DIVISION OF AGRICULTURE
RESEARCH & EXTENSION
University of Arkansas System

Agriculture and Natural Resources

FSA5010

Using Natural Regeneration to Promote Oaks in Upland Hardwood Stands

Kyle Cunningham
Associate Professor
of Forestry

One of the largest problems facing forest landowners with upland hardwood lands in Arkansas is reestablishing a desirable stand after a harvest. Many upland hardwood stands are harvested with little or no regard for the condition of the future stand. Simply stated, if adequate numbers of desirable trees are not properly reestablished after a harvest, there will not be an adequate number of desirable trees present to manage a stand after it begins to grow. Remember, every harvested upland hardwood stand will regenerate, but without proper planning there is no control over the condition of the resulting stand.

Natural regeneration is a system that can be very useful for regenerating upland hardwood stands. It provides forest managers a method to plan for the regeneration of an upland hardwood stand using the trees present in the stand. It is a cost effective means for regenerating an upland hardwood stand. When properly conducted, it can regenerate a stand that is dominated by desirable trees, such as red and white oaks.

Why Focus on Oak Regeneration?

There are non-oak species that have commercial, wildlife and other values. Tree species including white ash, black walnut, black cherry and others can help forest landowners achieve their management goals. Although these non-oak species can be considered desirable for many management objectives, they can also be a significant form of competition for developing oak seedlings. Desirable non-oak species, along with undesirable species such as maple and elm, can further complicate oak natural regeneration.

From a commercial standpoint, oaks are important for a wide range of wood products, such as flooring, furniture, dimension lumber and others. Oaks are also an important source for shelter, nesting habitat and food for many wildlife species. Furthermore, oaks provide aesthetic, environmental and other values as well. Oaks are often viewed as the most important species in a hardwood stand for many different management objectives. Because of their importance to so many different objectives, oaks should be the primary focus of most upland hardwood management.

What Is Natural Regeneration?

As the name implies, natural regeneration is a system for regenerating a stand of trees using the reproduction produced naturally by the trees in a stand. Natural regeneration is composed of new seedlings, advanced regeneration and stump sprouts.

New seedlings are seedlings that have recently germinated and usually are only a few inches tall. In years with good acorn crops, large numbers of new seedlings can be observed in hardwood stands. However, these new seedlings do not have a well-established root

New seedlings lack the size to compete well after a harvest.

Larger advanced regeneration is a better competitor in harvested stands.

system or the proper size to compete for growing space after a harvest. Therefore, very few new seedlings will become established in a stand after a harvest.

Advanced regeneration is usually defined as seedlings present prior to harvest that are well established with a good root system. These seedlings are often 1 to 4 feet tall and have a diameter at ground level of ¼ to ¾ of an inch. These stems are generally in a better position (than new seedlings) to compete for growing space and become established in a newly regenerated stand. Advanced regeneration is the most important element to successful attempts at naturally regenerating upland hardwood stands.

Stump sprouts are stems that sprout from the stumps of harvested trees. Although stump sprouts alone are seldom abundant enough to regenerate a stand, they can play a vital role in compensating for low numbers of advanced regeneration.

Challenges With Oak Natural Regeneration

One of the more difficult challenges in using natural regeneration on upland sites is ensuring oak species are present in a newly regenerated stand. The presence of oak advanced regeneration is the key to successfully regenerating oaks. There are several factors that determine the minimum amount of oak advanced regeneration required to properly regenerate an upland hardwood stand after harvest. These factors include site quality, forest type, size of the seedlings present and the stump sprout potential.

Site quality relates to soil productivity, which tells forest managers which tree species will perform best on a given forest site. Perhaps the most significant effect of site quality is its impact on the competition to be expected. Higher quality sites are not only more productive for desired oak regeneration, but also for the grasses, shrubs and undesirable tree species that are competitors. Therefore, higher quality sites will, as a general rule, require larger numbers of oak advanced regeneration to be successful than lower quality sites.

Forest type can also have a significant impact on the amount of advanced regeneration required. Forest type refers to the species present in a hardwood stand. For example, if a hardwood stand contains a significant amount of fast-growing, shade-intolerant species such as sweetgum, one would expect that higher numbers of oak advanced regeneration would be required to ensure the survival of adequate oak regeneration. Many upland hardwood stands in Arkansas contain a significant amount of shade-tolerant species, such as elm and maple, which can create significant competition problems for oak regeneration. Often, some form of competition control (injection or directed spraying of herbicides) will be required to reduce the number of undesirable trees within a stand.

Not only is the presence of oak advanced regeneration critical, but the size of the seedlings and saplings is essential as well. Advanced regeneration may be 1 to 4 feet tall as compared to recent germinants, which are usually only 1 or 2 inches tall. If the majority of regeneration is small (less than 1 foot tall), many more seedlings would need to be present than if the majority of the seedlings are larger.

Stump sprouts also serve an important role in natural regeneration. The ability of a tree to produce stump sprouts is dependent on its size, age and the species of tree. Smaller trees (2 to 10 inches in diameter) that are relatively young (less than 40 years) typically generate a significant number of stump sprouts. For example, in the Ozark region (on good sites, site index = 70 or higher) one could expect approximately 86 percent of northern red oaks that are 6 to 11 inches in diameter and less than 40 years old to produce stump sprouts capable of eventually growing into the overstory. In contrast, approximately 36 percent of white oaks of the same size and age on the same site would have the potential to eventually grow into the overstory.

Determining the minimum number of oak advanced regeneration required to successfully regenerate a stand requires significant knowledge in hardwood management. There are evaluation tools available that are useful in determining the regeneration potential of upland hardwood stands. However, they can be complex for inexperienced hardwood managers. Furthermore, these evaluation tools are typically designed for a defined geographic area (such as the Ozark region) and should not be used outside of their defined area. Therefore, it is essential that landowners consult with foresters that are knowledgeable in hardwood management when evaluating the regeneration potential of upland hardwood stands.

Harvest Methods for Natural Regeneration

All hardwood management can be classified as either even-aged or uneven-aged. Even-aged management means that all of the mature trees (trees that will make up the final harvest) are within a few years of being the same age. Even-aged management is typically the method of choice for desirable tree species in the South, because they are usually intolerant of shade (such as pine, oak and ash).

Uneven-aged management involves maintaining a wide range of tree ages within a stand. Due to a shading effect created by a significant presence of overstory trees, uneven-aged management can be difficult when attempting to regenerate tree species that are intolerant of shade. If a landowner is not careful, managing upland hardwood stands with an uneven-aged system can lead to a high proportion of undesirable shade-tolerant species.

Commonly Used Even-Aged Methods

There are several types of harvests that produce an even-aged stand. Two methods commonly used in the South include clearcutting and a shelterwood harvest. Clearcutting (removing all canopy trees in one operation) is often viewed negatively, because it can leave degraded stands. In many cases, this concept is true because the operation is not properly planned and implemented. In order for a clearcut harvest to be successful in regenerating upland hardwoods, two primary concerns must be met: (1) a substantial amount of desirable advanced regeneration (along with potential stump sprouts) must exist before the harvest, and (2) the harvest must remove all of the canopy trees. Often, clearcuts that focus only on low harvest costs and current stand value leave a significant amount of small-diameter, undesirable stems that make it difficult for desirable species, such as oaks, to regenerate and develop. However, if applied properly, clearcutting can be an excellent method for regenerating desirable hardwoods.

One of the series of cuts in a shelterwood harvest designed to promote oak regeneration.

A shelterwood harvest involves a series of cuts (two or three) which leave mature, desirable trees (such as oaks) on a site to produce and protect regeneration. A critical first step in a shelterwood is to remove the majority of small-diameter, undesirable stems (such as elm and maple) in order to reduce competition and promote desirable species. In stands with a large amount of non-merchantable trees, this process is often accomplished through an herbicide injection of undesirable stems. The next step is to harvest a significant portion of the merchantable stems present, generally between 50 to 60 percent of the stand, which will produce optimal conditions for desirable (oak) regeneration. This partial harvest is designed to remove a large portion of the stand, while leaving trees to provide an environment that will allow desirable regeneration to become established prior to the final harvest. After desirable regeneration has been established (typically three to five years), some or all of the residual trees can be removed in the next harvest. Some landowners may want to keep widely scattered residual trees. However, residual trees will impede the growth and development of oak seedlings in the immediate area.

Uneven-Aged Methods

Uneven-aged methods commonly include single tree selection or group selection. Single tree selection is a harvest method where scattered individual trees are removed and new regeneration is established in the opening. The primary concern with this method in the South is that it often promotes shade-tolerant species, which are usually the undesirable stems (such as elm, maple and others). The small openings generated by single tree selection generally will not maintain light levels that promote desirable shade-intolerant species (such as oaks).

Group selection involves removing groups of trees to create openings for regeneration. Group selection creates a small opening (usually about two acres) that will regenerate similar to a clearcut harvest. Group selection is often viewed as a method that is basically a series of small clearcuts. This method will create situations that promote desirable species, but the same criteria as a clearcut harvest must be met.

Selecting a Regeneration Method

Selecting a regeneration method should be primarily based on the amount of oak advanced regeneration present in a stand. The goal of regeneration should not be to regenerate a pure oak stand. Upland hardwood landowners should seek to regenerate a mixed stand that contains a significant oak component (at least 40 percent).

If it is determined that sufficient oak advanced regeneration exists under current stand conditions, clearcutting may be the best method for some upland hardwood stands.

If sufficient amounts of oak advanced regeneration exist and clearcutting is not a preferred method, group selection may be the harvest method of choice. Remember, group selection will remove a series of small patches (approximately two acres) that regenerate similar to a clearcut harvest.

If group selection is employed, landowners should conduct stand improvement (such as removal of undesirable trees) that will promote oak advanced regeneration in the non-harvested areas.

In stands that do not contain adequate amounts of oak advanced regeneration, a harvest method that allows oak advanced regeneration to become better established will be necessary. In such stands, the shelterwood method will usually provide the best results.

A key point to remember is that the length of time required for a shelterwood harvest to be successful at establishing large oak advanced regeneration can vary. The size and total number of oak advanced regeneration present before the harvest begins will have a significant impact on how long it will take to complete the harvest. This time period could range from three to five years. In some cases, it could take ten years or longer to establish oak advanced regeneration that is large enough to compete when the overstory is completely removed.

Group selection involves removing patches of trees.

Conclusion

Natural regeneration provides an economical and efficient tool for meeting a wide range of management objectives in upland hardwood stands. Due to the complexity of the techniques involved, careful planning and implementation are required when performing harvests designed to promote natural regeneration. It is important to remember that hardwoods will regenerate naturally with little or no planning, but there is no control of the condition of these stands without planning. Therefore, forest landowners should always seek the services of a professional forester before conducting natural regeneration activities in upland hardwoods.

References:

Hicks, R. R., Jr. 1998. Ecology and Management of Central Hardwood Forests. John Wiley and Sons, New York. 412 pp.

Sander, I. L, and D. L. Graney. Regenerating Oaks in the Central States. In: D. Loftis and E. Charles eds. 1993. Oak regeneration: serious problems, practical recommendations. Gen. Tech. Rep. SE-84, Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station. 319 pp.

Sander, I. L., P. S. Johnson and R. Rogers. 1984. Evaluating Oak Advance Reproduction in the Missouri Ozarks. Research Paper NC-251. St. Paul, MN: U.S. Dept. of Agriculture, Forest Service, North Central Forest Experiment Station.

Acknowledgments: Gratitude is due to **Dr. Tamara Walkingstick**, contributing author on the original publication of this fact sheet.

KYLE CUNNINGHAM is an Extension Associate Professor of Forestry with the University of Arkansas, Division of Agriculture, Cooperative Extension Service, Little Rock.

FSA5010R-PD-8-21R