Collecting seed from the seed orchard at the Oklahoma Department of Agriculture, Food, and Forestry - Forestry Division's Forest Tree Improvement Center near Idabel, Oklahoma. After "plus-trees" are identified in the woods, small branches from them are brought here and grafted to provide trees for production of improved genetic quality seed. This form of tree improvement allows landowners to very quickly benefit from faster growing, more resistant tree seedlings improving the health and productivity of their woodlands.

Lifting seedlings at the Oklahoma Department of Agriculture, Food, and Forestry - Forestry Division's Forest Regeneration Center near Washington, OK. This practice is done in the winter months when the seedlings are dormant. Great care is taken to minimize damage to their roots to ensure a healthy seedling which can survive and grow vigorously when planted.

forest management techniques have produced a forest now perceived as valuable and beautiful to Oklahoma and the nation.

Tree improvement in Oklahoma woodlands can be accomplished by natural or artificial regeneration methods. To improve native shortleaf pine stands, natural regeneration can be applied to select the best trees to be left as seed or shelterwood trees. Natural regeneration of hardwood stands is accomplished by selecting the worst trees for harvest and leaving the best to provide seed for the next forest.

Artificial regeneration is generally a quicker and more effective means of improving the genetic quality of forest stands. Trees exhibiting the appropriate quality characteristics are chosen. Woody material is collected from these quality trees which is grafted on root stock at a seed orchard. Seed orchard trees are grown for early, frequent, and abundant crops of seed. This seed is cleaned, germinated, and planted in tree nurseries to provide abundant quality seedlings for planting. With proper care, planted seedlings provide rapid tree improvement for forest landowners.

Landowners can expect rapid tree improvement by planting improved tree stock. Proper seedling selection, planting, initial care and protection are very important in establishing an improved forest. These topics are covered in an Extension Fact Sheet series available free of charge from your local OSU Extension Center.

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Tree Improvement in Oklahoma Woodlands

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Oklahoma forests provide many products for society to enjoy. These products include: recreation, high quality water, wildlife habitat, rangeland, and timber. Demand for these products has increased dramatically, however the land needed for their provision has been shrinking because of agricultural demands, urban expansion, road development, and wilderness set-asides. Consequently, foresters have been required to make production of these products more efficient.

Selection of fast growing trees and trees better able to resist insects, disease, drought, and wind damage is one method of increasing forest productivity. Forest genetics and its application to forest management (tree improvement) provides a process to select traits in a tree which have important impacts on rate and type of tree growth and tree health.

This forest tree improvement selection process can vary in intensity based upon landowner objectives. Natural regeneration can be utilized and genetic improvement attained through selection of the best trees to leave on a forest site for reproduction of the future forest. Trees with poor traits are taken out of the woodlot. Artificial regeneration, on the other hand, entails removing a block of trees and planting or seeding selectively bred seeds or seedlings to grow into the next forest.

This fact sheet attempts to summarize the methods landowners can use to improve the quality of forest trees.

History of High Grading

Eastern Oklahoma has experienced a century of forest use. Most of what are now lush oak and pine forests in the Ouachita Mountains of Eastern Oklahoma were cut for their sawtimber in the late 1800s and early 1900s. The trees containing the highest quality sawlogs were removed during this period. Early loggers did not consider improvements in genetic quality when selecting trees to harvest, instead they cut the best and left the rest. This practice is called high grading. Due to the uncontrolled build-up of fuels, wildfire was common following these harvests. The control of wildfire began during the 1920s and 1930s. This allowed the remaining seeds and sprouts of lower quality trees and shrubs to grow up into what is now the naturally regenerated mixed hardwood and pine forests of the region.

High grading, or single-tree selection of only the best species of good form, has been a common practice throughout

The oak-pine forest of Eastern Oklahoma contains a mixture of tree species and tree sizes. During the late 1800s and early 1900s loggers removed the best formed trees. In general, these trees which were removed were the most resistant to disease and insect infestations and were the fastest growing. Today's trees have regenerated from the lower quality trees of the past.

eastern Oklahoma simply because it is a profitable harvesting method. Only the highest value trees were removed leaving a stand of poorer formed, less valuable tree species to grow and regenerate the future forest. This practice can be thought of as negative selection. Tree improvement in a forest stand relies on the opposite practice known as positive selection.

Natural Regeneration

Tree improvement can take on an important role in naturally regenerated stands of either pines or hardwoods. The key to tree improvement is to understand that the trees left on a forest site will produce the trees for the future forest.

Pine forests can be naturally regenerated to improve tree form by selecting the best trees to be left as "seed trees" (positive selection). This can be done using even-aged regeneration techniques. Examples of these techniques are the seed-tree method and the shelterwood method. For more information on specific regeneration techniques, please refer to OSU Extension Fact Sheet F-5028, "Even and Uneven-Aged Forest Management."

Tree improvement in hardwood forests is slightly more complex. It requires an understanding of the individual characteristics of hardwood species to be reproduced. In general, however, guidelines to carry out tree improvement in hardwood stands can be found in OSU Extension Fact Sheet F-9439, "Managing Your Woodlot for Firewood."

The major point to understand in natural regeneration tree improvement is the trees left on a site following a thinning or harvesting are the trees which will produce offspring with similar characteristics for the future forest. For tree improvement to occur in a naturally regenerated stand, the best-formed and best-type of trees will be left in the forest. The poorer-formed, lower-value tree species will be removed from the forest so they will not regenerate. For species tending to sprout, this may require deadening the stumps of the undesirable individuals and species. In some cases, the quality of the existing stand may be so poor that tree improvement options are severely limited. In these cases, it may be better to harvest the stand and start over with quality seed or seedlings.

A seed-tree cut allows for tree improvement in a forest stand. The best "seed trees" are left on a site at the proper spacing to allow for regeneration of the next forest. The trees in this next forest will have characteristics similar to these best trees which were left as the "seed trees."

Removal of poor quality trees is the key to tree improvement in hardwood forests. Obvious problems such as above in A, swollen stems; B, seams or breaks in bark; C, mechanical wounds caused by logging or other equipment; and D, poorly healed branch stubs are easy to spot.

Artificial Regeneration

A more intensive method of tree improvement applied regularly to many of Oklahoma's forested acres is what foresters call "artificial regeneration." Artificial regeneration is the establishment of a forest stand by direct seeding or by planting tree seedlings grown elsewhere. This method can be applied to large acreages, typical of forest industry activities, or to small areas where only a few dozen trees are planted. The tree improvement opportunity in artificial regeneration methods lies within the seed selection and the seedling production processes.

Nurseries, in conjunction with tree improvement seed orchards across the South have been able to dramatically improve the quality of seedlings available today. Artificial regeneration can be more costly in the planting phase of forest management. However, the potential monetary returns are usually greater and the benefits of genetic improvement are more fully realized than with natural means.

The Seed

Genetic improvement in seedlings produced for artificial regeneration begins with identification of trees exhibiting characteristics deemed desirable by customers of the seedlings. These identified trees are often called "plus-trees." Characteristics looked for in "plus-trees" may include: rate of growth, disease and insect resistance, wind resistance, straightness of the trunk, form, good wood qualities, and any other desired characteristics.

Once a "plus-tree" has been identified, woody material is collected from the upper branches of the tree. This material is grafted onto seedling rootstocks to get all the plus-trees into one location for ease of operation. This is called a seed orchard, which has the specific purpose of producing abun dant supplies of improved seeds.

The "plus-tree" material is grafted onto root stock of the same species to allow nursery managers to produce seed quickly. It takes from five to ten years to produce seed from a grafted tree. This seed will exhibit the characteristics of the "plus-tree." Testing is done periodically to ensure the trees produced from the improved-seed are indeed genetically better than average trees found in the woods (or "woods-run" trees).

Trees are much like other plants and animals, they are comprised of a complex of genes. Forest geneticists are finding many desirable tree traits are under strong genetic control. The key to the success of forest tree improvement work is genetic control. Testing results have shown "plus-tree" selection can produce up to 20 percent or more wood volume than "woods-run" trees. Further controlled breeding and testing will improve the quality of seed produced from second, third, and fourth generation seed orchards.

Seed trees in an orchard are cared for with the objective of producing as much seed as often as possible. This seed is collected, processed, and shipped to nurseries for the production of seedlings.

Removal of poor quality (cull) trees will allow sunlight, moisture, and nutrients for trees possessing higher quality traits. Note above the tree with the fork on the right and the suppressed tree on the left could be removed to improve growing conditions for the well-formed tree in the middle.

The Nursery

When seed is received at the nursery, it may be in a dormant state, depending on the species. If dormant, prior to being able to germinate, this seed will need to go through specific processes to break down the dormant condition. This generally requires a cold or cold and wet period, simulating the winter months. Once dormancy is broken, the seeds are ready to germinate and can be planted.

Since these seed are valuable, and to facilitate proper management in the nursery, planting the seed is a critical step. Sowing of the seed is done using a machine built solely for this purpose. This seeder allows the nursery manager careful control of sowing density, to ensure proper spacing of the seedlings. Proper density, combined with manipulation of water and nutrients, enables the nursery manager to grow the trees to the proper size and physiological condition to ensure high survival of the tree seedlings when taken to the field and planted. Control of sowing density also ensures the nursery manager will be able to produce the greatest number of plantable seedlings possible from the valuable genetically improved seed.

In Oklahoma, most tree species can be taken from seed to a plantable seedling in a single growing season. Once this is accomplished, the seedlings have to be carefully prepared for transfer to the planting site and planting. This process includes lifting, grading, packing, and shipping.

Because of the thousands of tree seedlings grown every year, most nursery activities are mechanized, including lifting. Lifting is done in the winter season, when the seedlings are dormant and best able to survive the process. Lifting is the removal of the seedlings from the nursery beds while minimizing damage to their roots. The seedlings' roots are undercut, gently shaken from the soil and immediately moistened with a fine spray, placed in protective containers and moved to the nursery grading facility. Here the seedlings are inspected to ensure quality. Seedlings too small, too large, damaged, or diseased are removed. The remaining quality trees are then counted, packaged in special moisture holding bags, and placed in cold storage until shipment to a customer or the planting site. The seedlings are usually shipped in refrigerated trucks to ensure they arrive at their destination in prime condition, ready to grow when planted.

Prior to purchasing seedlings, good landowner management planning is important. Planning will ensure appropriate seedlings are selected which are best for the location where they are planted and fit in with the landowners' long-term objectives. For more information on planning for tree planting, obtain OSU Extension Fact Sheet F-5023, "Tree Planting Objectives and the Seedling Selection Process."

Prior to planting seedlings, care is needed to ensure the seedlings planted will survive and thrive. For information on obtaining seedlings, planting trees, and recommendations for early maintenance of planted seedlings, obtain OSU Extension Fact Sheet F-5024, "Seedling Availability, Planting, and Initial Care." The first few years of a planted tree's life are important for good tree growth. Information on maintenance of planted seedlings can be obtained in OSU Extension Fact Sheet F-5025, "Early Protection and Care for Planted Seedlings." Fact Sheets are available, free of charge, from your local OSU Extension Center.

Summary

Oklahoma woodlands have experienced over a century of exploitation. Many of the forest practices applied during the late 1800s and early- to mid-1900s gave little regard to the future stand of trees. High grading, or single-tree selection of the finest logs has resulted in a large acreage of lower quality trees, predominantly hardwoods. The application of good forest management practices on many acres has resulted in improvement in the quality of forests in Oklahoma. A good example is the management applied to extensively cutover and burned woodlands included in the Ouachita National Forest which was established in 1934. Professional U.S. Forest Service managers, through tree improvement and