Appendix

Appendix A

Important Questions a Landowner Should Ask a Tree Planting Contractor

Prior to entering a contractual agreement for tree planting, a landowner should obtain the following information from potential contractors.

1. Will vendor sign a contract with landowner? (Helpful to provide sample contract.)
2. How long has contractor been planting trees?
3. How are crews handled and supervised?
4. Are crews paid on an hourly or a production basis?
5. Does contractor have access to cold storage for seedlings?
6. Can contractor provide references or take landowner to previous planting job? (Both preferred.)
7. How will contractor care for and handle seedlings on site?
8. If contractor is providing seedlings, what is provenance of seeds or seedlings. (This information should be verified by a forester not connected to contractor.)
9. How are seedlings transported by contractor to planting site?
10. How will contractor verify trees planted per acre?
11. What method will contractor use to plant seedlings (dibble, hoedad, or machine)?
12. Will contractor guarantee planting job for survival?
13. How will contract differences be resolved?

GENERAL CONDITIONS REGARDING TREE PLANTING CONTRACTS

- Any extra work requested by the landowner will increase the cost.
- The contractor agrees to perform all work in a workmanlike manner and according to the methods described previously.
- The landowner accepts full responsibility for damage to any person or property caused as a result of inaccurate marking or designation of boundary lines around the area in which the work is to be performed, or around the property in general, and will hold the contractor harmless from any claim against the contractor for damage or liability resulting from such cause.
- The contractor may not subcontract any part of this contract without prior written approval of the landowner.

(Frank A. Roth II, Alabama Cooperative Extension Service)

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Appendix B

Tree Planting
Contract

This contract is entered into on this the _____ day of_____ ,

19____ , by and between _____ (Landowner)

and _____ (Contractor) for tree planting

on _____ acres in _____ County, _____
(State).

Each party agrees to the following terms of this contract, which is binding on both parties.

The Landowner agrees:

1. To accurately describe, show, or have the contractor show where the seedlings are to be planted and to provide rights of ingress and egress to the planting site for all personnel, materials, and equipment to perform the planting operation.

2. To provide the contractor with sound, plantable seedlings, unless other arrangements have been made to supply them.

3. Upon satisfactory completion of planting, according to the terms of this contract and upon presentation of a proper invoice by contractor, and verification of correct planting, to pay the contractor in the amount of $_____ per acres for each acre planted.

The Contractor agrees:

1. To notify the landowner or his agent when he intends to begin planting.

2. To properly care for and plant seedlings according to the following specifications.

Planting:

A. Seedlings will be planted in rows approximately feet apart and seedlings will be planted feet apart in the rows.

B. The intent is to plant approximately well-spaced seedlings per acre, without varying more than an average of 50 seedlings per acre from this count. In any event, no more than 800 or less than 600 seedlings will be planted per acre (350-450 for hardwoods).

C. Contractor will plant only one seedling at a time.

D. Planting hole must be free of trash.

E. Seedlings will be planted at least as deep, and no more than 3 inches deeper, than they grow in the nursery.

F. Roots will be firmly packed at the top and bottom of the hole. They will be straight, not balled, twisted, or U-rooted.

G. Seedlings will be protected from heating and freezing. They will be kept moist and cool at all times and their roots will not be exposed to drying while planting.

H. Tree seedling roots will not be pruned or cut by contractor unless approved in writing by the landowner or his agent to contractor.

3. Contractor shall guarantee that seedlings will be planted so that planting will meet the specifications for planting under a cost-share program. Contractor accepts responsibility for familiarity with cost-share program specifications.

4. The effective date of the agreement shall be _____ , 19 _____. The contractor shall complete the work in this contract by _____, 19 ____, at which time this agreement shall terminate.

It is understood and agreed by both parties that in the event of a disagreement that cannot be resolved by the two parties that an arbitration team will be selected in the following manner: The contractor and landowner will select a member each and these two members will select a third member. The three-member team will collectively arrive at a remedy for the disagreement that will be honored by the landowner and the contractor.

We, the undersigned agree to the terms of the above contract.

_____	_____
Landowner	Witness
_____	_____
Date	Witness
_____	_____
Contractor	Witness
_____	_____
Date	Witness

Appendix C

OPERATIONAL GUIDELINES FOR HANDLING SEEDLINGS

Kenneth F. Jeffries[1]

Abstract. - Realizing that seedling mortality is not caused by any one phase of the reforestation process, the North Carolina Division of Forest Resources has developed seedling handling standards for lifting, delivery and storage, and field planting.

Like most of you, we have experienced varying degrees of seedling survival problems over the last few years. The high cost of site preparation and the increased use of improved seedlings make poor survival much harder to take and also harder to explain to the boss and/or landowner.

We feel that poor practices in the nursery will reduce survival to some degree. If improper practices continue through storage, transport, and planting, the cumulative effect will most likely end in a planting failure.

We have developed standards for seedling processing in three general categories: (1) Nursery lifting and processing standards, (2) District/county delivery and storage standards, and (3) Field handling and planting standards. (Note: Only (2) and (3) are reproduced here).

These three stages of the reforestation process are divided into three classes of days: (1) Normal conditions, (2) critical conditions, and (3) severe conditions.

As you might expect, any one of these requirements could be below par, but excellent conditions in the other requirements could compensate and allow a normal condition to exist. Just as in setting fire readiness plans, some experience and judgment is required. I will go through the highlights of these standards.

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[1] Senior Staff Forester, Nursery and Tree Improvement, North Carolina Division of Forest Resources, Department of Natural Resources and Community Development, Raleigh, NC.

(Note: This material is condensed from Jeffries 1983)

District/Contractor Delivery and Storage Standards

Normal Day

Temperature: 35° F to 75° F
Relative humidity: 50 percent +

Delivery

1. Vehicles used for transporting seedlings will have a cover to shade and protect seedlings.

2. Bags/bundles will not be stacked over three deep per layer unless spacers are used to provide air circulation between layers.

3. At least 12 inches of air space between top of bags/bundles and cover will be left to avoid heat buildup.

4. Vehicles 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 deter mined.
   a. Things that indicate seedling deterioration:
      (1) Sour smell - fermentation
      (2) Yellow needles
      (3) Trees hot to the touch
      (4) Mold developing

   If any of these conditions exist, contact the District Staff Planting Coordinator prior to planting. b. Things that indicate dead seedlings:
      (1) Bark, especially on roots, slips off easily
      (2) Cambium layer has turned brown
      (Do not plant if these conditions exist.)
5. Inspect and repair torn bags immediately.

Storage

1. Store seedlings in a building, shed, 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 (usually longer).
      (2) Bales with seedlings dipped in clay slurry will keep from 8 to 10 weeks.
      (3) Bales with seedlings packed in moss will keep from 8 to 10 weeks, but will require watering of bales at least two times per week.

   b. Temperatures inside storage area from 38° to 50° F.
      (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.
(3) Bales with seedlings packed in moss will keep 2 to 3 weeks but will require watering at least two times per week.

c. Temperatures inside storage area above 50° not exceeding 75° F - seedlings should be removed within 3 to 5 days.

2. Bags/bundles should be stacked on pallets or slats and should not be stacked over two deep without spacers to allow air circulation between

layers.

Critical Day

Temperature: 76° to 85° F

Relative humidity: 30 to 50 percent

Delivery

1. Field delivery in nonrefrigerated vehicles should be held to a minimum. Seedling delivery from a nonrefrigerated storage point to destination should not exceed 1 hour's time.

2. Vehicles used for transporting seedlings will have a cover to shade and protect seedlings.
3. Bags/bundles will not be stacked over two deep per layer unless spacers are used to provide air circulation between layers.
4. At least 12 inches of air space between top of bags/bundles and cover will be left to avoid heat buildup.

5. 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.
a. Things that indicate seedling deterioration:
(1) Sour smell-fermentation (2) Yellow needles (3) Trees hot to the touch (4) Mold developing b. Things that indicate dead seedlings: (1) Bark, especially on roots, slips off easily (2) Cambium layer has turned brown
Do not plant if these conditions exist.

6. Inspect and repair torn bags immediately.

Storage

1. Store seedlings in a building, shed, etc. that will protect from freezing and heating. If temperatures inside storage area is above 75° F, do not store seedlings more than 24 hours.

2. Bags/bundles should be stacked on pallets or slats and should not be stacked over two deep without spacers to allow air circulation.

Severe Day

Temperature: 85° + or 32° F or less
Relative humidity: 30 percent **or less**

Delivery

1. Field delivery in nonrefrigerated units should not be made when the temperature is 85° F or higher.
2. Field delivery in noninsulated units when the temperature is 32° F or less will be made only if the vehicle is covered adequately to prevent freezing. a. Caution - seedlings can heat excessively on a cold day if vehicle is parked in the sun and seedlings are dead packed, preventing air circulation. b. Unload seedlings immediately upon arriving at destination.
3. Inspect and repair torn bags immediately.

Storage

1. Seedlings should not be stored in bags/bundles for more than a few hours at temperatures above 85° F. Lethal temperatures occur in bags/bundles at 118° F, but seedlings can be weakened or damaged if the temperature in the bag/bundle remains at 85° F for very long.
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 not been frozen more 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.

Field Handling and Planting Standards

Normal Conditions

Temperature: 35° to 75° F
Relative humidity: 50 percent +
Wind: Less than 10 mph
Soil moisture: 0-30 buildup

On-Site Storage of Seedlings

1. Bags/bundles should not have prolonged exposure to direct sunlight. Store the seedlings in a 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 opaque plastic, canvas, or plywood.

3. Bags/bundles should not be stacked in layers more than two deep without spacers. Spacers allow air to circulate freely around the seedlings and keep them cool. (Heat builds up even at low storage temperatures when the seedlings are stored in direct sunlight or without air circulation - especially in sealed bags).

4. Keep close check on seedlings stored at the planting site and water **uncoated** roots of seedlings in bags or bundles if roots begin to dry. Be careful not to puddle water in bags, as excess water can drown root tips or promote mold on the seedlings.

5. Do not water **coated** roots of seedlings since the water will remove the coating. Since the coating of roots will not give absolute protection against moisture loss, restrict the exposure of the roots the same as if they were uncoated.

6. Inspect and repair torn bags immediately.

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

8. Keep **opened** bundles covered at all times with wet burlap. Keep in shade.

9. If **opened** bags of seedlings, coated or uncoated, must be kept for over 2 days before planting, seedling roots must be dipped in water and bag tightly closed, or heel seedlings in.

10. If **opened** bundles of seedlings are not used shortly after opening, they should be heeled in.

11. Store trays of containerized seedlings in shade and keep root plugs wet until seedlings are planted. During storage, open book-type containers and check moisture of root plugs.

Culling Nonplantable Seedlings

1. Open only one bag/bundle at a time. Be careful not to leave open more than a few minutes.
2. 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.

3. Cull 1-0 **loblolly** or 2-0 **white pine** seedlings that have:
   a. Broken, skinned or weak stem
   b. Fermented smell
   c. Mold on needles
   d. Slippery bark
   e. Root collar smaller than 1/8th inch
   f. Root collar larger than 3/8th inch (large seedlings must be balanced; have a balanced root-to-top ratio)
   g. Root systems less than 4 to 5 inches long
   h. Roots systems longer than 12 inches if more than 50 percent of the laterals must be pruned in order to plant
4. Cull 1-0 **longleaf** seedlings if root collars are smaller than ¼th inch or tap roots shorter than 7 inches.
5. Cull **containerized** pine seedlings that are very small and poorly developed. Also, cull seedlings if root plug has become dry and hard.
6. Cull **hardwood** seedlings having root collars smaller than 1 /4th inch. Also, cull broken or skinned seedlings and seedlings with stems that have not hardened off.

7. Roots must be kept visibly moist at all times. If not visibly moist, dip roots in water. If being placed back in bag, shake excess water from roots prior to placing in bag to prevent puddling. (Do not dip **coated** seedlings). Close bags properly.

8. For best results, assign one trained person to be responsible for culling seedlings. Closely supervise and check on culling procedures. Be sure the person(s) is properly trained.

Critical Conditions

Temperature:	76° - 85° F
Relative humidity:	30 - 50 percent
Wind:	10 mph +
Soil moisture:	30 - 80 buildup

On-Site Storage of Seedlings

1. Bags/bundles should have minimum exposure to direct sunlight.
2. Otherwise, very closely follow same standards for Normal Conditions.

Culling Nonplantable Seedlings

1. Make a special effort to keep roots of seedlings exposed to sun and wind for no longer than 3 minutes.
2. Otherwise, follow very closely the same standards for Normal Conditions.

Severe Conditions

Temperature:	32° F or less; ground frozen or 85° F +
Relative humidity:	30 percent or less
Wind:	15 mph +
Soil moisture:	80 + buildup

* Note: If weather forecast indicates cold temperatures that will freeze ground for several days immediately after planting, do not plant.

On-Site Storage of Seedlings

1. Seedlings will not be stored at planting site under these conditions. Bags/bundles should be stored in a building, shed, etc. that will protect from freezing and/or heating.

2. Refer to Storage Standards as given under **District/Contractor Delivery and Storage Standards,** Severe Conditions.

Culling Nonplantable Seedlings

1. Culling will not take place at planting site.
2. Culling is permissible in a building, shed, or other protected area.
3. When culling in such an area, follow very closely the same standards for Normal Conditions.

Tree Planting Operation

All planting should STOP, unless localized site exceptions exist.

Localized Site Exceptions

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

Summary

We realize this system will not solve all problems with survival, but we believe it is a start in the right direction.

Pressures from tree planters and from within our own organization will probably prevent strict adherence to the guidelines, but if we can reduce plantation failures by 50 percent, we will have made the effort worthwhile.

Appendix D

Inspection and Evaluation of Planting Jobs

The success of your planting job depends on careful attention to all of the factors previously mentioned. However, to ensure that you have received a quality job, a thorough inspection is needed.

Stocking represents the number and distribution of living seedlings over the plantation. Depending on spacing, 600 to 800 trees are usually planted per acre. Adequate stocking information is used to determine whether replanting a portion or the entire stand is necessary. A systematic sampling system is the best method to sample stocking. The number of properly planted live trees is counted in fixed-area plots, usually circular plots. These plots are uniformly spaced across the plantation.

One sampling method is to use 1 / 100th acre circular plots (11.78 ft radius) spaced in cardinal directions as follows:

Acreage limits	No. of plots	Spacing
1-60 acres	1 per acre	211 ft (3.2 chains)
61-90 acres	1 per 2 acres	297 ft (4.5 chains)
91 + acres	1 per 3 acres	363 ft (5.5 chains)

Once the plot center is established, all trees inside the plot are counted and a "four-needle" test is performed. Each plot is tallied on the planting inspection form. All seedlings inside the plot are checked for above-ground problems, and are tallied on the form. Above ground problems include cull seedlings, shallow seedlings, excessively deep seedlings, or seedlings not packed properly. Once the trees inside the plot are inspected and tallied, you will need to excavate seedlings outside of the plot to check for below-ground problems. Below-ground problems include improper planting angle of the root system (greater than 30° from vertical), "J" rooted seedlings, "L" rooted seedlings, twisted or balled roots, improper pruning, and cull seedlings (taproot less than 5 inches). For the first five plots two trees are sampled per plot. After these 10 trees are inspected, if there is over 10 percent below-ground problems, then begin to sample 4 trees per plot until you have 10 percent below-ground problems.

Once all of the plots are tallied, calculate the totals on the form.

$$\text{Total trees per acre} = \frac{\text{Total planted trees}}{\text{No. of plots}} \times 100$$

After taking out the unsatisfactory trees per acre, you have the total of satisfactory above-ground trees per acre. The excavation factor is derived by dividing the correct excavated seedlings by the total seedlings excavated. This factor is multiplied by the satisfactory above-ground trees per acre to determine the total planted trees per acre. This figure should be within 10 percent of the desired seedlings per acre for the planting job to be acceptable.

There is a large amount of time spent to inspect and evaluate the planting job; however, a much larger expense has been made to plant your seedlings. The job must be done correctly if you are to ensure a quality stand.

(Texas Forest Service)

FMD#61

PLANTING INSPECTION FORM

Field Tally

PLOT NO.	NATURAL TREES	TOTAL PLANTED TREES	UNSATISFACTORY TREES U	D	C	S	E	N		SATIS-FACTORY TREES	EXCAVATED TREES				COMMENTS

Tract Data

LANDOWNER: ____________

COUNTY: ____________

SHEET: ________ OF: ________

Treatment Acreage: ____________

Date Completed: ____________

Date Inspected: ____________

Vendor: ____________

Inspecting Crew: ____________

____

____

Seedling Type: ____________

Spacing: ____________

Seedlings/Acre: ____________

Bag Dates: ____________

____

Mark on the ground and on the tract an easily located starting point. The distance to the first plot is ____________

____

chains on a bearing of ____________

____

TOTALS					
					Correct Excavated Seedlings / Total Seedlings Excavated = ________ = (Factor)
	Total Planted Trees Per Acre	Minus Unsatisfactory Above Ground Trees Per Acre	Satisfactory Above Ground Trees Per Acre	Times Satisfactory Excavation Factor	Total Properly Planted Trees Per Acre

To be completed only if problems are found:

☐ Unsatisfactory: ☐ Bags out of date ☐ Improper genetic line ☐ Bags exposed to sunlight & overheating (temp: ______)

☐ Torn bags ☐ Improper culling ☐ Seedlings dry ______ **Bags were Confiscated**

☐ **Improper Planting (specify):** ____________

☐ **Improper Equipment (specify):** ____________

Comments: ____________

VENDOR'S SIGNATURE: ____________ **INSPECTOR'S SIGNATURE:** ____________ **DATE:** ____________

Planting Problems

Above Ground

U - Unidentified cause of death
D - Debris, grass, leaves, or other material in the planting hole or furrow
C - Cull seedlings –
top less than 5 inches root collar
diameter less than
1/8 th inch
lacking secondary needles
S - Shallow seedling (not planted deep enough) -root collar above ground roots showing above ground
E - Excessively deep seedling (planted too deep) - terminal bud less than 3 inches from the ground
N - Not packed properly –
too loose failed "four-needle test"
no second dibble hole
top of the planting hole not closed
bottom of the planting furrow not closed
seedling pushed over by packing wheels

Below Ground

X - Improper planting angle of the root system – greater than 30° from the vertical
J - J-rooted seedling
L - L-rooted seedling
T - Twisted or balled roots
P - Pruned improperly torn off lateral roots tap root pruned to less than 8 inches tap root pruned with a dull instrument
C - Cull seedlings - taproot less than 5 inches

Pest Problems

A - Town ant damage
W - Pales Weevil damage

M - Tip Moth damage

G - Pocket Gopher damage

B - Browsing damage (rabbit, deer, cattle)
F - Fusiform Rust

(Texas Forest Service)