Natural Regeneration Using Seed Trees

Over the past few decades, the forestry field has moved away from the traditional "cut and walk away" approach to regeneration; however, one of the most serious forest management problems in Mississippi is still a lack of proper regeneration. This is especially true on nonindustrial, private forestland holdings. Unless a stand of desirable crop trees is regenerated on these lands, all the intermediate management available is relatively useless. All forestry endeavors either start with or eventually end up at the regeneration stage, but many landowners do not realize that several options are available and that regeneration work should start long before the harvest of the current crop of trees.

Reasons for not regenerating are varied and, for the most part, not ecologically or economically savvy. One of the most common reasons is the belief that trees will regenerate themselves with no managerial input. This is true, but, without active regeneration efforts, we have little to no control over what species will occupy the site, nor do we control the length of time necessary for regeneration to occur in this situation.

Another major concern in regeneration is cost. While money is a valid consideration, it should not be prohibitive because many regeneration options are available. Often, when landowners learn the per-acre cost of site preparation, seedlings, and planting can be $100 to $200 for pines and $200 to $500 for hardwoods, many of them immediately stop considering any regeneration work. Does regeneration have to cost so much? The answer is "no," but the alternatives to high-cost systems require careful planning and effort from the forest manager or landowner before harvest. Typically, if no provisions were made for regeneration prior to timber being cut, the amount of effort, money, and time needed to reestablish the stand increases dramatically.

The landowner may have alternatives for regeneration. These alternatives will be determined by these factors:

- what is occupying the site currently
- what is desired on the site
- when regeneration efforts will begin

The key to regeneration is to manage your stands so that you have alternatives, then use the most cost-effective system to obtain the desired crop.

Seed-Tree Regeneration

The seed-tree system is a harvest/regeneration activity in which an appropriate number of individual trees is left across an area to provide seed for the production of the next crop of trees. While there is no provision for improving genetics above what is already present on-site, the method is a good choice for naturally regenerating shade-intolerant species like the southern pines. Interest in naturally regenerating pines has decreased in the last few decades due to the improved genetics available in the most current seedling stock; however, due to decreased demand and stumpage prices for pine sawtimber, seed-tree regeneration is once again becoming a regeneration method of interest to landowners.

It is important to evaluate any given stand to determine whether or not seed-tree cutting is a sound option. If you have the desired species of adequate quality and you properly manage them, seed-tree cutting can provide satisfactory results on most land holdings. Research has shown that seed-tree cutting does not improve desirable hardwood regeneration in most situations.

Preharvest Activities

For seed-tree cutting to be successful, you must control undesirable vegetation to allow desirable seedlings to establish. This work usually starts 4 to 5 years before harvest, with annual or biannual prescribed burns in pine stands that will give some control of undesirable species and also prepare a seedbed. It is important to remember that most light-seeded species require exposed mineral soil for proper germination and seedling establishment.

Injection or other timber stand improvement (TSI) methods should be used on larger stems that cannot be controlled with burning unless they are to be sold in the harvest. For more detailed information regarding stem injection and TSI, please read MSU Extension Publications 2942 *Tree Injection for Timber Stand Improvement* and 1281 *Timber Stand Improvement*. When preharvest preparation activities are complete, trees to be left for seed production can be marked.

Desirable Seed Trees

When marking a seed-tree cut, the goal is to leave the absolute best trees of the desired species. The following characteristics are desirable for all seed trees: tall, straight, well-pruned, well-developed crown, average seed production, disease-free, superior volume growth, and wind-disseminated seeds. Volume production is extremely important, so most species appropriate for this method develop in even-aged stands or even-aged groups. Consequently, trees can be compared to others in the immediate area to evaluate their total growth and development.

The best trees must be left because poor regeneration may be obtained if poor quality seed stock is all that remains post-harvest. If you cannot leave these "superior" trees, use another form of regeneration to start the next stand. With proper management and careful thinning during the next rotation, seed-tree cutting should be a viable option when regeneration is next required.

How Many Trees to Leave?

The number of required leave trees is a function of the following:

- desired amount of regeneration
- seed production by individual tree
- expected seed survival
- height of trees
- projected tree mortality (loss)

Critical Facts

1. Average number of cones per bushel (can count conelets to estimate seed production for the following year):
   Loblolly = 35
   Longleaf = 25
   Shortleaf = 40
   Slash = 30

2. Average number of seeds per bushel of cones:
   Loblolly = 18,000
   Longleaf = 4,000
   Shortleaf = 34,000
   Slash = 9,500

3. Seed survival:
   1 to 3 percent of sound seed should produce seedlings (varies due to site, seed, drought, insects, and predation)

4. Seed distribution:
   On average, loblolly pines will distribute seeds a distance of twice the tree's height. Shortleaf seeds will travel farther, while slash and longleaf will not travel as far.

Example

How many loblolly pines should be left to regenerate an area if seed production is expected to be one bushel per tree and average tree height is 75 feet?

Number of seedlings desired = 2,000–3,000/Ac
Number of seed produced/tree = 18,000
Expected seed survival = 2 percent
Seedlings produced per tree = 18,000 x 0.02 = 360
Number of trees required = 2,000 ÷ 360 = 6 trees/Ac*
Height requirement = no restriction

*You may want to leave an extra two to four trees per acre for potential loss (windthrow, bark beetles) or seed-crop reduction.

Distribution of Trees

Select and mark trees with adequate distribution to provide seeds fully to the entire area. The direction of the prevailing wind at the time of seed fall dictates the distribution and location of seed trees.

Trees should be left along the harvest boundary on the side from which prevailing winds will come. Trees to be harvested in the area should be left along this boundary, or if the adjacent stand of trees is deemed to be of acceptable quality, you could expect seeds to blow into the regeneration area from that source. Conversely, no trees are needed on the edge opposite from the direction of prevailing winds.

Perhaps the easiest way to approach the task of ensuring proper seed-tree distribution is to consider leave trees in terms of rows that run perpendicular to the prevailing wind. For loblolly pine, these rows can be spaced approximately two times the height of the trees themselves. For example, if the average height of the seed trees is 75 feet, the rows of leave trees could be about 150 feet apart. In terms of positions within rows, seed trees are typically spaced a distance apart that is equal to the average height of the trees. So, in the example of 75-foot trees, the distance between trees within rows would be 75 feet.

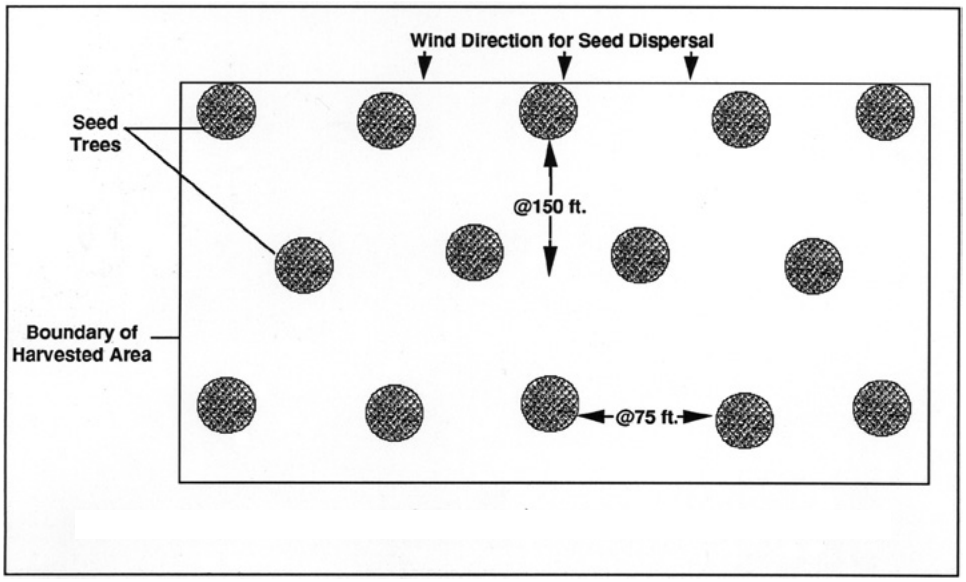

Figure 1. Schematic of seed tree distribution if trees were 75 feet tall (note wind direction).

Figure 2. Seed-tree harvest. Photo by John D. Hodges.

Use with Hardwoods

A basic premise of seed-tree operations is that the seed will be spread across the harvested area by wind. For this to work, the species must be light-seeded.

Most light-seeded hardwoods are not desirable for timber management, but this method could be used for a few (e.g., sweetgum, yellow poplar, green ash, cottonwood, and sycamore); however, most hardwood species that are currently desirable for timber production are heavy-seeded.

Species such as oak and black walnut have seeds that are far too heavy to be spread by wind. For this reason, seed-tree harvesting is not a good choice for regenerating most desirable southern hardwood species.

Postharvest Activities

After harvest activities are completed, another prescribed burn will help to reduce the debris load and make final preparations of the seedbed. It is important to note that this burning should be before seed fall, which typically occurs in late October or November in Mississippi.

Evaluate seed-tree areas during the winter following the first postharvest growing season. This work is more accurate and efficient in the winter. Tiny, green pine seedlings will contrast against the dormant, brown vegetation on the area. It also is easier to access and move across the site in winter.

As soon as adequate density and stocking of regeneration is achieved, remove the seed trees. If seed trees are not removed, they will have a negative impact on the development of established regeneration. They also will continue to disseminate seeds across the area, and that can cause an overstocking of seedlings.

With current market conditions, it is increasingly hard to sell small volumes of sawtimber. Thus, on small parcels of land, it may be difficult to market these seed trees; however, it is essential to remove them, or even cut them and leave them if necessary, to promote development of the next crop of seedlings.

If adequate regeneration has not been achieved after 2 years, you will need to burn the site to control undesirable vegetation and prepare a new seedbed. This could happen if your planned regeneration year is extremely droughty or if an unexpected flood takes the seeds away from the area. This is not a typical occurrence.

Figure 3. Young pine seedlings in a seed-tree cut. Photo by Brady Self.

Figure 4. Adequate regeneration in a 3-year-old seed-tree attempt. Photo by Brady Self.

Application of the Method

Most forested areas in Mississippi can be successfully regenerated using the seed-tree method, but there are exceptions. Seed-tree regeneration is not appropriate for areas that flood frequently, on those areas with steep topography, or on shallow soils.

On frequently flooded areas, seeds are often washed away, and areas with steep topography may experience down-slope washing during heavy rainfall. Seedling density may be unacceptably high in the areas where seeds collect, while being too low across the remainder of the area. Areas with extremely shallow soils will suffer excessive damage to seed trees due to windthrow.

Remember, these trees are highly vulnerable to the forces of nature once they are left with no surrounding vegetation. Seed-tree regeneration works best in areas of fairly level topography with adequate soil moisture during the growing season for seedlings to survive and develop.

Summary

Overall, seed-tree regeneration presents an excellent opportunity for most of the forestland owners in Mississippi who want to grow pine or other light-seeded species; however, it is important to remember two major items before you attempt to use seed-tree regeneration.

First, regeneration is not free. It is much less expensive than the artificial regeneration alternatives, but prescribed burning and timber stand improvement work are expenses. In addition to out-of-pocket costs, timber sale revenue may be less, since the area was not clear-cut. The latter cost or loss of revenue may be small and/or negligible in many cases, but landowners should be aware of it and determine if it outweighs regeneration through artificial means.

Second, landowners should not try to use this method if they do not have good-quality trees in the stand to be harvested. Attempting to take a poor-quality stand and regenerate a high-quality successor using the seed-tree method typically results in failure.

The seed-tree method has limitations but also presents great opportunities. Working within those limitations and realizing the opportunities will benefit Mississippi's forest resource and landowners who properly apply the method.

Additional Reading

Londo, A., B. Hatcher, J. Kushla, R. Rousseau, J. Auel, M. Measells, J. Henderson, T. Traugott, T. Deloach, G. Hughes, D. Bales, D. Gaddis, E. Nebeker. 2016. Managing the family forest in Mississippi. Mississippi State University Extension publication 2470. 100p.

Self, A.B. 2019. Tree injection for timber stand improvement. Mississippi State University Extension publication 2942. 4p.

Self, A.B. 2019. Timber stand improvement. Mississippi State University Extension publication. P1281. 4p.

This work is supported by the USDA National Institute of Food and Agriculture, Renewable Resources Extension Act Project No. MISZ069400, Accession No. 1002390.

Publication 1816 (POD-05-20)

Revised by **A. Brady Self**, PhD, Associate Extension Professor, Forestry; from an earlier edition by **Andrew W. Ezell**, PhD, Professor Emeritus, Forestry.

MISSISSIPPI STATE UNIVERSITY™

EXTENSION

Produced by Agricultural Communications.

Extension Service of Mississippi State University, cooperating with U.S. Department of Agriculture. Published in furtherance of Acts of Congress, May 8 and June 30, 1914. GARY B. JACKSON, Director