



LONGLEAF PINE ECOSYSTEM RESTORATION: ESTABLISHING LONGLEAF PINE SEEDLINGS

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Forestry Notes provide technical information on management practices and related topics for use by NRCS conservationist, cooperators, and land owners and managers.

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Longleaf pine ecosystems once dominated much of the southeastern United States ranging from southern Virginia to Florida to eastern Texas. Characterized by an open canopy of longleaf pine and a low, species-rich understory, these systems covered approximately 92 million acres. By 1920, land clearing and intensive logging practices significantly reduced the virgin longleaf canopy. Subsequently, natural longleaf regeneration was impeded by a lack of seed source, free-ranging hogs and fire suppression, which disrupted the canopy and understory interaction necessary to sustain the ecosystem. Today, less than 3 percent of the original acreage remains.

Since a longleaf pine component is critical to the ecosystem restoration process, interest in longleaf pine establishment has been renewed. In the absence of an existing seed source, planting bare root or containerized seedlings is the preferred regeneration option. Planting success depends on: (1) appropriate seedling density and spacing arrangements; (2) well-prepared, competition-free planting sites; (3) fresh, healthy, top quality seedlings; (4) careful handling of seedling from lifting to planting; (5) precision planting; and (6) proper post-planting care.

Seedling Density and Arrangement

Research in South Africa, Australia, New Zealand and the United States found that optimum sawtimber production for any pine species occurs when initial survival rates are no more than 400 evenly spaced seedlings per acre. In 1947, South African studies recommended planting longleaf pine at 300 trees per acre followed by an initial thinning at age 6 to 180 trees per acre. These results suggest an acceptable sur-

vival density for timber production would range between 300 to 200 seedlings per acre. Assuming mortality rate would range between 33 and 56 percent, a target planting density of 450 properly planted seedlings per acre would result in a commercially productive open-canopied longleaf stand.

Habitat restoration involves the development of understory vegetation with a planting arrangement designed for future tillage and harvesting interventions. Planting row intervals spaced 12 feet or wider allow flexibility for an array of future interventions. A planting density of 450 seedlings per acre gives each seedling 96 ft² of potential growing space. Seedling spacing within a row can be determined by dividing row interval width into 96 and then round up to the nearest whole number. Thus, a 14-foot row interval would yield a 7-foot interval within rows. Minimum within row interval is 6 feet. Table 1 provides some suggested seedling density and spacing combinations. Wider row intervals result in fewer planting rows per acre, which lowers site preparation and planting costs and reduces intervention disturbance.

Table 1. Longleaf pine seedling planting arrangements

Planting Density	Row Interval	Seedling Interval
Seedlings/ Acre	Feet	Feet
453	12	8
444	14	7
453	16	6

Site Preparation

Longleaf pine is difficult to establish without vegetation control because it is intolerant to soil resource competition and shade. The type and degree of site preparation will depend on site conditions.

On recently harvested sites use mechanical or herbicide treatments to suppress woody vegetation. Early seedling growth and development is best when herbicides are used with a mechanical treatment, a prescribed burn or a V-blade planter. On old fields and pastures, scalping, disking and/or ripping help break up sod layers and hardpans. These treatments are most effective when herbicides are used to suppress encroaching vegetation. It is especially important to suppress bermudagrass and bahiagrass before applying mechanical treatments in pastures or old fields. For best results, broadcast or band spray grasses in August prior to planting with one of the following herbicide treatments (Hains, 2002a):

- (1) Accord™ 5-6 qt/acre;
- (2) (Tank mix) Accord™ 3 qt/acre and Oust™ 2 oz/acre; or
- (3) Arsenal™ 20-24 oz/acre.

Other herbicides labeled for grass control may also be used. Complete mechanical treatments so that late summer and fall rains can firm the soil prior to planting. Do not plant directly in subsoil furrow, plant on either side so the taproot can extend into the furrow. Maintain vegetation suppression around seedlings until an adequate number of seedlings have initiated height growth (approximately 70%).

Seedling Planting Stock Selection

Bare root Seedlings

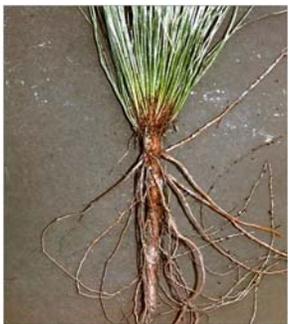


Figure 1. Longleaf pine bare rooted seedling

Longleaf pine seedlings have no stem and resemble a carrot with a clump of pine needles on top. Ideal bare root seedlings should have:

- (1) a root collar diameter (RCD) of 0.4 to .6 inch;
- (2) a stout, 6 to 8-inch or longer tap root;
- (3) at least 6 first-order lateral roots with evidence of ectomycorrhizae (roots have a feltlike covering

- of fungal hyphae which benefits seedling growth);
- (4) a winter bud with scales;
- (5) abundant, large, fascicled needles, free of brown-spot disease;
- (6) been undercut in the nursery bed well before lifting; and
- (7) a seed source from the same region as the planting site.

Containerized Seedlings



Figure 2. Longleaf pine containerized seedling

There is increasing interest in using containerized longleaf pine seedlings because they have an extended planting season and can be used to replant partial regeneration failures in the year they occur. Studies have shown that both fall-planted and late winter-planted containerized longleaf seedlings have better survival and growth compared to winter-planted bare root seedlings. Ideal containerized seedlings should have:

- (1) a root collar diameter (RCD) of 0.25 to 0.3 inch;
- (2) a 4 to 6-inch tap root;
- (3) numerous lateral roots with evidence of ectomycorrhizae; and
- (4) abundant, fascicled needles, free of brown-spot disease.

Both types of seedlings should be grown at reputable nurseries.

Seedling Care and Handling

Nursery to Field

Proper care and handling of seedlings from the nursery to the field includes:

- (1) pick-up from the nursery the day lifted;
- (2) minimize root exposure to wind, heat and sun;
- (3) refrigerated transportation (if possible) to the planting site;
- (4) store in a cool, well-ventilated area for no more than two weeks.

Field Care

Seedlings should be planted within three days of delivery. If seedlings have to be stored for a longer period, arrange for refrigerated storage. Longleaf bare root seedling planting season extends from November to March. Containerized seedlings can be planted earlier than November if necessary, but no sooner than September and no later than April. Plant when weather is favorable. Planting during the early part of the season is best. This allows seedlings time to grow new roots before the dry weather of April and May. Avoid planting during periods of low soil moisture, dry weather, freezing or high temperature, low relative humidity and high winds. Take a sufficient number of seedlings to the field for one day of planting and keep them cool and moist.

Precision Planting

Attention to detail during planting is critical. Seedlings planted too shallow will die quickly, and a seedling planted too deep will die slowly. Position taproots of bare root seedlings straight down in the hole with root collars at or slightly below the ground line with the bud fully exposed. Containerized seedlings should be planted with the taproot straight down and the root collar approximately 0.25 inches above ground line. Choose a tree-planting contractor carefully. Planting failures frequently result from improper seedling handling and planting. Paying \$5 to \$10 more per acre for a reputable contractor can help ensure seedling survival and minimize the possibility of replanting (Fig. 3).



Figure 3. Site prepared row of longleaf seedlings.

Post Planting Care

Prescribed Fire

Fire is an option for seedling release, brown-spot control and habitat development but it may not be the most cost-effective treatment. If average brown-spot infection exceeds 20% of the

cumulative foliage on sampled seedlings, use fire to control the disease unless the fire will result in excessive mortality. Prior planning and a persistent burning schedule are necessary for success. Failure to follow an appropriate schedule can lead to habitat degradation. Seedlings in the early stages of height growth are most susceptible to fire kill, especially when heavily infected by brown-spot. A post planting burning plan would include the following:

- (1) Establish firebreaks either at time of planting or during the first growing season. If a site preparation burn was used then firebreaks would be present.
- (2) The initial post plant burn should be done in the winter (Dec.-Feb.) following the first growing season while seedling are in the grass stage. This burn releases seedlings from vegetative competition during the spring of the second growing season.
- (3) The next scheduled burn will be in the spring (March-April), prior to bud break, of the third, fourth or fifth growing season. The timing depends on seedling height growth, 70% of seedlings should be 3 feet or taller. Since this burn is for habitat development, it should be applied as soon as possible. For best results, the fire should be lit by a string of spot fires.
- (4) Subsequent spring burns and firebreaks maintenance should be scheduled every two to three years.
- (5) In Louisiana, all fires will be conducted using the Louisiana Smoke Management Voluntary Guidelines, will include a written burning plan and will have at least one certified prescribed burn manager present on site from ignition until the burn is completed and declared safe according to prescribed guidelines. Recommend using the Louisiana Department of Agriculture and Forestry to plan and conduct burns.

Herbicide Applications

Evaluate root systems before a post-plant herbicide application. If new roots have not grown from the container plug or the original bare root system, it is not advisable to apply soil-active herbicides over the newly planted seedlings. Seedlings having a vigorously developing root system (more than 2" of new growth since planting), will tolerate soil active herbicides. Test soil pH prior to applying any herbicide because Oust (the most

popular herbicide) becomes more active as soil pH increases. If soil pH is above 6.0, Oust should be applied at the lowest recommended rate, and apply no more than 1 oz per acre above 6.5. Avoid using Oust when soil pH is above 6.7. The following pre-emergent herbaceous suppression treatments can be broadcast or band sprayed between Mid-March and early-April (Hains, 2002b).

- (1) Oust™ 2-4 oz/acre;
- (2) (Tank mix) Velpar L™ 24-32 oz/acre and Oust™ 2-4 oz/acre;
- (3) (Tank mix) Velpar DF™ 10.67 oz/acre and Oust™ 2-4 oz/acre; or
- (4) Oustar™ 10-12 oz/acre.

If the establishment practices are followed and seedling planting is limited to December through March 1, then there is no need to plant at a rate exceeding 450 seedlings per acre (Fig. 4 and 5).



Figure 4. One-year-old seedling without site preparation.



Figure 5. One-year-old seedling with site preparation.

References

Barnett, J. P., R. K. Dumroese, and D. J. Moorhead. 2002. Proceedings: Workshops on growing longleaf pine in containers – 1999 and 2001. Gen. Tech. Rep. SRS-56. Ashville, NC: USDA, FS, Southern Research Station. 63p.

Boyer, W. D. 2000. Long-term effects of biennial prescribed fires on the growth of longleaf pine. pp. 18-21. In W. Keith Moser and Cynthia F. Moser (eds.) Fire and forest ecology: innovation, silviculture and vegetation management. Tall Timbers Fire Ecology Conference Proc., No. 21.

Craib, I. J. 1947. The silviculture of exotic conifers in South Africa. British Empire Forestry Conference, 36 p.

Demers, C. and A. Long. 2000. Longleaf pine regeneration. SS-FOR-13 Univ. of Florida Extension Service. 5p.

Franklin, R. M. 1997. Stewardship of longleaf pine forest: A guide for landowners. Longleaf Alliance Report No. 2.

Hains, M. 2002a. Longleaf Note #4: Before planting dichotomous key for site preparation on agricultural lands. Longleaf Alliance, Andalusia, AL (www.longleafalliance.org). 2p.

Hains, M. 2002b. Longleaf Note #5: After planting dichotomous key for herbaceous release on agricultural lands. Longleaf Alliance, Andalusia, AL (www.longleafalliance.org). 2p.

Haywood, J. D. 2000. Mulch and hexazinone herbicide shorten the time longleaf pine seedlings are in the grass stage and increase height growth. *New Forest* 19: 279-290.

Pesticide Precautionary Statement

Pesticides used improperly can be injurious to humans, animals, and plants. Follow the directions and heed all precautions on the labels.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registration of pesticides are under review by the U. S. Environmental Protection Agency, consult your State forestry agency, parish agricultural agent or State extension specialist to be sure the intended use is still registered.

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