Artificial Regeneration of Shortleaf Pine

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Figure 1: Artificial regeneration of shortleaf pine at Turtle Educational State Forest, North Carolina. The site was prepared for planting with prescribed burning (far left) and planted (middle) on a 7 x 10 foot spacing using bareroot seedlings from the NC Forest Service nursery. Seedlings after three growing seasons (far right). Credit: NC Forest Service

Shortleaf pine *(Pinus echinata)* was once described as the most widely distributed southern pine[6]. Today, its range has significantly declined. Successful artificial regeneration of shortleaf requires planting high quality seedlings or seeds, suitable site selection, adequate site preparation, proper planting techniques, and effective competition control (Fig. 1).

Site Selection

Though shortleaf is adaptable to a variety of sites and soils, certain conditions result in better growth than others. Use our Site Suitability Tool to determine if your site is right for regenerating shortleaf pine.

Site Preparation

Artificial regeneration of shortleaf can occur on abandoned agriculture fields, forest harvest/ clear cut sites, and under low basal area (BA) forests (e.g. 20-60 BA). Shortleaf pine seedlings are shade intolerant and seeds must be in direct contact with the mineral soil for germination. For this reason, site preparation techniques that clear woody and herbaceous understory vegetation, thin/ harvest overstory vegetation, and reduce poor soil conditions prior to planting are necessary to ensure seedling or seed germination success. The following site preparation techniques are recommended for effective artificial regeneration of shortleaf pine under varied forest management:

- **Prescribed burn:** is a low temperature, controlled burn by trained professionals. It is used to reduce slash and control competition and is often recommended to complement mechanical and chemical treatments. A site preparation burn is most effective when applied in the late summer. Overall, this technique works best when a burning program is established several years prior to artificially regenerating the site.

- **Chemical control:** use of site prep herbicides to control competing vegetation. This is important to reduce seedling competition in the first few years of growth. Herbaceous weed control is also important in the years following planting[10]

Figure 2: Planting shortleaf pine at a site that was ripped and burned prior to regeneration. Photo taken at the Ouachita Nat. Forest. Credit: USDA Forest Service

- **Mechanical:** use of heavy equipment to remove vegetation or improve soil conditions. Common methods include shearing, chopping, scalping, and ripping. Ripping of eroded, compacted, or rocky sites (Fig. 2) has successfully improved seedling performance on rocky soils in the Ouachita mountains[9] or compacted soils in the Piedmont region. Hard or rocky soils make planting seedlings difficult, thus resulting in poor survival rates.

Artificial Regeneration Options

Shortleaf pine is artificially regenerated by planting bareroot (Fig. 3) or containerized seedlings (Fig. 4), available through nurseries, or by sowing seeds (direct seeding). Selecting one method over another is dependent on the site and desired economic investment. Planted seedlings exhibit better survival and stocking control; use genetically improved seeds more efficiently; and prevent the need for pre-commercial thinning in comparison to direct seeding[2,5]. Direct seeding may be more appropriate for certain sites, such as regenerating large areas following destructive wildfires or on difficult terrain[4].

Figure 3: Bareroot shortleaf pine seedlings, Weyerhaeuser Nursery at Magnolia, AR. Credit: USDA Forest Service

Figure 4: Shortleaf pine seedlings in containers. Credit: USDA Forest Service

Seedlings

Artificial regeneration of shortleaf pine with seedlings requires use of high quality stock from a reputable nursery, as well as proper handling, storage, and planting techniques. As already mentioned, adequate competition control before and after planting should also occur. Time of planting is important. Seedlings are commonly planted from late fall till early spring. Through most of its range, February through March is usually the most ideal time to plant[1]. Seedlings planted earlier are subject to cold weather damage. When the ground is frozen roots cannot take up moisture. Also, if seedlings are exposed to strong winds they can dry out. Seedlings planted late may be exposed to spring droughts when the root systems have not had time to become established.

Care and handling activities include time of lifting, sorting, length of storage, method of storage, and transportation. Table 1 provides seedling care and handing information of shortleaf seedlings[3]. Although many have thought that the techniques used for loblolly pine are sufficient, research has shown that shortleaf seedlings are more sensitive to handling and storage conditions than loblolly.

Bareroot and container seedlings can be planted either by hand or machine.

- **Bareroot:** Proper handling and storage of bareroot stock is crucial to ensure low seedling mortality rates. Bareroot seedlings cost less than container seedlings. See Table 1 for a bareroot seedling quality guideline.

- **Container:** Container seedlings have improved seedling survival compared to bareroot seedlings[2,5]. Historically, the survival of bareroot seedlings has been poor,[8] so use of container stock should be considered even if it is more expensive than bareroot seedlings. Container size is important. Generally, containers with 50 seedlings per square foot, with 6 cubic inches of media, work well.

Table 1: Bareroot shortleaf pine seedling size recommendations[†].

Seedling Characteristic	Mexal & South 1991	Anon. 1989	Barnett 1986	Wakeley 1954
Shoot height (inch)	6 - 10	8	6 - 10	4 - 12
Root Collar Diameter[††]				
Cull (mm)	< 4	----	< 2.5	< 3
Optimum (mm)	> 5	4.8	2.5 - 5	< 3
Root to Shoot Ratio[†††]	> 0.4	0.4	0.4	----
Lateral roots (# roots)	> 7	> 5	7	----
Tap root length (inch)	----	6	4 - 10	----

[†]Adapted from: Artificial regeneration of shortleaf pine. 1992. John Mexal. In: Proceedings of the shortleaf pine regeneration workshop. USDA Forest Service GTR 90: 172-186.
[††]This is the stem diameter at ground height.
[†††]Measured in oven dry weight. Optimum is 1:2.5 (0.4). For example, a 0.9 g root (dry weight) should have a shoot mass no greater than 2.25 g.

Direct Seeding

Direct seeding is a viable, lost cost alternative for establishing shortleaf pine on sites that are inaccessible, of low productivity, or where a minimal investment is desired. In Missouri, an estimated 10,000 acres have been direct-seeded with shortleaf pine; half of which are at Mark Twain National Forest[7].

Use quality seed that has been stratified and repellant-treated, properly handled and stored. Sow shortleaf pine seed during February to April using a half pound of treated seed per acre in spots, or rows, or evenly broadcast by hand or aerially.

Pine seed must have sufficient light and come in direct contact with bare mineral soil. Site preparation by prescribed fire and chemical or mechanical methods should be used to ensure this condition before direct seeding. Adequate soil moisture is critical for good germination. Consider the potential for drought before seedling[4]. Avoiding seeding on sites that have deep, sandy soils that dry out quickly after rain and areas of severe frost.

References

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