



ArborGen
The Reforestation Advantage

Seedling Care & Planting Guidelines

Bare root and containerized tree seedlings must be handled carefully from the time they are harvested at the nursery until they are transplanted in the field. Equally important is planting seedlings correctly. This booklet will tell you how. Proper seedling handling is complicated by the variety of environmental conditions that may occur during this critical time between harvesting and transplanting. Monitor environmental conditions continuously. Adjust field operations as necessary to adhere to these guidelines. By following these standards, you enhance the likelihood of a successful planting. Reforestation costs are the landowner's primary forestry investment during a timber stand's life. Good seedling survival sets the stage for the next forest's productivity and the landowner's returns on investment. With more and more landowners planting advanced genetics seedlings such as MCP® and Varietals following these guidelines is especially important.



The following forest tree seedling handling and planting guidelines were developed for broad practical field use. They include a general description of seedling handling, followed by lists of specific “Do’s and Don’ts.” If you have questions regarding a planting tract issue or planting project, contact an ArborGen Reforestation Advisor or Nursery Manager for recommendations.

Bareroot Seedlings

Bareroot pine seedlings are vulnerable plants that require careful handling. The four primary rules for tree seedling care between the nursery bed and out-planting are:

- Keep seedlings moist.
- Keep seedlings cool.
- Handle seedlings gently.
- Keep storage duration short.

Every effort must be made to keep roots moist while the tree is out of the ground. The nurseries spray seedling roots with a gel to reduce moisture loss. The trees are then commonly packed in moisture-resistant Kraft boxes. These practices are effective. Once a box is opened, the seedlings should be planted immediately.



Seedling roots must not be allowed to dry out! If a box of seedlings is only partially used, the box should be closed and stored in a shady, cool place.

Seedlings use stored food to survive transplant shock. These critical food reserves are depleted quickly if the trees are stored warm. To conserve this stored energy and promote seedling survival, trees should be stored as cool as practical without freezing. Inside box temperature guidelines for storing bareroot tree seedlings are:

Bareroot Seedling Storage Guidelines

Storage for 1-5 Hours

Ideal	34° - 40°F
Tolerable	40° - 50°F
Risky	50°- 60°F
Damage Probable	60°- 80°F
Damage Occurring	more than 80°F

Storage for More than 5 Hours

Ideal	34° - 40°F
Tolerable	40° - 50°F
Risky	50°- 60°F
Damage Probable	more than 60°F
Damage Occurring	less than 32°F





Keep Seedlings Cool

Talk to an ArborGen Reforestation Advisor or Nursery Manager before planting trees that have experienced abnormally high or low temperatures. Seedling survival will suffer if seedlings are exposed to excessively high or low temperatures. The level of mortality is directly related to the length of exposure to these temperature extremes. An exposure to 80°F for two hours can significantly reduce survival.

Handle Seedlings Carefully

Seedlings must be protected from physical damage. Seedling boxes should not be thrown or walked on. Physical abuse of the seedlings can lead to reduced seedling survival. Get professional advice before planting trees that have been excessively damaged.

Minimize Storage Time

As the length of seedling storage increases, seedling vigor decreases. Under ideal conditions this loss in vigor is very slow. The further storage conditions are from ideal, the faster the loss in vigor. Seedlings should be stored without refrigeration only when weather conditions permit. Even under ideal conditions, seedling storage should be kept as short as possible.



Seedling Transportation

DO

- Transport seedlings in a refrigerated van with temperatures maintained between 34°F and 45°F whenever possible.
- Keep inside box temperatures below 60°F.
- Keep truck bed free from pesticides and other chemicals.
- Keep truck bed free from sharp objects.
- Promptly repair or replace torn boxes.
- Shield seedlings from direct sunlight, wind, and temperature extremes.
- Minimize transportation time.

DO NOT

- Allow seedlings to freeze.
- Ship trees without refrigeration when air temperature exceeds 70°F.
- Walk on or stack heavy objects on seedlings.
- Routinely open seedling boxes to inspect seedlings. (Open only if the box has been damaged and/or been too hot or cold).

Refrigerated Seedling Storage

DO

- Store seedlings in coolers if possible.
- Maintain cooler temperatures between 34°F and 40°F.
- Provide good air circulation around the boxes.
- Plant trees as soon as possible after removal from cold storage.

DO NOT

- Store pesticides or other chemicals that could harm seedlings in cooler with seedlings.
- Store nondormant seedlings. (**Nondormant trees should be planted within two days of lifting.**)

Non-Refrigerated Seedling Storage

DO

- Plant seedlings as soon as possible.
- Protect seedlings from direct sunlight and temperature extremes.
- Allow space for air circulation between seedling boxes.

DO NOT

- Allow seedlings to freeze. (If freezing briefly occurs, thaw slowly without artificial heat)
- Plant seedlings that have been frozen for two or more days.
- Allow temp in the box to get above 50°F.

Field Handling & Planting Guidelines

DO

- Schedule tree planting when during the “dormant season” of November through February.
- Protect seedling boxes from exposure to the wind, sun, and temperature extremes.
- Store seedling boxes in the shade or under a reflective tarp.
- Keep seedling root exposure to an absolute minimum.
- Open only one box of seedlings at a time.
- Remove only one handful of seedlings at a time from the seedling box when sorting.
- Keep presorting to a minimum.
- Use care when separating roots.
- Transfer trees from seedling boxes to mechanical tree planter boxes or hand planter bags quickly.
- Keep seedling roots covered with moist burlap, in planting bags, or in buckets with moist medium.
- Cull seedlings significantly smaller than the rest while planting.
- Plant when there is good soil moisture.
- Train all personnel before allowing them to plant.
- Closely supervise the planting crew.
- Remove one seedling at a time from planting bags.
- Plant trees at the same depth they grew at the nursery or slightly deeper.
- Pack the soil firmly around each seedling. (Don’t leave air pockets.)
- Plant in accordance with instructions listed in this booklet.

Field Handling & Planting Guidelines

DO NOT

- Empty the whole seedling box when sorting seedlings.
- Leave seedling boxes open or seedlings exposed.
- Carry excess trees on machine planters.
- Expose seedling roots to the elements.
- Allow seedling roots to dry out.
- Cull the seedlings before planting.
- Hit or vigorously shake roots to remove soil.
- Store seedling boxes close to a fire.
- Use a fire to thaw frozen seedlings.
- Plant in unusually dry or hot conditions.
- Remove seedling from planting bag until planting hole has been made.
- Allow planted trees to have “L” or “J” roots since survival and growth will be sacrificed.
- Plant when soil is frozen.
- Plant when soil is saturated with water.
- Allow planting foreman to plant. (The foreman should supervise.)



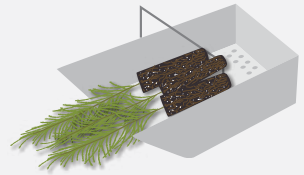
Root Pruning

Bareroot seedlings should not be pruned after leaving the nursery. Root pruning by tree planters can result in poor survival and growth.

Seedlings are lateral root pruned and undercut at the nursery by expertly trained staff and **should not need any root pruning** to be properly planted in the field.



Carry seedlings in a planting tray or canvas bag



Do not carry seedlings with roots exposed to sun and wind

Dibble bars are simple, shop-built tools for planting seedlings. They're also available from forestry equipment suppliers.



for Bareroot Seedlings



for Container Seedlings

Hand Planting



1. Insert dibble straight down. Pull backward to open hole



2. Remove dibble and place seedling at correct depth.



3. To hold seedling in place, insert dibble part way into soil, push forward, closing top of planting slit.



4. Insert dibble straight down into soil behind last hole.



5. Pull dibble backward, then push forward, packing soil firmly against roots.



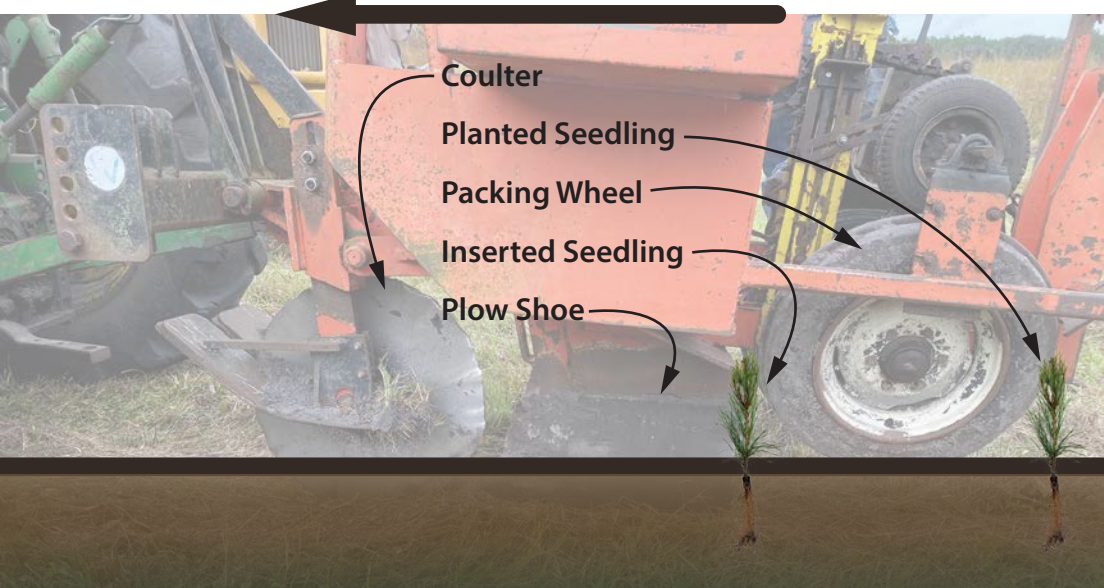
6. Fill last hole by firming with heel.

IMPORTANT: Do not carry more than one or two seedlings in hand during planting. Seedlings must not be overly exposed to air and sunlight.

Mechanical Planting



Direction of Travel



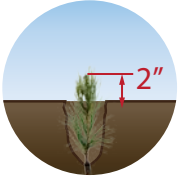
1. Insert seedling in vertical position well forward in open trench.
2. Hold seedling in vertical position until soil closes around roots.
3. Release seedling ahead of packing wheels.

Common Planting Errors



Too Shallow

Root collar and roots exposed, drying out roots.



Too Deep

Pine bud within 2" of ground line.



"J" or "U" Roots

Roots form "J" or "U" shape resulting in poor or weak root development.



Too Loose

A firm pull on one needle cluster moves plant.



Excessive Tap Root Pruning

Pine seedling roots should not be pruned shorter than 5". Hardwood seedling roots should not be pruned shorter than 6".



Not Erect

The tap root should not be planted at more than 30° from perpendicular.



"L" or Drag Root

Seedling pulled along in trench by planter.

Weather Condition Classification

Day Classification	Weather Conditions	
BEST	Temperature	33° - 75°F
Plan to do most of the planting during these days	Relative Humidity	50% +/-
	Wind	Less than 10mph
	Available Soil Water	75% to Field Capacity
MARGINAL	Temperature	76° - 85°F
Be extra careful and take precautions if planting on these days	Relative Humidity	30% - 50%
	Wind	10 - 15mph
	Available Soil Water	50% - 75%
CRITICAL	Temperature	Less than 32°F or More than 85° F
Do not plant on days when one or more of these conditions are present.	Relative Humidity	Less than 50%
	Wind	15+ mph
	Available Soil Water	Less than 50%

IMPORTANT: Day Classification should drop to that of the weather condition with the poorest rating.

Planting Density

Spacing (feet)	Trees Per Acre
5 x 5	1742
5 x 6	1452
5 x 7	1245
5 x 8	1089
5 x 9	968
5 x 10	871
6 x 6	1210
6 x 7	1037
6 x 8	908
6 x 9	807
6 x 10	726
6 x 12	605
6 x 15	484
7 x 7	889
7 x 8	778
7 x 9	691
7 x 10	622
7 x 12	519
7 x 15	415
8 x 8	681
8 x 9	605
8 x 10	545
8 x 12	454
8 x 15	363
8 x 25	218

Spacing (feet)	Trees Per Acre
9 x 9	538
9 x 10	484
9 x 12	403
9 x 15	323
10 x 10	436
12 x 12	303
12 x 15	242
12 x 18	202
12 x 20	182
12 x 25	145
13 x 13	258
13 x 15	223
13 x 20	168
13 x 25	134
14 x 14	222
14 x 15	207
14 x 20	156
14 x 25	124
15 x 15	194
15 x 20	145
15 x 25	116
16 x 16	170
16 x 20	136

Summary

1. Keep seedlings cool.
2. Keep seedlings from freezing.
3. Keep seedlings moist. Seedling roots must never be allowed to dry out even for a few minutes.
4. Handle seedlings carefully.
5. Keep storage duration short.
6. Don't plant small, weak seedlings.
7. Don't plant when soils are dry.
8. Don't plant when weather conditions are critical.

ArborGen Nurseries & Distribution Sites

