tubes, stimulate early height growth and protect seedlings from animal browsing. Note emerging seedling after one year's growth.

Tree shelters are not the solution to all tree establishment problems and they are expensive. Selecting and preparing a good quality planting site, using large, vigorous planting stock, and controlling weeds during and after establishment have a substantial impact on the success of tree planting projects. Tree shelters will not guarantee success if the basic rules represented by the plantation establishment triangle are not followed.

If young oak trees have been severely damaged by animals (Fig. 8), all is not lost. Cut back severely browsed or girdled trees at the ground line anytime during the dormant season. The strong sprouting of established oaks allows lost growth to be recouped in very short order. After the first year of growth, trim back the sprout clump to the single most vigorous stem. Of course, sprouts must be protected from weeds and animals or the damage cycle will start over again. Tree shelters can be used to protect sprouts during these rehabilitation measures.

Effects of Fire

What about protection from fire? Wildfires always are a concern to a landowner, and they should be actively prevented or suppressed. Oaks, however, are widely regarded as "fire adapted" because of their deep taproots and strong sprouting abilities, so fire is not as much of a concern as it would be with conifer plantations. Oaks top-killed by a fire sprout back vigorously and regain their former size quickly. Some ecologists even regard fire as beneficial to oaks because it helps them reach or maintain dominant positions in a stand in competition with less fire-adapted species. In fact, after it has become well established, repeated spring or fall prescribed burning of a young oak plantation at 3- to 5-year intervals (Dey and Parker, 1996) may be a way to give oaks an edge over competing trees and brush, or to rejuvenate a severely browsed stand. Because we do not have sufficient experience, this approach cannot be fully recommended, though individual landowners may wish to experiment with it. Check local fire laws and use proper procedures when doing prescribed burning!

Fig. 8. This 14-year-old tree was severely browsed by deer during its early years, which caused excessive branching and crooked growth. Timely corrective pruning could have given this tree some timber potential.

Conclusions

The plantation establishment triangle is a good way to think about tree planting projects in a comprehensive way, which should lead to greater and more frequent success. Though millions of seedlings of oak and other species are planted by small private landowners in the North Central Region each year, the estimated rate of success for these plantations is less than 25 percent. This lack of success is a result of many mistakes, including poor planning, poor site selection and preparation, poor species selection, poor quality planting stock, poor planting techniques, and poor protection from weeds and animals. All of these usually can be prevented with good planning based on the plantation establishment triangle, plus modest expenditures of labor and money. The success or failure of any tree planting project ultimately rests with the landowner. Reading and closely following the recommendations of this publication and others available at local county Extension offices or elsewhere (see bibliography below) can be the first step toward a successful oak plantation. The pride and sense of accomplishment you'll feel and the economic gains that future generations will reap will make the effort well worthwhile (Fig. 9)!

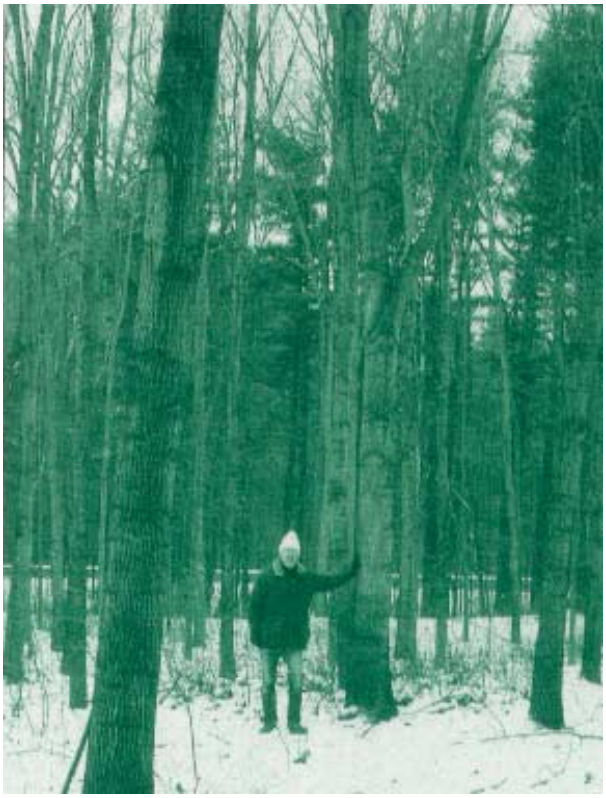

Fig. 9. The payoff-a 36-year-old red oak plantation with some trees already small sawtimber size.

Bibliography

The following publications were used, in part, in preparing this bulletin or are recommended for further reading:

von Althen, FW. 1983. Animal damage to hardwood regeneration and its prevention in plantations and woodlots of southern Ontario. Information Report O-X-351. Sault Ste. Marie, Ontario: Great Lakes Forest Research Centre.

von Althen, F.W. 1990. Hardwood planting on abandoned farmland in southern Ontario. Sault Ste. Marie, Ontario: Great Lakes Forest Research Centre.

Brenneman, R. 1982. Electric fencing to prevent deer browsing on hardwood clearcuts. Journal of Forestry, vol. 80, pp. 660-661.

Dey, D.C., and W.C. Parker. 1996. Regeneration of red oak (Quercus rubra L.) using shelterwood systems: ecophysiology, silviculture and management recommendations. Forest Research Information Paper No. 126. Sault Ste. Marie, Ontario: Ontario Ministry of Natural Resources.

Johnson, PS., C.D. Dale, K.R. Davidson and J.R. Law. 1986. Planting northern red oak in the Missouri Ozarks: a prescription. Northern Journal of Applied Forestry, vol. 3, pp. 66-68.

Loftis, D.L., and C.E. McGee (eds). 1993. Oak regeneration: serious problems, practical recommendations. General Technical Report SE-84. Asheville, N.C.: U.S. Forest Service, Southeastern Forest Experiment Station.

Bibliography (cont.)

Lantagne, D.O. 1989. Increasing hardwood planting success using tree shelters. Forestry Fact Sheet 12. East Lansing, Mich.: Michigan State University Extension.

Stroempl, G. 1987. Growth and quality of red oak planted in red pine plantation openings. Forestry Research Report No. 1 17. Sault Ste. Marie, Ontario: Ontario Ministry of Natural Resources.

Stroempl, G., and P.W. Secker. 1995. Guide to the group shelterwood cutting method for regenerating northern red oak. Forest Research Information Paper No. 120. Sault Ste. Marie, Ontario: Ontario Ministry of Natural Resources.

Teclaw, R.M., and).G. Isebrands. 1986. Collection procedures affect germination of northern red oak (Quercus rubra L.) acorns. Tree Planter's Notes, vol. 37, no. 3, pp. 8-12.

[1]See Michigan State University Extension bulletin E-2218 (1990), "Some fundamentals for successful weed control in forest crops," by D.O. Lantagne, and Michigan State University Extension bulletin E-2219 (1990), "Forest herbicides for weed control," by D.O. Lantagne, R. Heyd and D. Hall, for more information on herbicides and their use.

[2]See Michigan State University Extension bulletin E-771 (1989), "Tree planting in Michigan," by D.O. Lantagne and M. Koelling, for more information on care and planting of tree seedlings.

This publication was coordinated by IDEA- Information Development for Extension Audiences, a collaborative effort initiated by the North Central Cooperative Extension Services to increase the efficiency and effectiveness of developing, producing, and/or marketing educational products nationwide. Publications are subject to peer review and prepared as a part of Cooperative Extension Activities in cooperation with the Cooperative State Research Education and Extension Services (CSREES) - US Department of Agriculture, Washington, D.C. The following states cooperated in making this publication available. For additional copies, contact the publishing university.

For copies of this and other North Central Regional Extension resources, contact the distribution office of the university listed below for your state. If your university is not listed, contact the producing university (marked with an asterisk).

Purdue University
Media Distribution
301 South Second Street
Lafayette, IN 47901-1232
(317)494-6794
*Publishing university

Michigan State University
Bulletin Office 10-B Ag. Hall
East Lansing, MI 48824-1039
(517) 355-0240

University of Minnesota
Distribution Center
20 Coffey Hall
1420 Eckles Avenue
St. Paul, MN 55108-6064
(612)625-8173

University of Nebraska
Dept of Ag. Comm. 105
Ag. Comm. Building
Lincoln, NE 68583-0918
(402) 472-3023

In cooperation with IDEA (Information Development for Extension

Issued in furtherance of Cooperative Extension work, Acts of Congress of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and Cooperative Extension Services of Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin. Arlen Leholm, Extension director, Michigan State University, E. Lansing, MI 48824.

November 1997