

**Natural Resources Conservation Service  
Texas Forestry Technical Note, TX-FS-12-4**

**Tree planting** is a widely used method to regenerate cutover sites and return cropland or pastures back to forested land. Planting trees allows one to adjust tree species and density on their acres while influencing wildlife habitat as well. Tree planting can also be used to create windbreaks and shelter belts providing a buffer from wind, snow, dust and noise.



## Seedling Planting Guidelines

### CAUTION – READ

1. Safety – the planting operation should be performed safely as the environment will have several hazards that can make walking difficult such as briars, down woody material, etc.
2. Seedling care – Seedlings should not be exposed to extreme temperatures, wind or contaminants (fuel or herbicides).
3. Seedling roots must not be exposed to excessive drying conditions – do not hold a handful of seedlings while you are planting or leave the bag or box of seedlings open.
4. Planting quality – Seedlings should be planted to the proper depth and firmly packed to ensure the highest likelihood of survival. One can tell if the seedlings are packed tight by grasping a few needles and pull upward – If the seedling moves it is not firmly packed, if the needles pull off then it is firmly packed.

**Seedling handling:** Handling involves seedling storage, transit and field handling.

#### *Seedling Storage:*

1. Avoid damaging seedling bags or boxes to minimize damage to seedlings, tape up any hole to prevent moisture loss and drying of the seedlings.
2. Keep seedlings and their containers out of direct sunlight.
3. Allow space for air circulation between seedling boxes/bags.
4. Don't allow seedlings to freeze. (Don't plant seedlings frozen for more than 2 days)
5. Plant seedlings within two weeks of lifting if possible.
6. Seedlings four weeks or older should be carefully checked for mildew, mold or decay.

#### *Transit:*

1. Prevent injury when lifting seedling bags or boxes by keeping your back straight and lifting with your legs.
2. Keep seedlings shaded and covered. A tarp will work if the vehicle is not covered (ie. van or truck with camper shell).
3. Drive at speeds allowed by law and road conditions.

4. Keep seedlings away from contamination commonly fuels or herbicides.
5. Keep the area with seedlings free from sharp objects.
6. Don't allow seedlings to freeze.
7. Don't stack seedlings more than 2 boxes/bags deep without spacers to provide support.

*Handling seedlings before and during planting:*

1. Keep seedlings moist – Dry roots kill seedlings.
2. Keep seedlings shaded and covered - High temperatures kill seedlings.
3. Don't prune the roots unless the laterals are long (5" or longer) – prune the laterals with a sharp machete to 3 to 4 inches in length. A good root system is essential to seedling growth and survival.
4. Don't beat seedlings against objects to remove clay slurry
5. Close boxes or bags and place out of direct sunlight
6. Remove only minimum number of seedlings that can be planted quickly to avoid exposing roots to wind and sun very long.
7. Discard cull seedlings – seedlings with a stem diameter smaller in diameter than a kitchen match, dry seedlings, or seedlings without a good root system.
8. Don't dump out the whole box or bag of seedlings to sort them before planting.

**Hand Planting:**

Hand planting allows areas to be planted not suitable for machinery due to debris, terrain, wet conditions and availability of suitable machines.

1. If area has duff, litter, etc., rake to bare mineral soil to ensure proper seedling depth and tightness.
2. Remove no more than 3 or 4 seedlings (drop any culls) from the planting bag.
3. Make the planting hole wide and deep enough to insert the root system so the seedling is straight and the roots are straight down in the planting hole. (It is highly undesirable to have the roots curled up in the planting hole).
4. Lift the seedling up in the hole until the root collar is slightly below the soil level for loblolly, slash and shortleaf pines and for longleaf pine plant the root collar at the soil level keeping the terminal bud above ground.
5. Pack the seedling firmly using your planting tool eliminating the air pockets. See diagram at the back of this document.
6. Plant when there is good soil moisture.
7. Don't plant when the ground is frozen.

Tools for hand planting include a dibble bar, hoe dad, or sharp shooter shovel. A planter bag worn around the waist makes the planting faster and more efficient keeping the seedlings moist and readily available. Seedlings properly planted by hand should have a high percentage of surviving trees.

Hand planting with bare-root seedlings usually occurs between late December and early April. The seedlings have to "harden off" or set buds at the end of the growing season and in southern nurseries this usually does not occur until late November or early December. This hardening off is a little easier to

visualize with hardwood seedlings as the leaves fall off and one can easily see the buds. In planting loblolly, slash or shortleaf pines and the hardwood species, the seedlings should be planted at the root collar which is the location the seedling grew in the nursery (where the above ground and below ground portion of the seedling meet). Longleaf seedlings should be planted at a depth where the root collar is slightly above the soil line ensuring that the terminal bud stays above the ground.

The earlier one can plant their seedlings (Jan – Feb) the more time the seedling will have to establish their root systems. The better the roots get established, the better the seedlings can survive dry conditions that will occur during the summer months.

Containerized seedlings have a wider window for planting beginning in late October and going through April. Containerized seedlings are grown in tubes that help the seedling develop a dense root system that is fairly easy to plant. Containerized loblolly, slash and shortleaf pines can be planted with the entire root plug placed in the planting hole. The terminal bud is well away from the ground line. Containerized longleaf pines however are planted in the grass stage meaning that you have a root plug, a very short stem and a terminal bud surrounded by the needles. Plant containerized longleaf pine with a small portion of the plug above the planting hole to ensure the terminal bud is above the ground.



**The photo shows an example of hand planting hardwood seedlings. Some positive things to notice is only one seedling out of the container, a wide planting bar, seedlings with their roots protected and moist in the bucket.**

#### **Some common hand planting errors include:**

- Planting the seedling too shallow: The root collar and roots are exposed above the soil drying out the roots.
- Planting the seedling too deep: The hardwood seedlings root collar is 2” or more below the soil surface and loblolly/shortleaf/slash pines terminal bud is within 2” of the ground line while longleaf pines has the terminal bud below the soil line.

- J or U Roots: Roots form a J or U shape from the seedling being pushed into the planting hole resulting in the primary root to point to the side or back upward. This problem contributes to poor root development and seedling problems. (Avoid by making the planting hole a little wider before planting the seedling.)
- Seedling too loose: A firm pull on the seedling should not move the plant. The seedling should be packed firmly in the soil.
- Seedling not erect: The tap root should not be planted at more than 30° from perpendicular.

### **Machine Planting:**

Machine planting can be accomplished on areas that have received good site preparation, have little debris remaining on the site; areas that have been windrowed or bedded; old fields or farmland being converted back to forests.

There are many safety concerns to consider during machine planting operations as a person is being pulled behind a tractor or dozer. Some items to consider for safety are how the planter communicates with the tractor operator, first aid kit, personal safety gear, fire extinguisher, etc.

1. Only open enough seedlings to fill the planting box. Keep the seedlings upright with the roots down out of the wind. A little water can be added to the planter box to keep the roots moist.
2. Do not cut or prune the roots.
3. Do not leave unplanted seedlings exposed to sun and wind.
4. Plant seedlings along the contour.
5. Do not plant the seedlings too deep or too shallow, when holding the seedlings and placing them in the planting rip do not release them until the packing wheels start to close the rip. Otherwise the seedlings will drop too deep covering the terminal bud. On the other side, do not pull the seedlings upward as the seedling will be planted too shallow exposing some roots.
6. Periodically check the planted seedlings for firmness or packing, planting depth and number of seedlings per acre.
7. Look for skips in planting as the planter may have difficulty in getting seedlings out of the holding tray.
8. The planting operation needs to occur at speeds where the proper number of seedlings are planted which takes coordination between the operator and planter.

Machine planting is an effective method of planting seedlings if the operator and planter work as a team. The operator has to be constantly aware of the safety hazards and protect the individual riding in the planter.

- With machine planting, make sure the seedling depth is satisfactory and that the seedlings are not leaning due to being dragged by the planter. The seedlings should be upright and firmly packed in the soil.

### How many seedlings per acre:

Everyone has their reasons for a particular planting density and spacing. One might want to mow between the planted rows so the rows need to be wider than the available equipment. There are many options available (see Table 1). You can calculate the number of seedlings needed per acre by multiplying the spacing between seedlings, for example (10 X 10 = 100); dividing 43,560 sq ft per acre by the sq ft spacing provides the number of seedlings needed per acre. Our example:  $43,560/100 = 436$  seedlings per acre. Thus, you can substitute any spacing and determine the number of seedlings needed per acre.

**Table 1: Various spacings and initial planting densities for tree seedlings**

Spacing (feet)	Square Feet per	Number of Tree/Shrub Seedlings per Acre
5 x 5	25	1,742
6 x 6	36	1,210
6 x 8	48	907
8 x 8	64	680
8 x 10	80	544
10 x 10	100	436
10 x 14	140	311
12 x 12	144	302
12 x 16	192	227
14 x 14	196	222
10 x 20	200	218

Ideally, the planting operation should be checked out by personnel with the Texas Forest Service. However, in some instances the TFS may not be available so an approved Technical Service Provider may be used. Thirdly, NRCS personnel may be used to evaluate the planting operation. If this is the case, here are some tips on checking out a planting job.

### How to quickly check behind a planting operation:

What needs to be checked? Proper planting of seedlings – depth and firmness; number of seedlings properly planted per acre.

#### *How many seedlings per acre?*

A quick way to determine the number of seedlings planted on an acre is to obtain a cane pole or an extending fishing pole at least 12 feet in length. Mark on either a point at 11'8" long. This distance is equivalent to a 1/100<sup>th</sup> acre plot radius. Holding the pole over a fixed point and then move the pole around making a circle and count each seedling that is contained in the 1/100<sup>th</sup> acre plot. Each seedling represents 100 seedlings per acre. For plantings with fewer than 600 trees per acre a 1/50<sup>th</sup> acre plot may be used (16.7' plot radius). Sample multiple plots and average the seedlings per acre.

**For example:** The goal is to hand plant 545 trees per acre (8 X 10) spacing. The planting check found:

Plot 1 = 5 seedlings; Plot 2 = 6 seedlings; Plot 3 = 5 seedlings; Plot 4 = 5 seedlings, you would have 525 seedlings planted per acre. That's the average number of seedlings tallied in the sampled plots. The field measurements are compared against the targeted seedlings per acre and should be within 10% for a satisfactory planting job. The 525 is within the 10% guide for number of seedlings per acre. The question is now how many of the seedlings were satisfactorily planted. From this example, 21 seedlings were located on our 1/100<sup>th</sup> acre plots so no more than 2 seedlings can be unsatisfactory, if 3 or more are unsatisfactory then the planting will fail.

The following provides a guide in determining number of plots needed per acre by tract acreage:

1 to 60 acres – 1 plot per acre

61 – 90 acres – 1 plot per 2 acres for hand plantings to 5 acres for machine plantings

91+ acres – 1 plot per 3 acres

Tract maps can be created with plots laid out on the proper spacing to fulfill the requirements provided above using newer versions of ArcGIS or other GIS mapping software.

Once at the tract, the inspector should orient their self and use their map to navigate to plot 1.

- Mark the center of the plot with a pin flag
- Using a plot radius tape or device, count and check all seedlings in the specified plot radius.
- Seedlings should be checked for proper planting depth, proper closure of the hole, and proper packing of the seedling in soil. To check that seedlings are properly packed, grab a seedling by 3 to 5 needles and gently pull on the seedling, if the seedling moves up or down then the seedling is not properly packed.
- Results should be documented on the seedling inspection form
- When between plots (i.e. traveling from one plot to the next) carefully dig up two seedlings and check for underground planting problems but properly replant seedlings to maximize survival. (**This is not required for container plantings**)
- Results should be documented on the seedling inspection form
- Continue to next four plots and repeat.
- After plot 5 the inspector will need to calculate the excavation factor. The excavation factor is the percentage of good seedlings being dug up and can be calculated by dividing the number of good trees that have been dug up by the total number of seedlings that have been dug up. (See example below)

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*Calculating Excavation Factor:*

*After 5 plots*

*10 total trees dug up*

*1 J-root for a total of 9 good out of the 10*

*Good trees divided by total = percentage or in this case  $9 \div 10 = 0.90$  or 90%*

The excavation factor should be calculated after every 5th plot. If at any time during the inspection the percentage falls below 90% the inspector should begin digging up four trees rather than two. While digging up four seedlings, if the percentage rises back above 90% then the inspector may resume digging up only two seedlings.

Once the entire tract has been inspected the inspector should then determine the total trees per acre. The total trees per acre should be within 10% above or below the original planting prescription. Above ground problems should be documented for each plot and deducted from the plot total while below ground problems will be deducted from the total inspection number and both will be used to determine whether the tract passes or fails.

#### *Above ground*

1. Examine a planted seedling as it should be planted close to the root collar where it grew in the nursery. For longleaf pine, be sure the terminal bud is not buried and is above the soil line. For other pine species, the root collar can be planted below the soil line but do not cover the terminal bud, in fact it should be 2" or higher above the soil line.
2. For pine species, pull upward on a few needles. If the seedling is planted firmly, the needles should pull off in your hand. If the seedling starts lifting out of the ground, the seedling is not firmly planted. No seedling should be capable of moving up or down easily in a planting hole.
3. Seedlings not firmly planted will dry out in the planting hole and not survive.
4. The main root should be completely below the soil line.
5. For pine seedlings, the green side goes up.
6. For Hardwood seedlings, the root collar should not be more than 2" below the soil line.
7. Hardwood seedlings should be firmly packed in the soil and if pulled on they should not easily move in the planting hole.
8. Be observant in the field, you may find discarded seedlings, piles of roots that have been cut off of the seedlings, unplanted seedling boxes or bags exposed to full sunlight. These are practices that you do not want occurring on your planting site.
9. Spacing – improper spacing will cause either too many or too few seedling per acre.
10. Planting hole not closed up, additional holes created to close the planting hole should be stomped shut.
11. Excessive lean in seedlings.

#### *Below ground*

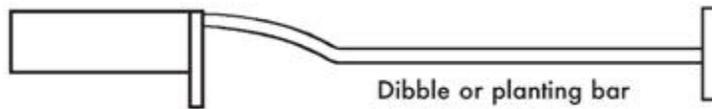
12. A few seedlings will need to be dug up to examine for J, L or U roots by using a shovel. Carefully remove the soil and notice the shape of the roots. No more than 10% of all seedlings planted should have J, L or U roots (the primary tap root).
13. Tap root not 5 inches long, the tap root should be a minimum of 5 inches or be culled.
14. Cull seedlings less than 1/8<sup>th</sup> inches in diameter.

A planting check-out form is available labeled "*planting check sheet*" that you can use to document the planting operation. Ninety percent of the planted seedlings should be satisfactory.

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The following illustration shows the proper hand planting technique:

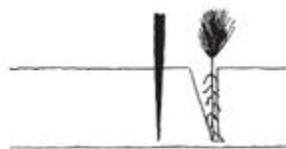
### *With Dibble or Planting Bar*



1. Insert dibble at angle shown, and push straight up.



2. Remove dibble, and place seedling at correct depth.



3. Insert dibble 2 inches toward planter from seedling.



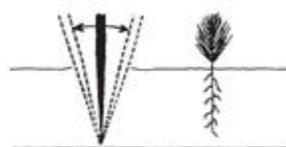
4. Pull handle toward planter, firming soil at bottom of roots.



5. Push handle forward from planter, firming soil at top of roots.



6. Insert dibble 2 inches from last hole.



7. Push forward, then pull backward to fill hole.



8. Fill in last hole by stamping with heel.



Machine planting a cut-over site.



Machine planting pine seedlings. (note: the green side is up, nearly straight with the roots below the ground line, minimal soil disturbance)



Planting hardwood seedlings.



Hardwood seedling roots, note where the root was undercut in the nursery, new root growth