MISSISSIPPI STATE UNIVERSITY EXTENSION

Direct Seeding: A Forest Regeneration Alternative

Direct seeding is an artificial regeneration method that has fallen out of common use in the South, yet the technique can still provide a less expensive regeneration option for landowners in some scenarios. The technique involves planting seed from a desirable species for forest regeneration purposes. It can be accomplished either by hand or from the air. Another, more common, form of artificial forest regeneration is planting tree seedlings. Both methods have advantages and disadvantages, depending on the particular situation. Either method offers the opportunity to introduce a new species. When a site is occupied by undesirable species, the only way to convert crop species is to eliminate existing cover and replace it with seed or seedlings of desirable species.

Advantages of Direct Seeding

Lower Initial Cost

The most notable advantage of direct seeding is the lower initial cost as compared to planting seedlings. The cost of direct seeding is usually one-third to one-half of the cost of planting seedlings.

Easier to Use in Remote Areas

Another advantage is that direct seeding can be easier to use in remote or inaccessible areas. Although most forest land in the Southeast is less rugged and more easily accessed than some land in western states, there are areas where it

is difficult to move equipment, supplies, and contract labor. In those situations, it is easier to broadcast seed by hand or from the air than to plant seedlings.

Root Systems of Trees are Natural

The root systems of trees that develop from direct seeding are natural. When seedlings are planted, the root system may be distorted or end up in an 'L' or 'J' shape if the planting hole is not deep enough. A distorted root system reduces seedling growth, and shallow planting usually reduces tree survival rate.

More Flexible Window of Application

You can cover large areas quickly, especially when direct seeding is done aerially. Also, there is a longer time span to complete the work than when seedlings have to be planted. Seedlings must be planted while they are still dormant and when the planting site is cool and moist. Depending on the species, direct seeding can be done in the fall or spring with many more days available to complete the seeding.

Sow longleaf pines in the fall (before mid-December) or early spring. Sow loblolly, shortleaf, and slash pines in mid-spring and late spring. Typically, oak acorns are sown in winter or early spring, but they may be sown any time of year. This provides flexibility when sowing areas that may be flooded during winter. One last advantage of direct seeding is the quick response following a fire, flood, or other natural disaster.

Disadvantages of Direct Seeding

Reduced Control of Spacing and Stocking

The most notable disadvantage of direct seeding is reduced control over spacing and stocking (number of trees). The number of seeds sown is based on assumptions of survival. It is always possible that too many trees will survive, resulting in an overcrowded situation that may require a precommercial thinning to correct (Figure 1). Precommercial thinning involves cutting or killing some trees before they reach commercial size so remaining trees can grow better.

The opposite situation is also possible, and survival may not be adequate to stock an area fully with trees. In this scenario, supplemental seed sowing is required to get enough trees to occupy the site fully.

Either corrective measure costs money, and initial cost savings could be lost. Even when survival rates are acceptable, tree spacing is not as uniform as in planted seedling areas, making cultural operations throughout the rotation harder to accomplish, especially those requiring moving equipment across the area.

Spacing problems are worse on steep slopes where seeds are washed downhill after rainfall, resulting in loss of seed and highly uneven distribution. For these reasons, direct seeding is not recommended for steep slopes.

Figure 1. Direct seeded loblolly pine stand that is 30 years old. Stocking is too high for profitable growth, and the stand is at high risk for disease and insect infestations.

High Mortality in Droughty Soils

Another disadvantage of direct seeding is high mortality on droughty sites, especially sandy soils. During the first month after germination, the root system of the seedling is still near the soil surface. If the soil dries out too much, the tiny seedling dies, so caution is warranted if seeding excessively droughty areas.

Longer Rotations and Lower Yields

When compared to plantations of planted seedlings, areas that have been directly seeded usually require longer rotations and produce lower merchantable yields. This may or may not be a disadvantage, depending on an economic analysis of costs, goals of ownership, and financial ability of the owner. Growing trees is much like growing most other crops in that the more money invested in management, the bigger and better the final yield, up to a certain point. However, a good crop of timber can be grown in stands started by direct seeding.

Appropriate Sites for Direct Seeding

Basically, any site you can plant with seedlings can also be directly seeded. The only exceptions are the excessively droughty areas previously discussed or where soil pH is alkaline. Loblolly and shortleaf pines can be sown on most sites throughout Mississippi. Longleaf and slash pines prefer a warmer climate and can be sown in southern Mississippi. Bottomland oak species are sensitive to topographic positions in the landscape. Usually several species of oak are sown and matched to site positions. Please consult Mississippi State University Extension Publication 2004 *Bottomland Hardwood Management: Species/Site Relationships* online at extension.msstate.edu for more information on matching hardwood species to sites. These are three areas where direct seeding has the greatest application: remote or inaccessible sites (previously discussed), poor or low-productivity sites where growth of trees would not make the cost of planting operations economically feasible, and any land area where a minimal investment is absolutely essential.

The last category is perhaps the most important because many private landowners do not want to invest in intensive site preparation and planting in today's timber markets. It is better to direct seed these areas rather than allow them to regenerate "naturally," which usually results in mostly undesirable species taking over the area.

Species Selection

Virtually any species of tree can be grown by direct seeding on the appropriate site. Many owners want to grow a crop of trees for timber production and wildlife habitat, so this limits the list of species. Four major factors affect species selection: goals of ownership, geographic location, hazard potential, and seed availability.

You must decide the goals of ownership first, since they control choices in the other categories. If you want to grow pine timber, your list of choices may be different from a landowner who wants to produce habitat for white-tailed deer.

Geographic location and hazard potential basically mean that the species should be matched to the site. Putting species on sites where they grow best with the least likelihood of loss results in the most successful direct seeding efforts. This means you need a substantial amount of information on the site and the tree species. Consider getting professional advice before starting.

Seed availability is the last, but not least, item to consider. You must purchase seeds or collect and prepare them. Collecting seeds requires a considerable effort, but it is not nearly as difficult as preparing them. MSU Extension Publication 2421 *Growing Your Own Oak Seedlings* (available online at extension.msstate.edu) offers useful information on basic seed collection and care techniques. Pine seeds should be de-winged and oak acorns have to be de-capped, and then seed must be stratified. Stratification involves storing seed at a certain cold temperature for a certain time to promote germination.

For best results, after stratification, treat seeds with an insecticide, fungicide, and animal repellent before sowing. Unless you are familiar with all these procedures, it is best to purchase seed that has already been treated and tested. After purchase, sow the seed as soon as possible. If storage is required, store stratified pine seed at a temperature between 25 and 40 degrees Fahrenheit, and store oak acorns at 35 degrees Fahrenheit.

Site Preparation

Site preparation for direct seeding must accomplish two purposes. First, mineral soil must be exposed. You can do this by burning or disking the area if it is an old field. Sow pine seed directly on the soil surface. Most oaks, however, will establish best if the acorn is planted 2 inches deep. For either choice, mineral soil must be exposed to the seed.

Second, some degree of competition control is highly desirable. Burning and disking reduce the initial amount of competing vegetation, although resprouting and weed seed germination will occur. If economically feasible, an application of herbicides is beneficial in areas where

competing vegetation is well established and hard to control. An added benefit from competing vegetation control is the reduced seed predation by animals. While it may seem counterintuitive, in areas with little competition control, small animals can eat nearly all the acorns that have been sown. This is because the greater cover in untreated areas provides protection against predators for these small animals.

Sowing Seed

You can sow pine seed aerially or from the ground by hand or machine. Aerial seeding of oak acorns usually results in poor survival unless you take subsequent measures to cover the seed with soil.

Sowing rates are influenced by various factors, including site condition, quality of seed, method of seed distribution, and number of trees desired. Sowing by hand requires fewer seed but requires more labor and time. A helicopter can seed 2,000 acres per day, and aerial work is the only practical way to seed areas that are inaccessible or where debris restricts ground movement. Private landowners in the same general area can combine their work and employ aerial seeding services. Seed distribution from the air is referred to as broadcast work.

Another form of broadcasting is ground distribution with a cyclone seeder. Depending on site conditions, one person can cover 12 to 15 acres per day. These seeders are adjustable to accommodate various seed sizes and result in uniform seed distribution across the area.

The other two forms of ground seeding are row seeding and spot seeding. Both methods require much less seed per acre than broadcasting. In row seeding, seeds are dropped 1 to 2 feet apart along parallel lines of travel across the area.

This is slower than broadcasting, since rows are usually 8 to 10 feet apart. If site conditions are unfavorable for survival, make your rows closer to ensure better stocking.

You can use spot seeding for pine and oak regeneration. In pine seeding, a fire rake is often used to clear a spot on the ground, usually 1 to 2 feet in diameter, and five to eight seeds are dropped in the clearing. These spots are normally on an 8-foot spacing, but you can reduce spacing for areas with poor survival conditions. Table 1 gives critical information on seed and sowing rates for the major southern yellow pine species. These rates are average recommendations and can be modified to meet different stocking requirements and site conditions.

When spot seeding acorns, plan to sow about 1,500 to 2,400 acorns per acre, or allow 18 to 30 square feet per acorn. For instance, a spacing of 3 feet between acorns in the row and 10 feet between rows (approximately 1,500 seeds per acre) has shown good results. Since acorns need to be covered with soil, use a metal bar or sharp stick to make a hole in the gin and drop acorns in. For best results for most oaks, make holes consistently 2 inches deep.

Table 1. Recommended sowing rates.

Species	Seeds Per Pound[1]	Sowing Method	Sowing Rate Per Acre (Number)	Sowing Rate Per Acre Pounds[2])
		Broadcast	15,000	3.24
Longleaf	4,700	Rows[3]	2,900	0.63
		Spots[4]	4,350	0.94
		Broadcast	14,000	1.11
Slash	14,500	Rows	2,900	0.23
		Spots	4,350	0.35
		Broadcast	12,000	0.75
Loblolly	18,400	Rows	2,150	0.14
		Spots	3,650	0.23
		Broadcast	20,000	0.48
Shortleaf	48,000	Rows	4,350	0.10
		Spots	5,800	0.14

Source: Campbell, 1982, as shown in Barnett, 2014.

1 Wakeley's averages.

2 Weights based on stratified repellent-treated seed that are 100 percent sound.

3 Rows 10 feet apart for all species. Spacing within rows: 1.5 feet for longleaf and slash, 2 feet for loblolly, and 1 foot for shortleaf.

4 Spots spaced 6 by 10 feet, six seed per spot for longleaf and slash, five per spot for loblolly, and eight per spot for shortleaf.

Safety

It is important to remember that treated seed have toxic chemicals on them. Never handle these treated seed in any way without suitable personal protective equipment, such as latex gloves and a breather mask.

Evaluation of Seeding

Since many variables affect success of direct seeding work, careful inventories are required to evaluate the results. As mentioned, too many or too few seedlings may result, and more than a casual stroll across the area is required to determine the number and distribution of seedlings (Figure 2). At least one inventory is essential at the end of the first growing season following seeding. Depending on results of this sampling, you might need a second inventory after the second or third growing season.

Regardless of the number of sample plots used, remember to distribute them evenly across the entire area. Map out a grid before sampling, and locate plots accordingly. Sample plots should be 1/1000 of an acre for broadcast areas. This is a circular plot with a radius of 3 feet 8.7 inches, which can be measured using string from a center point.

Use a minimum of 25 plots for any seeded area. On large areas, one plot per acre has been used successfully. During the inventory, count and record the number of seedlings in each plot separately.

Figure 2. Freshly germinated loblolly pine seedlings. Seedling numbers this high typically result in a need for precommercial thinning at some point later in the rotation.

To get the number of seedlings per acre for the area, a two-step procedure is involved:

- Get an average number of seedlings per plot by dividing the total number of counted seedlings by the total number of plots.
- Multiply the average number of seedlings per plot by 1,000 to find the average number of seedlings per acre.

To determine the stocking percentage:

- Divide the total number of plots with 1 or more seedlings by the total number of plots.
- Multiply the result by 1,000.

A successful seeding operation is one that results in 1,000 to 3,000 seedlings per acre with a stocking rate of 55 percent or greater. If the inventory indicates fewer than 1,000 seedlings per acre or less than 55 percent stocking, wait until the end of the second growing season and take an intensive inventory before reseeding or planting. Areas with more than 2,500 seedlings per acre at the end of the first growing season should be resampled at the end of the third year to determine if a precommercial thin is necessary. Row seeding and spot seeding may require different sampling approaches for best accuracy. However, the 1/1000 acre method may be used with confidence if enough samples are taken.

Summary

If proper procedures are followed, 80 percent of direct seeding operations of pines are considered successful. Success has been more elusive when direct seeding oak species, but failures are typically linked to lack of site preparation and matching species to site. However, direct seeding requires a great deal of background knowledge and training. For best results, consult a professional forester who has experience in this type of work.

Additional Reading

Barnett, J. P. (2014). *Direct seeding southern pines: History and status of a technique developed for restoring cutover forests* (USDA Forest Service, Southern Research Station, General Technical Report 187). Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station.

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