Purpose
To provide information and guidance for planting of Southern pine tree species. Plantings may be for commodity production, wildlife habitat enhancement or restoration, environmental quality or aesthetic enhancement.

Species Selection
The species planted (i.e., longleaf, slash, loblolly, sand pine) will be of local stock where practicable, well adapted to Florida’s climate and soil-site conditions and will be consistent with planting objectives. Southern pines, grouped by soil type and community, are listed in Section II-iii-C of the Florida Field Office Technical Guide.

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

Do not accept seedlings if any of these conditions exist.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Longleaf</th>
<th>Slash &amp; Loblolly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Stem Length</td>
<td>&gt; 8 in.</td>
<td>10 in.</td>
</tr>
<tr>
<td>Minimum Root Collar Diameter</td>
<td>&gt; 3/8 in.</td>
<td>&gt; 7/32 in.</td>
</tr>
<tr>
<td>Tap Root Length</td>
<td>7 in.</td>
<td>5 in.</td>
</tr>
<tr>
<td># Lateral Roots (&gt; 1 mm in diameter)</td>
<td>5+</td>
<td>5+</td>
</tr>
<tr>
<td>Mycorrhizae</td>
<td>Present</td>
<td>Abundant</td>
</tr>
</tbody>
</table>

a – for longleaf, the criteria measured is needle length.

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 to harvest a commercial product.

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 the range, while plantings for wildlife habitat enhancement or silvo-pasture are planted at less than 500 or 389 trees per acre, respectively.

The stocking rate (SR) measures the number of trees per acre using the following formula:
SR = \frac{43,560 \text{ (ft}^2/\text{ac})}{\text{Between-Row Spacing (ft) x In-Row Spacing (ft)}}

### Standard Row Spacing/Stocking Rates

<table>
<thead>
<tr>
<th>Standard Row Spacing/Stocking Rates</th>
<th>6 ft x 10 ft</th>
<th>8 ft x 11 ft</th>
<th>7 ft x 10 ft</th>
<th>6 ft x 12 ft</th>
<th>8 ft x 10 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>SR</td>
<td>726</td>
<td>495</td>
<td>622</td>
<td>605</td>
<td>544</td>
</tr>
<tr>
<td><strong>Between-Row Spacing (ft) x In-Row Spacing (ft)</strong></td>
<td>8 ft x 8 ft</td>
<td>454</td>
<td>9 ft x 12 ft</td>
<td>396</td>
<td>11 ft x 11 ft</td>
</tr>
<tr>
<td><strong>SR</strong></td>
<td>680</td>
<td>436</td>
<td>605</td>
<td>544</td>
<td></td>
</tr>
<tr>
<td><strong>SR</strong></td>
<td>605</td>
<td>360</td>
<td>605</td>
<td>544</td>
<td></td>
</tr>
<tr>
<td><strong>SR</strong></td>
<td>538</td>
<td>302</td>
<td>538</td>
<td>302</td>
<td></td>
</tr>
</tbody>
</table>

Silvopasture, or agropasture, plantings involve either a single, double or triple row set separated by wide alleys used to produce forage for grazing.

**Silvopasture Planting Configurations/Stocking Rates**

<table>
<thead>
<tr>
<th>Silvopasture Planting Configurations/Stocking Rates</th>
<th>Single-Row Sets</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Alley Width</strong></td>
<td><strong>Spacing between Rows</strong></td>
</tr>
<tr>
<td>20 ft</td>
<td>Same as alley width</td>
</tr>
<tr>
<td>30 ft</td>
<td>Same as alley width</td>
</tr>
<tr>
<td>40 ft</td>
<td>Same as alley width</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Stocking Rate (trees/ac.)</strong></th>
<th>6 ft</th>
<th>8 ft</th>
<th>10 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SR</strong></td>
<td>388</td>
<td>290</td>
<td></td>
</tr>
<tr>
<td>8 ft</td>
<td>340</td>
<td>272</td>
<td></td>
</tr>
<tr>
<td>10 ft</td>
<td>303</td>
<td>227</td>
<td></td>
</tr>
<tr>
<td>12 ft</td>
<td>279</td>
<td>209</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Double-Row Sets</strong></th>
<th>8 ft</th>
<th>10 ft</th>
<th>12 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 ft</td>
<td>363</td>
<td>290</td>
<td></td>
</tr>
<tr>
<td>30 ft</td>
<td>345</td>
<td>259</td>
<td></td>
</tr>
<tr>
<td>40 ft</td>
<td>290</td>
<td>218</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>Tribe-Row Sets</strong></th>
<th>8 ft</th>
<th>10 ft</th>
<th>12 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td>20 ft</td>
<td>372</td>
<td>297</td>
<td></td>
</tr>
<tr>
<td>30 ft</td>
<td>356</td>
<td>284</td>
<td></td>
</tr>
<tr>
<td>40 ft</td>
<td>389</td>
<td>292</td>
<td></td>
</tr>
</tbody>
</table>

| **SR** | 327 | 262 |
| 8 ft | 303 | 242 |
| 10 ft | 363 | 273 |
| 20 ft | 340 | 256 |

*n/a = stocking rates too large for silvo-pasture systems*

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**Site Preparation**

The purpose is to prepare a seedbed and to minimize competition during and shortly after planting. On most sites, some site preparation is usually necessary. Site preparation will be sufficient for the establishment and growth of selected species.

The most common forms of site preparation are: 1) prescribed fire, 2) mechanical, and 3) chemical herbicides or some combination thereof. Guidelines for herbicide use can be obtained from the Longleaf Alliance or your local forestry professional. 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 and pasture land with soil compaction or where plow- or hard-pan exist, subsoiling in combination with scalping may be beneficial. Scalping is necessary where sod forming grasses, weeds or forbs compete heavily with pine seedlings (i.e., pasture and crop fields). Bedding shall only be used where high water tables exist and bedding is essential for pine survival. See Forest Site Preparation - Code 490, Bedding - Code 310 and FL Technical Notes: Forestry FL - 19, for more information.

**Planting Dates**

Planting during December through January will provide the best survival and growth. Although planting during November through March is common, winter planting earlier than December or later than January in FL will often substantially reduce survival, due to insufficient soil moisture.

Planting of containerized pine seedlings can extend well beyond winter months with good results as long as the plants are stored, handled and planted properly, and will receive adequate water post-planting. For example, containerized longleaf planted during July and August has shown better survival than those planted during winter; especially, in sandy soil.

**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 this document.

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

**Planting Directions**

All trees, whether bareroot or containerized, should be:

- Planted vertically and the hole or furrow should be cut deep enough (at least ten inches for longleaf) to avoid L- or J-rooting.
- Containerized seedlings should be planted with the root plug completely covered with soil.
- For bareroot slash, loblolly and sand pine the root collar should be planted one to three inches deeper than nursery depth.
- For bareroot longleaf pine the bud should be at the normal ground line. If the bud is more than ¼ of an inch above ground or if it is buried greater than ½ of an inch deep after post-planting soil leveling, it is improperly planted.
- On sites that have been sub-soiled (a.k.a., ripped), seedlings should be planted 6 inches to the side of the rip.
- Seedlings should be firmly packed.
- The packing wheels should not depress the soil more than one and one-half inch.
- Plantings should follow topographic contours to avoid erosion problems.

Lists of planters can be obtained from the Florida Division of Forestry or forestry consultants.

**Planting Considerations**

Seedlings should be picked up immediately prior to planting with a minimum of storage prior to planting. Maximum storage conditions are achieved when temperatures are maintained between 34 and 38°F and with a relative humidity of 85 to 90%.

During transportation, storage, and planting, seedlings should be kept:

- loosely covered,
- out of direct sunlight,
- 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 would include:

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

Only enough seedlings for one day’s planting should be carried from storage to the field. Do not allow planters to carry seedlings in hand while planting (roots can be killed in as little as five minutes when exposed to wind). Bareroot seedlings should be carried in buckets or bags with a moist medium surrounding the roots. Containerized stock should be carried by the container, never by the stem.

Longleaf and sand pines are highly perishable and should preferably be planted within three days of lifting from the nursery. No seedlings should be stored longer than 10 calendar days after lifting.

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.

Do not prune roots.

**Maintenance**

Weeds should be controlled for at least two years post-planting. Mowing, rotational mowing between pine rows or chemical herbicides can be applied to affect control over weeds and stocking rates in young pine stands. This is especially important when trying to establish pines on land previously used as pasture or crop fields. Lists of recommended herbicides can be obtained from the Florida Division of Forestry or the Longleaf Alliance. 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 and at least one year old, 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, it is recommended that seedling roots be dipped in benomyl fungicide prior to planting. Brown spot needle blight may be controlled through the proper use of prescribed fire; however, a forestry professional should be consulted prior to use of fire for this purpose.

Plantings should be protected from wildfire and grazing. Cattle should be excluded from the stand until the terminal bud of the mainstem is above the normal browse line (= 5 to 6 ft). It may be necessary to exclude browsing wildlife through installation of electric fencing.

Permits may be issued to affect 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.

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 Timber Stand Improvement - Code 666, FL Technical Notes: Forestry FL - 20; consult with a professional forester). Snags (i.e., dead standing trees) and cavity trees should be left for wildlife.

Soil-based fertilizer recommendations for southern pines can be obtained from Jokela and Long (2000).

**Evaluating Planting Success**

Seedlings should be monitored to determine if they were planted properly. Seedlings should be vertically aligned and firmly planted. Pulling on a group of two or three needles should not dislodge the seedling prior to the needles breaking free. Placement of roots can be tested by carefully digging up an occasional plant to check for J- or L-root. An acceptable level would be less than 20% occurrence of J- or L-root.

A stand should be monitored for survival at the conclusion of the first growing season. Survival checks are usually conducted by the FL Division of Forestry; however, a survival monitoring plot technique, Part 636.5, Exhibit FL636-5, can be found in the National Forestry Handbook.

Survival is expected to be about 400 - 500 trees per acre one year post-planting, unless trees were planted as wildlife habitat or are used in a silvopasture system. Acceptable survival criteria are provided in NRCS’ FL Tree and Shrub Establishment Practice Standard - Code 612. If more than 500 trees per acre survive two years post planting, a future timber thinning may be required.

**References**


Longleaf Alliance. (http://sofserv.forestry.auburn.edu/la/)

NRCS, FL Field Office Technical Guide: Section II-iii-C
Section IV, Bedding, Code 310
Forest site preparation, Code 490
Tree/shrub establishment, Code 612
Forest stand improvement, Code 666

(190-V-NFH, Amendment FL-1, January 2002) 636-43(8)
NRCS, FL Technical Notes:
  Determining number of trees per acre, Forestry FL-16.
  Longleaf pine notes, Forestry FL-18.
  Planning guidelines for forest site preparation,
    Code 490, Forestry FL-19.
  Planning guidelines for forest stand improvement, Code 666, Forestry FL-20.

NRCS, National Forestry Handbook, Feb. 2001,
(http://nsscnt.nssc.nrcs.usda.gov/nfh/)
  Estimating tree & shrub survival in a plantation,
    FL612D. Part 636.5, Exhibit FL636-5.

NRCS, National Forestry Manual, Sep. 1998,
(http://nsscnt.nssc.nrcs.usda.gov/nfm/)


