POCKET GUIDE
TO SEEDLING
CARE
&
PLANTING
STANDARDS

FORWARD
Since reforestation costs are the major expense for landowners during the life of the timber stand, good survival and proper planting techniques are financially important to the landowner with benefits to forest industry, the planting contractor, and the State of North Carolina.
It is extremely important that forest tree seedlings be handled carefully and correctly from the time they are lifted until the planting is complete. In addition to improper handling, adverse weather conditions and poor soil moisture are obstacles to seedling survival. This pocket guide contains standards that are not only useful in any planting situation but must be utilized on any project receiving cost share funds. When followed, the standards for handling and planting should improve the likelihood of a successful planting. This pocket guide also contains information on correct planting techniques, machine planting, spacing, etc.
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PLANTING NON-DORMANT BARERoot SEEDLINGS

This pocket guide is designed for the care and handling of dormant bareroot seedlings. The Division uses chilling hours (the number of hours the seedling are exposed to temperatures between 32º and 46ºF) to determine dormancy. Once the seedlings have received more than 400 chilling hours they can be lifted for extended storage. Storage time for non-dormant seedlings is limited. In cases where early planting of non-dormant seedlings is requested, we require that all seedlings are stored in refrigerated vans with temperatures set to no more than 50º. Maximum storage times must follow these guidelines:

<table>
<thead>
<tr>
<th>Chilling Hours</th>
<th>Planting Guidelines</th>
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<tr>
<td>0-200</td>
<td>24 hour refrigeration, plant immediately.</td>
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<tr>
<td>200-350</td>
<td>2 weeks of refrigeration, plant immediately.</td>
</tr>
<tr>
<td>351-400</td>
<td>3 weeks</td>
</tr>
</tbody>
</table>

Chilling hours are recorded and can be obtained through the nursery that produced the trees. Planting of non-dormant seedling will NOT occur during SEVERE conditions.
CLASSIFICATIONS OF WEATHER CONDITIONS FOR TREE PLANTING

**Satisfactory Day:**
- Temperature: 33°--75°F
- Relative Humidity: 50%+
- Wind: Less than 10 mi/hr
- Soil Moisture: Moist

**Marginal Day:**
- Temperature: 76°--85°F
- Relative Humidity: 30% - 50%
- Wind: 10 mi/hr+
- Soil Moisture: top 1" dry

**Severe Day:**
- Temperature: 32°--or less, ground frozen* * or 85°F+
- Relative Humidity: 30% or less
- Wind: 15 mi/hr+
- Soil Moisture: top 3" dry

**NOTE:** If weather forecast indicates cold temperatures that will freeze ground for several days immediately after planting; **DO NOT PLANT.**
**Containerized Seedlings:**

There is currently no reliable research regarding minimum or maximum weather conditions in which to plant containerized stock. Be aware that atmospheric conditions have little detrimental effects on containerized stock as long as the soil is moist at time of planting, drought conditions do not prevail after the planting operation, and the seedlings are not exposed to temperature extremes during handling and storage. Planting of quality containerized seedlings improves survival and initial growth therefore refer to page 14 for culling standards.
DETERMINATION OF SEEDLING CONDITION

Seedlings should be inspected at the time of pickup and immediately before planting to determine their condition.

Things indicating seedling deterioration:
1. Sour smell - fermentation
2. Yellow needles
3. Trees warm to touch
4. Mold developing

Things indicating dead seedlings:
1. Bark slips off easily, especially on roots
2. Cambium layer has turned brown
3. Trees too hot to touch
4. Mold present on most of seedling
5. Seedling roots are powder dry.

(Do not plant if these conditions exist).

(If any of these conditions exist contact local Division of Forest Resources, District Seedling Coordinator prior to planting. The coordinator will contact the nursery that is the source of the seedlings).
SATISFACTORY CONDITIONS
TREE PLANTING STANDARDS FOR DELIVERY/TRANSPORTATION

Satisfactory Day:

1. Vehicles used for transporting seedlings will have a cover to shade and protect seedlings. A "Heat-Shield" is preferred.

2. Bags/bundles will not be stacked over 3 deep unless spacers are used to provide air circulation between layers. Boxes will not be stacked to the point of causing the box to crush, thus damaging the containerized seedlings.

3. At least 12" of air space between top of bags/bundles/boxes, and cover will be left to avoid heat build-up.

4. Vehicle will not be parked in direct sunlight. In case of emergency stops or breakdowns when stops exceed 45 minutes, seedlings should not be planted until their condition has been determined.
5. Inspect and repair torn bags with duct tape immediately.

TREE PLANTING STANDARDS FOR OFF-SITE STORAGE

Satisfactory Day:
1. Store seedlings in building, shed, basement, etc. that will protect from freezing, heating, and direct sunlight.

A. Ideal temperature 35° to 38°F. (These temperatures usually can be maintained only with refrigerated units.)
   (1) Bags stored under ideal conditions can be kept at least 3 months (sometimes longer), with the exception of bareroot Longleaf Pine.
   (2) Bales with seedlings dipped in clay slurry will keep from 8 to 10 weeks.
(3) Bags of bareroot Longleaf Pine need to be planted within one to two days of pickup from the nursery. Bags can be stored under ideal conditions for a **maximum of 10 days.** However, bareroot longleaf should be stored as little as possible.

(4) Many hardwood species are lifted with live leaves still attached to the seedlings. These are bagged with the leaves exposed and will dry out quickly even under ideal storage conditions. Hardwood seedlings must be inspected frequently and be watered as necessary.

B. **Temperatures inside storage area from 38° to 50°F.** (example: unheated basement)

(1) Bags stored under these conditions can be kept up to **3 or 4 weeks.**

(2) Bales with seedlings dipped in clay slurry will keep **2 to 3 weeks.**
C. Temperatures inside storage area above 50º not exceeding 75ºF.

(1) Seedlings should be removed within 3 to 5 days.

(2) Bareroot Longleaf pine should not be stored under these conditions.

2. Bags/bundles should be stacked on pallets or slats and should not be stacked over 2 deep without spacers to allow air circulation between layers.
TREE PLANTING STANDARDS FOR ON-SITE STORAGE

Satisfactory Day:
1. Store the seedlings in shaded location at all times.
2. If no shade is available at planting site, improvise a portable shelter such as a lean-to made of black plastic, canvas, or plywood with 1 foot air space between bags/bundles/boxes and shelter. A "Heat Shield" is preferred.
3. Bags/bundles should not be stacked in layers more than 2 deep without spacers (heat builds up even at low temperatures when seedlings are stored in direct sunlight or without air circulation - especially in sealed bags). Once again boxes should not be stacked to the point of crushing. If interior bag temperature exceeds 118 ºF do not plant these trees.
4. Keep close check on seedlings stored at the planting site. If roots begin to dry, dip roots in gel or other coating if available. It is preferred that a gel or a kaolin clay slurry be used to moisten roots. Otherwise dip in muddy water. Make sure roots are visibly moist at all times. "Sloppy wet" seedlings mold very quickly at warm temperatures. When using water, shake excess off.

5. Inspect and repair torn bags with duct tape immediately.

6. Keep opened bags closed tightly by folding flap over bag and laying flap-side down or by placing a band or cord firmly around bag. Keep in shade.

7. Keep opened bundles covered at all times with wet burlap. Keep in shade. If kept over 2 days, heel-in seedlings.

8. If opened bags of seedlings must be kept for over 2 days, roots must be dipped and bag tightly closed, or heel-in seedlings.
9. Store trays and boxes of **containerized** seedlings in shade and keep root plugs moist until seedlings are planted. During storage check moisture of root plugs.

**TREE PLANTING STANDARDS FOR CULLING**

**Satisfactory Day:**

1. Open only 1 bag/bundle/box at a time. Be careful not to leave container open more than a few minutes.

2. When handling, **carefully separate seedlings** to minimize damage to root system. Do not strike seedling root system on any object to remove any applied root coating. This can cause a loss of mychorrizae and damage the root system.

3. Remove **only a small number** (handful) of seedlings at a time. Do not allow the roots to be exposed to the sun or wind any longer than 5 minutes. Bareroot longleaf seedlings should not be exposed to sun, freezing
temperatures, and wind for longer than 30 seconds.

4. Cull 1-0 **Loblolly** or 2-0 **White Pine** seedlings that have:
   - Broken, skinned or weak stem.
   - Fermented smell.
   - Mold on needles.
   - Slippery bark.
   - Root collar smaller than 3/16 inch.
   - Root collar larger than 3/8 inch. Large seedlings must be balanced; have a balanced root-to-top ratio. This ratio should not exceed 1:2.5 (root:shoot)
   - Root systems less than 4½ to 5 inches long (4 ½” roots are allowable as long as the seedling is balanced)
   - Root systems longer than 12 inches if more than 25% of the laterals must be pruned in order to plant.
   - Broken or skinned tap root.
5. Cull **barefoot longleaf** seedlings that have:
   - Root collar diameter less than 3/8 or 4/10 of an inch.
   - Tap root shorter than 6 inches.
   - Less than 5 first order lateral roots (1mm or more in diameter).

6. Cull **containerized longleaf pine** that have:
   - Lost potting medium and thus have complete or partial exposure of the root system (plugs where the roots have grown down the side of the potting medium are OK).
   - Partial or complete loss of adequate root system.
   - Cuts or damage to the root system.
   - Dry plugs.
   - Loose potting medium that easily washes off during watering or during handling.
   - Presence of excessive contaminated substances such as weed and grass seeds and/or sprouting in the potting
Complete dead, brown or yellow needles (some at the bottom of the seedling are OK).
- Needle length less than 4" long.
- Plugs less than 5.5 cubic inches in volume (example: 1" x 1" x 5.5") and at least 4.5" deep.
- Root collar diameter less than 0.20".

7. Roots must be kept **visibly moist** at all times. If not visibly moist, dip roots in gel or other coating if available. Otherwise dip in muddy water. Close bags properly. Cull seedling if roots are dry.

8. Assign one properly trained person to be responsible for culling seedlings. Closely supervise.
TREE PLANTING STANDARDS FOR ROOT PRUNING

*DO NOT PRUNE UNLESS NECESSARY.*

Satisfactory Day:
1. Assign only properly trained persons to be responsible for root pruning. 
   Closely supervise.
2. When handling, carefully separate seedlings to minimize damage to root system.
3. Remove only a small number (handful) of seedlings at a time. Do not allow the roots to be exposed to the sun or wind any longer than 5 minutes. Root prune seedlings while culling, if feasible.
4. Roots must be kept visibly moist at all times. If not visibly moist, dip roots in gel or other coating if available. Otherwise dip in water. Close bags properly. Discard dry seedlings.
5. Do not root prune unless necessary to plant
seedlings at proper depth and to avoid J-rooting. Care must be used to plant long roots that are not pruned.

6. If excessively long laterals are pruned, they should not be pruned shorter than 5-7 inches. (See 9 and 10 below)

7. Prune roots to uniform lengths. This can be done by aligning root collars in bunches before pruning roots.

8. Use a sharp axe or hatchet for root pruning. Never break or twist roots off by hand.

9. Do not prune tap or lateral roots of loblolly and white pine seedlings shorter than 4½ inches in length.

10. Do not root prune the tap root of longleaf seedlings. Use a planting tool large enough to make a hole which will accommodate the larger root system of this species. Excessively long lateral roots can be pruned to no less than 6 inches. If any pruning is done, only use a sharp hatchet. Do not top clip needles shorter than 7 inches.
TREE PLANTING STANDARDS FOR THE TREE PLANTING OPERATION

Satisfactory Day:
1. **Train all new personnel** prior to allowing them to plant. Give refresher training to experienced planters at start of seasons (and later if poor techniques are observed). Do not assume labor is trained or skilled.
2. Organize hand crews to have a crew leader for every 5-6 planters. The crew leader should supervise the planting operation and correct any improper tree planting.
3. Check seedlings to be sure that they are of the correct species, geographic seed source, and of appropriate genetic quality.
4. While **hand planting**, carry seedlings in a canvas bag, bucket, etc. to protect the roots. Be sure roots are visibly moist before placing in container. If not, dip seedling roots in gel or other coating if available. Otherwise dip in water. **Do not carry**
seedlings in hand.

5. If **machine planting**, be sure roots are visibly moist before placing in seedling box on planter. If not, dip roots of seedlings as described above. Cover roots in seedling box with wet burlap or moist sawdust to protect from exposure.

6. When handling, **carefully separate seedlings** to reduce damage or breaking lateral roots. (Damage to laterals will reduce survival.)

7. When **hand planting**, make a fairly straight hole 8 to 10 inches deep. **Do not use dibbles or other tools that will not make a hole or slit at least 8 inches deep.**

8. When **hand planting bareroot longleaf**, use a planting shovel, pointed KBC planting bar, and/or other suitable planting tool that will permit the complete planting of the large longleaf seedling root system.

9. Remove only 1 seedling at a time from container.

10. Insert root system to bottom of hole and lift seedling to proper planting depth. Be sure
not to bend or twist roots. **Tap root should be straight.** L-roots that occur within 6 inches of the soil surface and L-roots that result in broken or ruptured root tissue are unacceptable. If planting at least 8” deep creates a minor J-root condition (upturned root no longer than ¼ - ½” at the bottom of the 8” hole), then this condition is acceptable (see picture on last page).

11. **Adjust planting depth** according to site drainage or soil type:
   - On **well-drained sites** (sandy loams and sandy soils) plant root collars 2 to 3 inches below ground line, except for longleaf.
   - On **poorly-drained sites** (silt and clay soils) plant root collars one inch below ground line (except for longleaf).
   - Plant containerized longleaf seedlings so that the root collar is at ground level or no more than ¼” above ground level. Do not cover the bud.
   - Plant bareroot **longleaf** root collars
below ground level, and the bud at ground level, when hand planting. When machine planting, see "Special Techniques for Planting Longleaf Pine", page 47.

**Warning** - Seedlings should not be planted in excessively wet, sticky soils or in standing water. Allow the site to dry before planting.

12. Plant seedling **vertical**. Do not exceed 30 degrees from vertical.
13. Close hole **tightly**. Make sure hole is closed at **bottom and top**.
14. Periodically **check and adjust planting machine** to insure proper seedling depth and proper packing by the machine. Minimum depth of planting slit is 9 inches (See page 43)
15. Space seedlings at approximate spacing prescribed for tract. Avoid planting seedlings in areas of loose soil that cannot be compressed around roots.
16. Do not plant within 3 feet of hardwood
stumps and sprouts.

17. Plant seedlings just as **near** the edge of windrows as possible.

18. Closely supervise and maintain quality control of planting at all times.

**Localized Site Exceptions**

If a localized site exception to the severe soil or weather conditions does exist, planting may continue. Follow the standards for marginal conditions.

*Note: If weather forecast indicates cold temperatures that will freeze ground for several days immediately after planting; do not plant seedlings.* This will avoid problems with frost heaving and potential seedling damage.
MARGINAL CONDITIONS
TREE PLANTING STANDARDS FOR DELIVERY/ TRANSPORTATION

Marginal Day:
In addition to the Satisfactory Day Standards:

1. Field delivery in non-refrigerated vehicles should be held to a minimum. Seedling delivery from a non-refrigerated storage point to destination should not exceed 1 hour.

2. Bags/bundles will not be stacked over 2 deep unless spacers are used.

3. Vehicle will not be parked in direct sunlight. In case of emergency stops or breakdowns, seedlings should not be planted until their condition has been determined.
TREE PLANTING STANDARDS FOR OFF-SITE STORAGE

Marginal Days:
1. If temperature inside storage area is above 75° F, do not store seedlings more than 24 hours.
2. Do not stack over 2 deep without spacers.

TREE PLANTING STANDARDS FOR ON-SITE STORAGE

Marginal Day:
1. Bags/bundles/boxes should have minimum exposure to direct sunlight.
2. Otherwise, very closely follow same standards for satisfactory conditions.
TREE PLANTING STANDARDS FOR CULLING

Marginal Day:
1. Make a special effort to keep roots of seedlings exposed to sun and wind for no longer than 3 minutes.
2. Otherwise, very closely follow same standards for satisfactory conditions.
TREE PLANTING STANDARDS FOR ROOT PRUNING

*DO NOT PRUNE UNLESS NECESSARY.*

Marginal Day:
1. Make a special effort to keep roots of seedlings exposed to sun and wind for no longer than 3 minutes.
2. Roots must be kept visibly moist at all times. Prior to placing back in bag or planting containers, dip roots in one of the following:
   - Gel (1 ounce of Terra Zorb gel/gal water). Also see instructions of other gel products.
   - Plain water (shake excess from roots)
3. Otherwise, very closely follow same standards for satisfactory conditions.

TREE PLANTING STANDARDS FOR THE TREE PLANTING OPERATION

Marginal Day:
1. Seedling roots must be coated with gel, clay, or water. Also, tops of seedlings should be wet (reduces transpiration).
2. Otherwise, very closely follow same instructions for satisfactory conditions.
SEVERE CONDITIONS
Severe Day:

1. Field delivery in non-refrigerant units should not be made when the temperature is 85°F or higher.
2. Field delivery in non-insulated units when the temperature is 32°F or less will be made only if the vehicle is covered adequately to prevent freezing. **Caution** - seedlings can heat excessively on a cold day if vehicle is parked in the sun and seedlings are tightly packed, preventing air circulation.
3. Unload seedlings immediately upon arriving at destination.
TREES PLANTING STANDARDS FOR
OFF-SITE STORAGE
Severe Day:
1. Seedlings should not be stored in bags/bundles/boxes for more than a few
   hours at temperatures above 85°F, or seedling damage will occur and survival
   will be adversely affected.
   A. Lethal temperatures occur in bags/bundles at 118°F.
2. Do not store seedlings in an area where the temperature is 32°F or less.
   A. Do not allow seedlings to freeze.
   B. If trees have been frozen less than 36 hours:
      (1) Thaw seedlings slowly.
      (2) Determine condition.
   C. If frozen more than 36 hours, then seedlings most likely have been severely
damaged and should not be planted.
Containerized seedlings will suffer severe mortality if the root ball temperature drops to 22 °F.

TREE PLANTING STANDARDS FOR ON-SITE STORAGE

Severe Day:
1. Seedlings will not be stored at planting site under these conditions unless in buildings, sheds, etc. that will protect from freezing and/or heating.
2. Refer to storage standards as given under marginal conditions.

TREE PLANTING STANDARDS FOR CULLING

Severe Day:
1. Culling will not take place at planting site unless in a building, shed, or other protected area; then follow the same standards for marginal conditions.
TREE PLANTING STANDARDS FOR ROOT PRUNING

*DO NOT PRUNE UNLESS NECESSARY.*

Severe Day:
1. Pruning will not take place at planting site unless in a building, shed, or other protected area.
2. When pruning in such an area, follow very closely the same standards for marginal conditions.

TREE PLANTING STANDARDS FOR THE TREE PLANTING OPERATION

Severe Day:
All planting should STOP, unless localized site exceptions exist. Be sure you document the on
site weather conditions when planting on a Severe Day.

TOOLS & TECHNIQUES
HANDLING TREATED SEEDLINGS

Seedlings are treated upon request at most nurseries for protection from Pales Weevil and/or browsing by deer.

Safety Precautions
1. Rubber gloves are to be worn when planting or handling treated seedlings.
2. When handling treated seedlings do not rub eyes.
3. Wash water and soap should be at the planting site or any other area when the treated seedlings are handled.
4. Hands should be washed prior to eating, drinking, smoking or chewing.

The pesticides used to treat seedlings are not highly toxic to humans, however, the above precautions need to be followed at all times.
Planting bars are suited to many types of soil, terrain and cover, and for planting in slash or brush because they can be used in confined spaces. They are used for planting most bare-root seedlings except those with very large, spreading root systems. KBC (pointed) bars are preferred for penetrating hard or rocky soils. OST (flat) bars work best in loamy soils.

Planting bars should be replaced when the bar is worn shorter than 8 inches.
STEPS IN BAR PLANTING:

1. Insert bar as shown and push handle away from planter.
2. Remove the bar and place seedling at correct depth.
3. Insert bar 3-4 inches toward planter from seedling and pull handle towards planter to close bottom of the hole.
4. Then push handle forward to close the top of the hole.
5. Remove bar and close the opening with your heel carefully to avoid injury to the seedling.
N. C. Division of Forest Resources
HOEDAD TREE PLANTING
TECHNIQUES

The Hoedad is a scalping and planting tool developed for use in the Pacific Northwest. It has become increasingly popular with tree planters in the southeast. Hoedads are particularly suitable for planting hillsides.

**The blade must enter the ground vertically to insure proper placement of the seedling.** Two brackets are available. The Earp bracket sets the blade at a 100-degree angle and is recommended for flat or gently rolling terrain. The standard bracket sets the blade at a 90-degree angle and is more suitable for mountainous terrain. Hoedads are restricted by heavy brush or slash where they cannot be swung freely for clean, deep penetration. Extra efforts are required to plant seedlings correctly under these conditions and in rocky and heavy clay soils. When hoedads are used to plant longleaf pine seedlings, extra care must be taken to insure seedling is correctly planted.
STEPS IN HOEDAD PLANTING

1. Swing hoedad from overhead downward, sinking the blade its full length vertically into the soil. Minimum depth of slot is eight inches.
2. Pull the blade upward slightly by lifting the end of handle.
3. Push the handle downward while pulling back to open hole.
4. With blade in cavity to hold back loose soil, carefully place seedling in hole making sure roots are fully extended, then remove the blade.
5. Close the hole by inserting hoedad behind the seedling to tighten soil by lifting up and pushing down on the handle. Also push soil toward seedling.
6. Be sure planting slot is closed completely.
HEELING-IN

Heeling-in provides satisfactory on-site short term storage of seedlings. If opened bags of seedlings must be kept for more than 2 days or if a bag is damaged beyond repair, the seedlings can be heeled-in.

1. Dig a V-shaped trench in a moist shady place.
2. Spread out the seedlings evenly in the trench.
3. Back fill the trench to completely cover the entire root system of the seedlings.
4. If possible, water the soil then firm the soil with feet.
MACHINE PLANTING
MECHANICAL PLANTING

Tractor-drawn planting machines offer production advantages on relatively flat, well-prepared sites and fields. Improved survival rates have been attributed to the reduction in root competition and to consistent soil packing. If the machine is out of adjustment or the planter is not competent, root deformation can be serious. Frequently check planting performance to insure proper planting, particularly when soil conditions and moisture change on the site. The planting and performance should be checked under actual site conditions and the proper adjustments maintained. Good success can be obtained with machine planting of bareroot stock longleaf seedlings however great care must be employed to prevent the common mistake of deep planting these seedlings. Some hardwood seedlings can be successfully machine planted but many cannot.
PLANTING SEQUENCE

1. Hold seedling horizontal at top of trencher.
2. Start downward arc motion.
3. Place seedling roots at maximum depth.
4. Start an upward motion to pull any J or L-root out of the seedling.
5. Hold seedling in vertical position where root collar is 1"-2" below ground line until soil closes around roots.
TROUBLE SHOOTER'S GUIDE FOR MACHINE PLANTING

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<thead>
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<th>Symptom</th>
<th>Possible Causes</th>
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<tr>
<td>L or J Root</td>
<td>- Insufficient weight or hydraulic pressure on frame or planting box</td>
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<tr>
<td></td>
<td>- Need hydraulic fluid</td>
</tr>
<tr>
<td></td>
<td>- Worn coulter (riding on hub)</td>
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<tr>
<td></td>
<td>- Gap between coulter and foot or shoe too great (buildup of debris)</td>
</tr>
<tr>
<td></td>
<td>- Worn planting foot or shoe</td>
</tr>
<tr>
<td></td>
<td>- Soil too dry</td>
</tr>
<tr>
<td></td>
<td>- Planting seedling too deep in trench</td>
</tr>
<tr>
<td>Seedlings damaged by packing wheels</td>
<td>- Packing wheel misaligned</td>
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<td></td>
<td>- Packing wheels too close</td>
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<tr>
<td>Seedlings thrown out of ground or planted at angle</td>
<td>- Angle of packing wheels too flat</td>
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<tr>
<td></td>
<td>- Releasing seedling too late</td>
</tr>
<tr>
<td></td>
<td>- Mud buildup on packing wheels</td>
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## TROUBLE SHOOTER'S GUIDE continued

<table>
<thead>
<tr>
<th>Issue</th>
<th>Possible Causes</th>
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| Seedlings not well packed | - Not enough weight or pressure on packing wheel or coulter  
- Hitch not adjusted correctly  
- Packing wheels too far apart  
- Ground too hard |  
| Debris in holes | - Need scalper or V Blade |  
| Seedlings too shallow | - Site prepared soil not settled  
- Releasing seedling too soon  
- Top link on planter not adjusted properly allowing planter foot to draft.  
- Coulter worn or not adjusted properly; coulter edge below foot point preventing foot from drafting.  
- Ground hard, add weight over coulter. |  

1 Forest Farmer Manual, March 1975, p.55
LONGLEAF PINE
SPECIAL TECHNIQUES FOR PLANTING LONGLEAF PINE

Whether done by hand or machine, placement of bare-root longleaf seedlings to the proper depth is perhaps the single most critical factor, outside of the weather, in artificial regeneration. Proper planting depth is where the base of the bud is at ground level and the root collar is completely below ground. Adjustments to this are needed when machine planting due to loose soils created by the packing wheels (see diagram below).

When machine planting in loose (sandy) soils,
bud should normally be covered with no more than 1/4 inch of soil. However, this may vary depending upon how much estimated soil erosion will occur after rains have taken place following tree planting. When planting in heavy (loams or clays) soils, tip of bud should be exposed. This may have to be varied depending upon the consistency of soil conditions and root mat. A knowledgeable person should periodically walk behind the planter to suggest necessary changes for each specific site.

Needle pruning is done to bring needle mass back to a closer balance with the root mass. This also reduces initial transpiration and wind damage which on drought problem sites is an additional advantage of needle pruning. No more than one-half the needle length should be clipped away. Needles should not be pruned to less than 7 inches.

Longleaf seedlings are very sensitive to damage from heat and drying out. Every opportunity to protect seedlings from freezing, drying, or
heating should be utilized. This cannot be over emphasized. Proper planting depth of seedlings is an absolute must.

Forestry Note #61. Establishment and Growth of Longleaf Pine on Drought Sites in North Carolina
HARDWOOD PLANTING
Planting & Handling Hardwood Seedlings

When planting hardwoods, special attention should be given to match suitable species to the site, plant good quality seedlings, and conduct proper tree planting. Do not plant small, inferior hardwood seedlings that are below minimum planting standards.

Quality Hardwood Planting Stock
Hardwood seedlings should be graded to select for seedlings with acceptable root collar diameters (RCD) and adequate root system with primary first order lateral roots (FOLR). For timber purposes, most hardwood seedlings should have at least a 3/8” RCD. Planting for other uses such as wildlife, wetland mitigation, riparian buffers can use smaller seedlings with at least a minimum of ¼” RCD, but the 3/8” RCD is still preferred. See table below.
<table>
<thead>
<tr>
<th>Species</th>
<th>Timber Purposes</th>
<th>Wildlife, Riparian or Wetland Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RCD</td>
<td>FOLR</td>
</tr>
<tr>
<td>N Red Oak</td>
<td>3/8”-1/2”</td>
<td>4-6</td>
</tr>
<tr>
<td>White Oak</td>
<td>1/4” –3/8”</td>
<td>2-4</td>
</tr>
<tr>
<td>Swamp Chestnut &amp; Cherrybark Oak</td>
<td>3/8” – ½”</td>
<td>2-4</td>
</tr>
<tr>
<td>Willow/Water Oak</td>
<td>½” – 3/8”</td>
<td>2-4</td>
</tr>
<tr>
<td>Green Ash</td>
<td>3/8” – ½”</td>
<td>2-4</td>
</tr>
<tr>
<td>Sycamore,Sweet gum</td>
<td>3/8” – ½”</td>
<td>4-6</td>
</tr>
<tr>
<td>Yellow poplar &amp; Black Walnut</td>
<td>3/8” – ½”</td>
<td>4-6</td>
</tr>
<tr>
<td>Water tupelo, Baldcypress</td>
<td>¼” – 3/8”</td>
<td>2-4</td>
</tr>
<tr>
<td>Overcup Oak</td>
<td>¼” – 3/8”</td>
<td>2-4</td>
</tr>
</tbody>
</table>
Root Pruning Standards

1. For hardwoods with spreading root systems, limit root pruning to only that required to avoid curled, bunched, or twisted roots in the planting hole.

2. For hardwoods with a prominent taproot, the taproot should be pruned no shorter than 6 inches in length and the lateral roots should be pruned no shorter than 5 inches in length.

Following seedling grading or root pruning, the tree planter is encouraged to keep the hardwood root system moist by using a planting gel or mycorrhizal root dip. These products may help to reduce the effects from transplant shock to the seedling.
Hand Planting Hardwood Seedlings
The tree planter should select the most appropriate planting tool for the species to be planted. If multiple species of hardwoods are to be planted, select the planting tool that will accommodate the seedling with the largest root system.
Acceptable tools for hand planting hardwoods include a KBC bar, a modified KBC bar, a long-handled round point shovel, and a power driven auger. The dibble bar has limited use for many of the larger sized hardwood.

Machine Planting
Machine planting of selected hardwoods is acceptable on appropriate soil types. These sites must allow the planter to operate at a coulter depth of at least 9”. Adjust the packing wheels to completely close the planting trench from top to bottom. Adjustments may be needed as soil type and moisture changes.
Hardwood species with large, spreading root systems (Northern red oak, cherrybark oak, black cherry, yellow poplar, black walnut) are not recommended for machine planting unless you have the specialized planter to accommodate the tall seedlings with larger root systems.
PLANTING HARDWOOD SEEDLINGS
Use a round-point shovel or power-driven auger (10-14 inch) to plant hardwood seedlings that have a large, spreading root system.

A. Dig a hole deep and wide enough to accommodate the root system.
B. Place the seedling in the center of the hole and spread the roots in a natural manner. Roots should not be bunched or twisted. Seedlings should be planted about an inch deeper than they grew in the nursery.
C. Back fill the hole and firmly pack soil around the roots to eliminate air pockets.
Some hardwood seedlings can be satisfactorily planted with a planting bar. These species typically have a prominent tap root and a more compact root system. A KBC type planting bar should be used.
Checking Hardwood Tree Planting

Hardwood seedlings should be planted with the RCD at ground line or 1” below the soil surface. The main stem and root system will be planted vertically upright, with no lateral roots exposed above the soil. Make sure that the planting hole is fully closed with the planting tool and the soil is firmly packed around the roots to eliminate any air pockets.
TREE PLANTING CONTRACTS
SUGGESTED PROVISIONS FOR TREE PLANTING CONTRACTS

Many forest landowners contract with vendors for tree planting services. It is in the best interest of both the landowner and the vendor to have a written contract which covers the details of the planting operation. In addition, the landowner should monitor the planting operation to insure compliance with the agreement. The following provisions should be considered in a "Tree Planting Contract". Although landowners can prepare their own contract, it is beneficial to employ a knowledgeable experienced consulting forester to assist with this.

1. Date of Agreement
2. Names and Addresses of Landowner and Vendor
3. Tract Location and Acres
   A description of the area(s) to be planted; including exact location(s), exact acreage(s), and if available, a map should be provided. The map may be attached to the contract and
become a part of the contract. Also, the boundary of the area to be planted must be clearly marked on the ground.

4. **Right of Ingress and Egress**
The planting crew must have the right of ingress and egress (entry and exit to the area).

5. **Source of Seedlings**
State if landowner or vendor will furnish the seedlings and who has the responsibility for proper transporting, storing, and handling of seedlings from the time they are picked up at the nursery until planted. State source of seedlings such as state, industry, etc., and geographic origin such as coastal or piedmont, and genetic quality, if improved stock.

6. **Planting Method**
The specific method of planting such as machine or hand planting using dibble bar, spade, or hoedad should be stated. To be eligible for cost share payments, the entire planting operation should meet NCFS Standards as stated in the most current
edition of “NCFS Pocket Guide to Seedling Care and Planting Standards”. These printed standards are available from the N.C. Forest Service.

7. **Species and Spacing**
   Spacing may be in feet (7 X 10 ft, 8 X 12 ft., etc) and number of seedlings per acre. Also, specify the species to be planted, the seed source, and indicate if the trees are to be genetically superior and of what genetic quality.

8. **Insect and Disease Control Measures**
   State insecticides, fungicide, or other insect/disease treatments or browse treatments by name, rate and extra cost, if applicable.

9. **Price Per Acre**
   Also include method, time, and terms of payment. On large acreage, partial payments may be appropriate.

10. **Survival Guarantee**
    Seedlings will be transported, stored, handled, and planted according to NCFS
Guidelines if cost-share funds are involved. Vendor may be responsible to replant, at no cost, areas of inadequate stocking levels which are a result of improper planting. The vendor cannot be held responsible for unsatisfactory levels of stocking resulting from adverse weather conditions after planting or other conditions beyond his control. In cases of disagreements over what constitutes adequate stocking, the vendor and landowner may mutually agree upon a third party to settle the dispute.

11. **Planting Period**
State time-frame by dates when planting must occur. Conditions which may allow for an extension may be included. The vendor should be required to notify the owner and NCFS prior to moving onto the tract to begin planting.
12. **Assignment of the Contract**
   A provision for or against the assignment of the contract to another party should be included.

13. **Fire Protection**
   The vendor should be required to comply with all fire laws and immediately suppress at his expense any fire originating from an accident or negligence on his part.

14. **Provision of Settlement of Disputes**

15. **Provision for Cancellation of the Contract**

16. **Financial Responsibility**
   It is usually in the landowner’s interest to maintain an “employer-contractor” relationship rather than an “employer-employee” relationship. The employer-employee relationship includes substantially more tax payments and reporting requirements than the contractor relationship. When employing a contractor, however, it is important that the landowner know or confirm that the contractor has:
➢ A valid business license, or has registered with the NC Secretary of State to conduct business in NC;
➢ Proof of general liability and worker’s compensation insurance;
➢ Proof that all migrant and/or seasonal workers have the required legal documents to work in the United States.

17. **Signature of all Parties and Notarization**
MISCELLANEOUS
SPACING OF SEEDLINGS

Spacing recommendations are determined by site quality, markets, accessibility, insect and disease problems, degree of site preparation and landowner objectives. The guidelines for the major pine species and hardwoods in general are:

<table>
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<tr>
<th>Species</th>
<th>Min./ Ac.</th>
<th>Max./ Ac.</th>
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<tbody>
<tr>
<td>Loblolly Pine</td>
<td>300</td>
<td>625</td>
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<td>White Pine</td>
<td>300</td>
<td>625</td>
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<tr>
<td>Longleaf Pine</td>
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<td>725</td>
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<tr>
<td>Shortleaf Pine</td>
<td>350</td>
<td>725</td>
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<tr>
<td>Hardwoods</td>
<td>200</td>
<td>365</td>
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For Christmas tree or hardwood plantation spacing see "Tree Planting Guide for use in North Carolina", available at N. C. Division of Forest Resources Offices.
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<th>#Trees</th>
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<td>1210</td>
<td>7 X 10</td>
<td>622</td>
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<tr>
<td>4 X 10</td>
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<td>519</td>
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<tr>
<td>5 X 8</td>
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<td>681</td>
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<td>871</td>
<td>8 X 10</td>
<td>544</td>
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<tr>
<td>7 X 9</td>
<td>691</td>
<td>12 X 12</td>
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NORTH CAROLINA DIVISION OF FOREST RESOURCES
Dept. of Environment, and Natural Resources
Division of Forest Resources
1616 Mail Service Center
Raleigh, N. C.  27699-1616
(919) 733-2162

REGIONAL OFFICES
Region I Region III
2958 Rouse Rd. 14 Gaston Mtn. Rd
Kinston, N.C. Asheville, N. C.
28504-7320 28806-9101
(252) 520-2402 (828) 251-6509

Region II
3490 Big Woods Road
Chapel Hill, N. C.
27517
(919) 542-1515
### DISTRICT OFFICES

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<th>Location</th>
<th>Address</th>
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<td>220 Sardis Road</td>
<td>828/667-5211</td>
<td>28806 -8504</td>
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<td>ELIZ. CITY</td>
<td>861 Berea Church Road</td>
<td>252/331-4781</td>
<td>27909 -7303</td>
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<td>FAIRFIELD</td>
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<td>910/437-2620</td>
<td>28306 -9202</td>
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<td>HILLSBOROUGH</td>
<td>3314 NC 86 South</td>
<td>919/732-8105</td>
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<td>LENOIR</td>
<td>1543 Wilkesboro Blvd. NE</td>
<td>828/757-5611</td>
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<td>LEXINGTON</td>
<td>304 Old Hargrave Road</td>
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<td>ROCKINGHAM</td>
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<td>SYLVA</td>
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<td>WHITEVILLE</td>
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NURSERIES
Claridge Nursery
762 Claridge Nursery Road
Goldsboro, N. C.
27530 -7965
(919) 731-7988

Linville River State Forest Nursery
6321 Linville Falls Hwy
Newland, N.C. 28657
(828) 733-5236

NC Division of Forest Resources Seedlings can be purchased through the nurseries above, or by calling
1-800-NCTREES
or by visiting our Forestry Store online at www.dfr.state.nc.us