Oak Regeneration *for the Future*

Oaks represent different things to different people, whether they are hunters, professional foresters, wildlife biologists, conservationists, landowners, or those who simply enjoy the outdoors. Oaks represent strength, endurance, beauty, and longevity.

The wood from various species of oaks is used for furniture, barrels, construction lumber, flooring, and railroad ties, and in the past it was used in ship building. Tannins found in oak bark are used in leather preparation. Native Americans made a type of flour from ground acorns, and acorns are also an excellent source of food for many wildlife species.

In Mississippi, a variety of red and white oak species are found on both bottomland and upland sites. The value of wood from the different oak species varies considerably, with cherrybark oak being the premier species. Oak wood quality varies by species but is also dependent on site characteristics that affect both growth and form characteristics.

Very few people understand the processes and conditions necessary for successful oak regeneration. To be considered a successfully regenerated oak stand, you should have at least 400 seedlings per acre at the end of age 1.

Artificial Regeneration

Like most hardwood species, oaks can be artificially regenerated using seedling planting stock. The type of planting stock can vary from 1-year-old bare-root seedlings to older seedlings grown in large containers. Oak survival and growth depend on a number of factors, including these:

- correctly matching the species to the site
- appropriate site preparation
- effective control of competing vegetation
- quality of the seedlings
- proper storage, handling, and planting

Seedling quality plays a critical role in growth and survival and can greatly affect the time frame for planting. Seedling standards include minimum root collar diameter of three-eighths of an inch, four to eight first order lateral roots (these are large diameter roots that extend from the taproot), an 8- to 10-inch taproot, and an 18- to 24-inch branched top (**Figure 1**). The branched top provides additional buds and greater leaf area. Seedlings with this type of top will have greater leaf area for photosynthesis, which is good for early growth. Grade your seedlings before go-

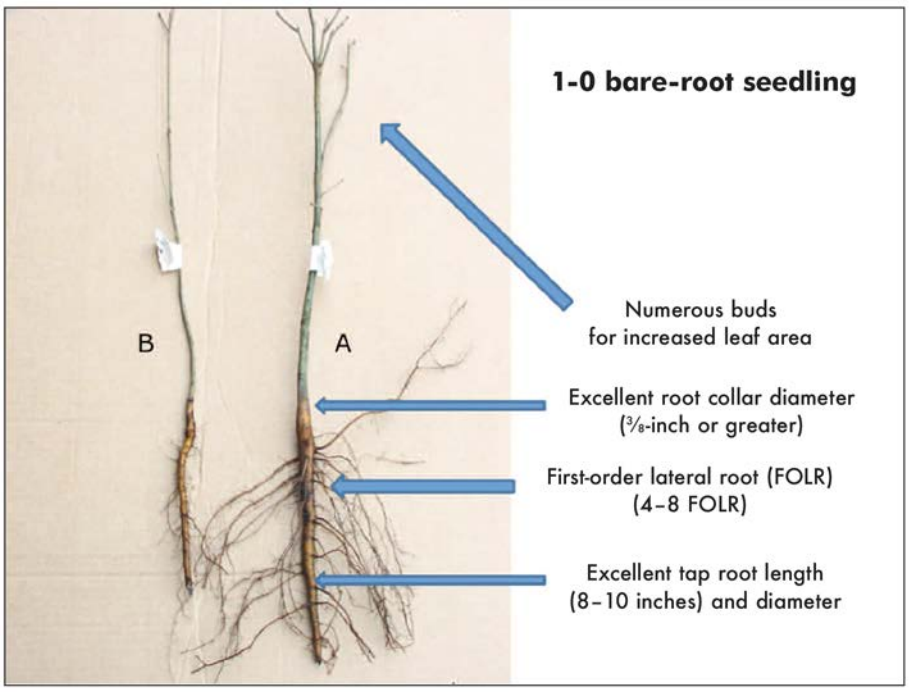

Figure 1. Seedling A shows the characteristics important in producing a high-quality seedling. Seedling B is a poor-quality seedling.

ing to the field to make sure you plant only high-quality oak seedlings.

As with all hardwood species, correctly matching the species to the site is extremely important to ensure survival and adequate growth. All oak species will perform well on soils that are fertile and have good year-round moisture availability. Unique or extreme sites (for example, sites that are poorly drained, are extremely dry, or have high pH) require specific species (**Table 1**).

Site preparation can be extremely intensive for hardwoods. Most artificial oak regeneration is done on old field sites. Use labeled chemicals a year before regeneration to eliminate undesirable vegetative competition from perennial grasses, weeds, vines, or unwanted trees.

Sub-soiling is one of the most important techniques to increase plant survival and growth. This technique breaks up any type of soil pan that may restrict root growth. Subsoil on the contour to lower the possibility of erosion.

Although conversion of natural stands to hardwood plantations can be done, it is extremely costly because of the intensive site preparation work and first-year establishment. The high cost of converting natural stands, the difficulty in matching species to sites, and difficulty in competition control are major reasons why artificial regeneration of hardwoods is not common.

Unlike most hardwoods, competition control during the early stages of an oak planting is less critical because oaks can grow through competition. In addition, you can apply Oust XP (active ingredient: sulfometuron methyl) over the top of dormant planted oak seedlings. In most cases, you can apply 2 ounces of Oust XP directly over the top of oak seedlings before bud break. Avoid using glyphosate during the first couple of years to ensure no seedlings are injured or killed. The second year, Oust XP can be reapplied before bud break.

How many seedlings should you plant per acre?

Some conservation programs require a spacing of 12 feet by 12 feet, or 303 trees per acre. This spacing tends to result in trees with large-diameter branches that are retained for many years, and overall poor stem form from the lack of other woody competition.

Although oaks can be planted at a variety of spacings, the closer the seedlings are planted, the better the form and early pruning characteristics tend to be. A spacing of 9-by-9-feet means that approximately 538 seedlings per acre will be planted. This spacing allows for better form and the use of mechanical equipment in controlling competition, if necessary.

However, if survival is very high, trees will have to be thinned before age 20 to allow the trees to continue to grow at an acceptable rate. Recent research has suggested that a mixture of oaks with other species such as boxelder, river birch, and sweetgum provide the woody competition necessary to keep the oak limbs smaller and help in the natural pruning process. While this argument does have merit, it is difficult and expensive to plant mixtures of species. However, if light-seeded hardwood species do invade oak plantations, it may be advisable to allow these species to grow together.

Even with quality seedlings, an ideal planting site, and competition control, height growth through age 3 will typically be rather slow as the seedlings are establishing an extensive root system. The rate of height growth between ages 5 and 10 will increase and average 4–5 feet per year. At a spacing of 9-by-9 feet on a good site, height growth will begin to slow after age 10 or as the trees begin competing with each other for light, nutrients, and water.

Mortality from suppression is rather low at this time but increases between ages 15 and 20 years. Therefore, at a 9-by-9-foot spacing, a thinning should take place between 10 and 15 years. Unfortunately, the size of the material will probably not be acceptable for pulpwood, but the bioenergy market could be an option. If a bioenergy market is not available, the best option is to thin using herbicides through injection.

No matter how this first thinning is done, the key is to make sure that the best crop trees are not harvested because these will be your future source of revenue. At this age, favorable traits are straight stems, small branches, early pruning, and lack of forking.

One problem with artificial regeneration of oaks is the lack of genetically superior seedlings. The Mississippi Forestry Commission, in conjunction with the Western Gulf

Table 1. Generalized soil/site types and oak species that would be acceptable to plant on these sites.

Soil/Site Types	Oak Species
saturated – good fertility	overcup oak, nuttall oak, water oak
moist – high fertility	cherrybark oak, shumard oak, white oak, swamp chestnut oak, northern red oak (upland sites)
moist – medium fertility	cherrybark oak, shumard oak, willow oak, water oak
somewhat dry – medium fertility	southern red oak, white oak, shumard oak
dry – low fertility	post oak, blackjack oak, and scarlet oak
Special Consideration	
high pH soils	shumard oak

Tree Improvement Cooperative, developed cherrybark and nuttall oak seed orchards on its nursery site near Winona, Mississippi.

Currently, the cherrybark seed orchard is producing a large amount of seed. This seed was initially collected for a trial with the Elberta Tree Nursery in Elberta, Alabama. The results were successful, and Elberta Tree Nursery began collecting seed in the winter of 2009. The goal is to expand this collection on a yearly basis so that adequate supplies of genetically superior cherrybark oak seedlings are available to forest landowners.

The evaluation process based on the age-10 data is ongoing to determine the best parents to leave in the nuttall oak orchard.

Natural Regeneration

Due to the high cost of artificial regeneration, the lack of genetically superior stock, and the extended period of time until harvest, hardwoods have primarily been regenerated naturally. To help ensure successful natural regeneration, you must address these questions:

1. What is the condition of the present stand?
2. Are there sufficient numbers of the desirable oak species in the present stand to form the next stand?

These questions often are not addressed, and the stand is harvested with little thought about the future stand. The makeup of the future stand is frequently left up to chance, which usually results in a stand with far less value than the previous stand. So how can you make sure the future stand is an improvement over the previous stand in both species composition and growth?

First, you must understand the regenerative capacity of the pre-harvest stand. To assist landowners in this task, Mississippi State University has developed a simple software program that allows you to establish a series of 0.01-acre circular plots with at least one plot per acre. The program can include counts of oak trees less than 1 foot tall, trees between 1 and 3 feet, trees greater than 3 feet, trees with dbh of 1.5–5.5 inches, trees with dbh of 5.6–10.5 inches, and trees with dbh of 10.6–15.5 inches.

Once the data has been entered, the analysis provided allows you to determine if there are enough oaks present on your land for a future stand that will have a large oak component. If there are fewer than 400 oak stems per acre, you will need to either accept this level of oak component or use artificial regeneration to increase the oak component. If there are greater than 400 stems per acre, you can cut the stand and allow it to regenerate naturally.

If adequate numbers of oaks are present in the main canopy but very little advanced oak regeneration is present, take steps to increase these numbers. The term "advanced regeneration" means the seedlings of the desired species are present and actively growing before the overstory is removed.

Because oaks do not regenerate in full shade, it is generally necessary to eliminate the understory and midstory vegetation so that sunlight reaches the forest floor. The elimination of the midstory and/or understory can be done mechanically or chemically. The decision depends primarily on the size and extent of the vegetation to be removed. Once this material is removed, you might want to remove some of the overstory trees, especially those that are not oak.

When the midstory and understory are removed, it is likely that oak acorn germination will increase, resulting in a large number of advanced regeneration seedlings that will become a part of the future stand. When oak seedlings are present in sufficient numbers, you can remove the entire overstory. Although some of the new oak seedlings will be damaged during the removal of the remaining trees, their root systems will allow them to resprout. Stumps from the pre-harvested trees may also sprout, providing an additional oak component.

The growth of a naturally regenerated stand generally will be slower than that of a correctly established artificially regenerated stand. This is because naturally regenerated oak seedlings will endure much greater competition from light-seeded hardwood species and increased vegetation. However, patience is key when growing oaks. Where sufficient numbers of oak seedlings are present before the overstory is removed, the future stand will no doubt have a strong oak component. Yet it will take time for these seedlings to battle their way through herbaceous and woody competition.

In cases where there is not a strong oak component in the overstory of the natural stand, planting correctly matched oak species would be a method of increasing the number of oaks on a per-acre basis. This combination of artificial and natural regeneration has been termed "enrichment planting." The seedlings planted could be small, 1-year-old bareroot seedlings or larger container-grown trees. In areas that receive periodic flooding, use larger seedlings that will not be covered completely by water during portions of the growing season.

Conclusion

Oaks can be regenerated artificially or naturally.

Artificial regeneration is best for land that was previously in pasture or used in agriculture. In this situation, sub-soiling is mandatory to break up any plow pans or inherent soil pans. Sub-soiling provides an excellent planting area and maintains moisture availability during the summer.

Natural regeneration is the more economical choice. However, you must take steps to ensure a high oak component in the next stand. You must remove the understory and midstory to allow for advanced regeneration of the oak component. Once sufficient oak advanced regeneration has been achieved, you may remove the overstory component.

In either case, the ability of the forester or landowner to manipulate the conditions for oak regeneration will determine the quality of the future stand and the revenue it produces.

References

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