



TREE/SHRUB ESTABLISHMENT

Conservation Practice Standard 612 Guidance - A

Southern Pines

Natural Resources Conservation Service (NRCS)

April 2014



Longleaf Pine (photo courtesy of the Longleaf Alliance)

Purpose

To provide information and guidance for planting, natural regeneration, and direct seeding of Southern pine trees (i.e., longleaf, *Pinus palustris*; slash, *P. elliottii*; loblolly, *P. taeda*; and sand pine, *P. clausa*). Any of the three methods may be used for commodity production, wildlife habitat restoration or enhancement, and environmental quality or aesthetic enhancement.

PLANTED SOUTHERN PINE

Species Selection

The species planted need to be of local stock when practicable, well adapted to Florida's climate and soil-site conditions, and be consistent with planting objectives. Southern pines grouped by soil type and indicator species are listed in Florida eFOTG Section II (a) (6).

Generalized Planting Recommendations for Pines with Respect to Soil-Site Conditions		
Species	Soil Moisture	Soil Characteristics
Longleaf	Moderately to well-drained	Clay substrate 5 to 10 ft deep or clay, limestone, or similar material within 5 ft
Slash	Moderately to poorly drained	Clay, limestone, or similar material within 5 ft
Loblolly	Moderately drained	Clay, limestone, or similar material within 5 ft
Sand	Excessively drained	Clay substrate deeper than 10 ft

Seedling Quality Criteria

Do Not Accept Seedlings if Any of These Conditions Exist:

- Sour smell
- Yellow needles
- Seedlings warm or hot to touch
- Mold present
- Bark, especially on roots, slips off easily
- Cambium layer is brown

Minimum Specifications for Bareroot Seedling		
Characteristic	Longleaf	Slash/Loblolly
Minimum stem/needle length*	>8 in.	10 in.
Minimum root collar diameter	> 3/8 in.	> 1/4 in.
Tap root length	7 in.	5 in.
# Lateral roots >1mm diam.	5+	5+
Mycorrhizae	Present	Abundant
*Stem length for Slash/Loblolly; needle length for Longleaf.		

Conservation practice standards and guidance are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resources Conservation Service.

Spacing and Stocking Rates

Trees should be spaced to allow growth at normal rates with normal form. Spacing should allow for and anticipate the need for future access in order to manage and protect plantings or harvest commercial product.

Stocking rate (SR) is used to express the number of trees per acre, and is determined by the between-row and in-row spacing chosen. It is calculated with the following formula:

$$SR = \frac{43,560 \text{ ft}^2 / \text{acre}}{\text{Between-row spacing, ft} \times \text{In-row spacing, ft}}$$

Standard Row Spacing/Stocking Rates	
6 ft x 10 ft = 726	8 ft x 11 ft = 495
8 ft x 8 ft = 680	8 ft x 12 ft = 454
7 ft x 10 ft = 622	9 ft x 12 ft = 403
6 ft x 12 ft = 605	10 ft x 11 ft = 396
8 ft x 10 ft = 544	11 ft x 11 ft = 360
9 ft x 9 ft = 538	12 ft x 12 ft = 302

Pine plantations for most commercial purposes are stocked with 500 to 700 plus trees per acre. Pine straw operations will be at the upper end of range, while plantings for wildlife habitat enhancement or silvopasture are planted at less than 500 and 389 trees per acre, respectively.

Silvopasture and other agroforestry plantings can involve either single, double, or triple row sets separated by wide alleys used to produce forage or agronomic/horticultural crops. Stocking rates achieved with differing within- and between-row spacing are shown in the table at the top of the next column.

Site Preparation

On most sites, some site preparation is usually necessary. The purpose of site preparation is to prepare a seedbed and minimize competition during or shortly after planting. The most common forms of site preparation are: 1) prescribed fire, 2) mechanical, and 3) chemical, or some combination of the different methods. Guidelines for herbicide use can be obtained from your local forestry professional or the Longleaf Alliance.

Silvopasture or Other Agroforestry Planting Configurations/ Stocking Rates				
Alley Width	Spacing Between Rows	Stocking Rate, trees/acre		
		Spacing within Rows		
		6 ft	8 ft	10 ft
Single-row Sets				
20 ft	Same as alley width	363	272	218
30 ft		242	182	145
40 ft		182	136	109
Double-row Sets				
20 ft	8 ft	n/a*	388	311
	10 ft	n/a	363	290
	12 ft	n/a	340	272
30 ft	8 ft	382	287	229
	10 ft	363	272	218
	12 ft	345	259	207
40 ft	8 ft	303	227	182
	10 ft	290	218	174
	12 ft	279	209	167
Triple-row Sets				
20 ft	8 ft	n/a	n/a	363
	10 ft	n/a	n/a	327
	20 ft	n/a	372	297
30 ft	8 ft	n/a	356	284
	10 ft	n/a	328	262
	20 ft	n/a	303	242
40 ft	8 ft	389	292	234
	10 ft	363	273	218
	20 ft	340	256	204
*n/a = stocking rate too large for silvopasture or agroforestry systems.				

In a clearcut site, herbicides work best if the site has been left fallow for one growing season prior to site preparation treatments. When planting on crop or pastureland with soil compaction or where plow- or hard-pans exist, subsoiling in combination with scalping may be beneficial. Scalping is necessary when sod forming grasses, weeds, or forbs are expected to compete heavily with the pine seedlings. Bedding should be only used where high water tables exist and bedding is essential for pine survival. Any site that requires bedding is not suitable for longleaf pine production. See

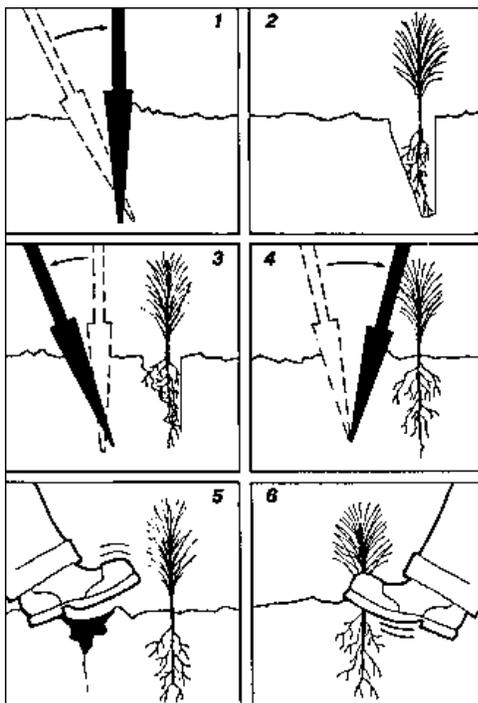
Florida NRCS Conservation Practice Standards [Tree/Shrub Site Preparation, Code 490](#); [Bedding, Code 310](#); and Florida Technical Notes: Forestry FL-19, for more information.

Planting Dates

Although bareroot pine seedlings can be transplanted between November and March, the best survival and growth rates have been observed for plantings made during the months of December and January due to better soil moisture. Containerized pine seedlings can be planted just about any time of the year as long as the plants are stored, handled and planted properly, and receive adequate water post-planting. For example, containerized longleaf planted during July and August has been shown to have better survival than those planted in the winter, especially in sandy soils.

Planting Methods

Hand planting involves the use of planting dibbles, hoedads, plug tools, or planting shovels. Proper use of these tools can be found in several of the references listed at the end of the document. The figure below illustrates an appropriate hand planting operation.



Machine planting involves the use of a mechanical tree planter that is pulled behind a tractor. Sometimes a V-blade is used on the tractor to clear logging debris and vegetation along the rows to be planted.

Planting Directions

All trees, whether bareroot or containerized (except longleaf), need to be:

- Planted vertically and the hole or furrow needs to be deep enough (at least 10-inches deep for longleaf) to avoid bending the taproot over resulting in L- or J- rooting. **Do not trim roots.**
- Containerized seedlings need to have the root plug completely covered with soil.
- For bareroot slash, loblolly, or sand pine, the root collar needs to be planted 1 to 3 inches deeper than nursery depth.
- For bareroot longleaf pine, the bud need to be at or slightly below the normal ground line. If the bud is more than ¼ inch above or more than ½ below the ground line after soil leveling, it is improperly planted.
- On sites that have been subsoiled or ripped, seedlings should be planted 6 inches to the side of the rip.
- Seedlings should be firmly packed. Pack wheels should not depress the soil more than 1½ inch.
- Plantings should follow the topographic contours to avoid erosion problems.

Longleaf plugs have different planting directions. On flat planted sites, plant plugs slightly above the soil surface. On scalped sites, plant the plug so 1 to 1½ inches of the plug is exposed above the soil surface. On extremely wet sites, 2 to 3 inches of a 6 inch plug should be exposed. See <http://www.longleafalliance.org/restoring-and-managing/restoration/planting-longleaf-pine-seedlings/planting-depth-is-critical> for more information on planting longleaf plugs.

Contact the local field unit operations of the Florida Dep. of Agric. and Consumer Services, Florida Forest Service (<http://www.freshfromflorida.com/Divisions-Offices/Florida-Forest-Service/Our-Forests/Field-Operations>) or forestry consultants in your area for information on commercial tree planters.

Planting Considerations

Pick up seedlings immediately prior to planting to minimize the storage period prior to planting. Longleaf and sand pines are highly perishable and need to be planted within three days of lifting from the nursery. No seedlings should be stored for longer than 10 days after lifting. Maximum storage conditions are achieved when temperatures are maintained between 34 and 38°F and 85 to 90% relative humidity.

During transportation, storage, and planting keep seedlings:

- loosely covered,
- out of direct sunlight,
- protected from wind and temperatures below freezing or above 50°F,
- separated from petroleum products or fumes,
- stacked no more than two bundles deep and provided with adequate ventilation,
- moist by watering root collars twice a week unless coated with clay slurry or otherwise treated.

Optimum planting conditions include:

- daytime temperatures between 35 to 60°F,
- relative humidities greater than 40%,
- windspeeds of less than 10 mph,
- adequate, but not excessive, soil moisture.

Take from storage only enough seedlings for one day's planting. Do not allow planters to carry seedlings in their hand while planting. Tree roots can be killed by as little as 5 minutes exposure to the wind. Carry bareroot seedlings in a bucket or bag with a moist medium surrounding the roots. Carry containerized stock by the container, never the stem.

Interplanting after the initial planting is normally not successful with loblolly, slash, or sand pines. Longleaf may be interplanted up to two years after initial planting.

Evaluating Planting Success

Monitor seedlings during the planting operations to determine if they were planted properly. Seedlings should be vertically aligned and firmly planted. You should not be able to dislodge or pull a seedling out of the ground after planting by pulling on a group of two or three needles before the needles break. Test placement of roots by occasionally digging up plant and looking for L- or J-shaped roots. Less than a 20% occurrence of misplanted seedlings is acceptable.

Stand survival should be determined at the end of the first growing season. Survival checks are usually done by the Florida Forest Service; however, a survival monitoring plot technique can be found in the National Forestry Handbook (Part 636.5) or in the Southern Regional Extension Forestry publication SREF-FM-001 (<http://www.sref.info/resources/publications/measuring-survival-and-planting-quality-in-new-pine-plantations>).

Survival is expected to be between 400 and 500 trees per acre one year post planting, unless trees were planted for wildlife or silvopasture or other agroforestry systems. Acceptable survival criteria for these other forestry systems are provided in Florida NRCS Conservation Practice Standard [Tree/Shrub Establishment, Code 612](#). If more than 500 trees per acre survive two years post planting, a future timber thinning may be required.

NATURAL REGENERATION OR DIRECT SEEDING

Site Selection

A sufficient seed supply, well-prepared seedbed, appropriate soil moisture, and vegetation controls are necessary for successful natural regeneration and direct seeding.

The best sites will be those with gentle or no slope and with medium moisture holding capabilities. Natural regeneration or direct seeding should not be used where slopes are steep and soils are susceptible to erosion or where soils are droughty or poorly drained.

Natural Regeneration

Definition

Harvesting merchantable trees that are either financially or biologically mature, in a way that will provide for regeneration of a forest stand.

Seed Tree Method

A seed tree cut is the strategic harvest of a mature stand that leaves a small number of seed source trees to facilitate natural regeneration. The seed tree cut is made approximately five years prior to the final harvest date. Control of the hardwood understory is essential well before the seed tree cut.

Seed trees should be dominant trees exhibiting the best of traits (e.g., straight, tall, large crowns, no disease, etc.) and a diameter at breast height (DBH) of at least 10 inches with a history of good cone production.

Minimum Recommended Number of Seed Trees to Be Left (Per Acre)				
	DBH (inches)			
	10	12	14	16+
Lobolly	12	9	6	4
Slash	12	9	6	4
Longleaf**	55	38	28	21

**Shelterwood cuts to a basal area of 30 ft² are recommended for longleaf.

Seed trees should be well spaced to facilitate even seed deposition. Supervise the harvest operation to insure that the seed trees are not damaged. Remove seed trees within two to five years after regeneration to reduce damage to seedlings and to provide added sunlight for young trees.

Shelterwood Method

A shelterwood cut involves leaving a relatively large number of seed trees per acre. This method is preferred for regeneration of longleaf, due to lower seed production and dispersal, seed losses to wildlife, and higher seedling mortality of longleaf pine.

Conduct a preparatory thinning to a basal area of 60 to 70 ft² per acre to enhance crown development and cone production 10 or more years before the planned removal cut. Hardwood control is also essential at this time.

The shelterwood cut is made approximately 5 years prior to the final harvest and trees are thinned to a basal area of 30 to 60 ft² per acre depending on the species present. Dominant longleaf should have at least a 15-inch DBH, while other pines should have at least a 10-inch DBH. Trees with a history of good cone production are preferred. There should be a minimum of 750 to 1,000 longleaf cones produced per acre for successful establishment. Seed trees should be well spaced to facilitate even seed deposition. Supervise the harvest operation to insure that the seed trees are not damaged. The residual stand of trees should be removed within 3 to 5 years to reduce damage to seedlings and to provide added sunlight for young trees.

Clearcut Method

All merchantable trees are removed. Site preparation is usually needed to enhance regeneration. See Florida NRCS Conservation Practice Standard [Tree/Shrub Site Preparation, Code 490](#), and Florida Technical Notes: Forestry FL-19. Natural regeneration methods such as seed-in-place and seeding from the side (i.e., seed sources from the periphery of the clearcut area) may be used.

Individual Tree Selection

This is the removal of trees individually or in small clumps. This type of harvesting creates an uneven-aged stand of timber. The stand is regulated by periodic volume removal. Re-generation is either continuous or periodic.

Direct Seeding

Definition

A known amount of seed is applied directly to the land resulting in a stand of desired species.

Seed

Use locally produced seed with greater than 85% viability and a minimum of 95% sound seed. Seed should be stored at 34 to 36°F prior to sowing.

Seeds may be treated to repel seed-eating insects, birds, and mammals. Loblolly and sand pine seed should be scarified to enhance germination.

Sowing Rates, Conditions, and Season

Direct Seeding Specifications				
Lbs per Acres			Temp °F	Season
Broad-cast	Row-Seeding	Spot-Seeding		
Longleaf				
3	1.5-2	0.75	<80	Fall
Slash				
1	0.6-0.75	0.5	<75	Spring
Loblolly				
1	0.5-0.75	0.5	<75	Spring
Depth of Planting - ≤ ½ inch				

Methods of Sowing

Aerial Seeding Method

This method is used on large tracts of land (>500 acres). Seeds are quickly and evenly broadcast from an airplane or helicopter.

Cyclone Seeder Method

Metered machine or hand-cranked broadcast seeders are used to distribute seed.

Row-Seeding Machine Method

A machine is used to plow a strip, distribute seed, and to cover and pack soil over the seed. Tractor and cultipacker-seeder, furrow seeder, or drill may be used. This method can also be used to sow large tracts of land, but not as quickly as with aerial seeding.

Spot Seeding Method

Hand-raked or hoed spots two feet in diameter on 8 x 8 spacing are sown with six to eight seeds.

Site Preparation

As with transplanted seedlings, the purpose of site preparation is to prepare a seedbed and to minimize vegetative competition during and shortly after seed establishment. Several weeks prior to seeding or seed fall, the seedbed should be prepared.

The preferred method of site preparation is prescribed fire either alone (minimum) or prescribed fire preceded by chopping, disking, or an application of herbicide(s). At least 50% mineral soil must be exposed. Guidelines for herbicide use can be obtained from the Longleaf Alliance (<http://www.longleafalliance.org/preparingthesite.html>) or a local forestry professional.

Evaluating Stand Establishment

A stand of slash or loblolly pine is considered adequate when there are about 1,500 evenly spaced, free-to-grow (i.e., free of overhead competition) seedlings per acre. A longleaf pine stand can be considered established when 1,000 to 1,500 seedlings have initiated height growth.

MAINTENANCE

Whatever method is used for stand establishment, weeds should be controlled for at least two years post-planting. Mowing, chopping or chemical herbicides can be applied to control over weeds and affect stocking rates in young pine stands. Lists of recommended herbicides can be obtained from

the Florida Forest Service or the Longleaf Alliance (<http://www.longleafalliance.org/restoring-and-managing/restoration/releasing-longleaf-pine-from-competition>). Herbicides can only be used as labeled.

Cool season to early growing season (i.e., April to May) prescribed fire can be used for control of competition in young longleaf stands, as long as seedlings are in the grass stage, root collars are > ¾ inches in diameter, fuel moisture is 15 to 25%, soil moisture is adequate and temperatures do not exceed 60°F. *Burning should not be conducted during, or immediately after, periods of extended drought.*

Where brown spot needle blight of longleaf is a problem, seedling roots need to be dipped in benomyl fungicide prior to planting. Brown spot needle blight can be controlled by prescribed fire; however, a forestry professional should be consulted prior to the use of fire for this purpose.

Protect stands from wildfire and grazing. Exclude cattle until terminal buds of the mainstem are above the normal browse line (≈5 to 6 ft). If necessary, exclude browsing wildlife through installation of electric fencing. See Florida NRCS Conservation Practice [Access Control, Code 472](#), for more information.

Permits can be issued to control of wildlife causing damage to commercial crop trees. Contact the appropriate Regional Office of the FL Fish and Wildlife Conservation Commission for more information (<http://myfwc.com/conservation/you-protect/assistanuisance-wildlife/>).

As trees mature and competition among trees increase, timber thinning will likely be required to reduce canopy closure and to allow canopy development of remaining trees. Trees of poor form, exhibiting low vigor, disease, etc., should be removed and the most valuable and the most vigorous should be left (See Florida NRCS Conservation Practice Standard [Forest Stand Improvement, Code 666](#); FL Technical Notes: Forestry FL - 20; and or consult with a professional forester. When practical, leave snags (i.e., dead standing trees) and cavity trees for wildlife.

REFERENCES

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