Nursery Operations

This section briefly describes some nursery operations that are critical for the production of high-quality seedlings. Landowners and planting contractors have little control over nursery practices, and most State, Federal, and forest industry nurseries can be relied upon to follow up-to-date practices in any case. If you are planning to buy seedlings from a small, independent nursery, you should assure yourself that the nursery in question is properly conditioning, lifting, and packaging its seedlings.

The few basics presented here are sufficient for a landowner or contractor to have that assurance. More detailed information on nursery management is readily available elsewhere (see Lantz 1985 in the list of references).

Conditioning

Seedlings that are actively growing in the nursery must be prepared for the shock of lifting, packing and storage. This conditioning treatment is meant to bring about a dormant condition in the seedling. Most southern nurseries reduce irrigation and fertilization in late summer and fall as part of this conditioning process. Undercutting, wrenching, and lateral root pruning are also used by many nurseries to prepare seedlings for lifting.

Nothing, however, induces dormancy quite as well as cold weather. The growth-dormancy cycle in southern pines, after all, is an adaptation to avoid plant injury in cold weather. To measure the probable depth of dormancy, many nursery managers record the number of chilling hours (hours when temperatures are between 32° and 46° F) after October 15. The geographic seed source of the seedlings determines the number of chilling hours required for dormancy. Some seed sources can be lifted and planted after 200 chilling hours, but storage should be for no more than 1 or 2 days. Most sources reach maximum dormancy after 400 chilling hours have accumulated.

PHOTO HARRY VANDERVEER

Color of dormant loblolly pine seedlings in winter.

Under ideal conditions, these seedlings can be stored for up to 8 weeks. Seedlings with fewer chilling hours should be handled with extra care and planted within 2 weeks.

Winter coloration can be an additional indicator of dormancy. When needles change from green to a brownish red-purple, the seedlings usually are at least partially dormant. It is important to distinguish between the color of dormant needles and the reddish-brown of dead needles. Also, the needles of some species and seed sources do not change color in fall and winter.

Lifting

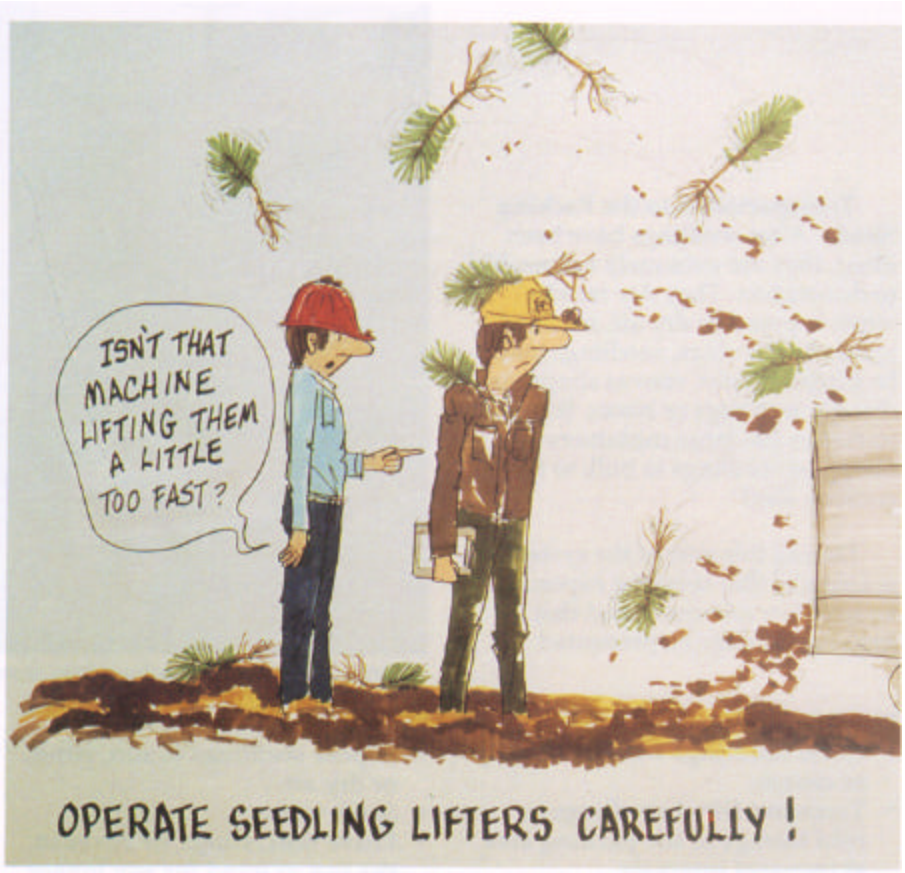
Gentle lifting of seedlings from the nursery beds is critical for their future survival and growth. Four factors must be considered if lifting damage is to be minimized: (1) weather, (2) method of lifting, i.e., hand or machine, (3) transportation to the packing shed, and (4) crew organization and supervision.

Weather—Optimum conditions for lifting seedlings are:

- air temperatures from 33° to 40° F
- relative humidity = 100 percent
- no wind
- overcast sky

When air temperatures are above 50° F, relative humidities are less than 50 percent, wind velocities greater than 10 mph, and it is a bright, sunny day, seedlings will lose moisture very rapidly. Under these conditions extra care must be exercised to prevent seedlings from drying out. When the soil is frozen, lifting should be delayed until the soil has completely thawed. Attempting to lift when the soil is frozen is certain to damage seedlings.

A number of organizations have developed weather classification systems with categories like normal, marginal, and critical, which are similar to fire danger ratings. The type of operation (lifting, shipping, or planting) is tailored to the weather category. For example, under critical weather conditions, lifting and planting operations should be postponed. When conditions improve to marginal, limited lifting and planting may be permitted but special care must be exercised.



System of lifting—The objective of lifting is to gently separate the roots of the seedling from the soil. Seedling harvesters are designed to lift pine seedlings quickly and efficiently with a minimum of damage. When weather and soil conditions are optimum, and the machine is properly adjusted and operated, seedlings are not damaged. However, if any part of the lifting system is not operating properly, seedlings can be severely damaged. Many organizations limit the use of seedling harvesters to optimum conditions, and lift by hand under other conditions.

Do:

- **Lift only when the weather is favorable.**
- **Coordinate the lifting system so that seedlings are protected at all times.**
- **Ensure that lifting machines are properly maintained and adjusted and that they are operated carefully!**

Do Not:

- **Permit harvesters to be operated under adverse weather conditions.**
- **Permit lifting crews to "slap" seedling roots against tubs, tractors, or boots.**
- **Permit harvesters (and particularly "root knockers") to be operated at high speeds.**

Transportation to the Packing Shed—After seedlings have been lifted, they are extremely vulnerable to desiccation. They dry rapidly when exposed to dry air, sun, and wind. At this stage, seedlings may be placed in tubs, canvas slings, or directly into bags or boxes. Some nurseries use large containers to transport seedlings in bulk to the packing shed.

During this part of the system, it is essential that seedling exposure be kept to a minimum and that physical damage be prevented.

Do:

- **Cover seedlings with wet burlap or canvas.**
- **Transport lifted seedlings to cold storage or the packing area at frequent intervals.**

Careful lifting protects seedlings from exposure.

Do Not:

- **Expose seedlings to sun, wind, or dry air.**
- **Stack tubs.**
- **Leave tubs, slings, or boxes in the sun or wind for any longer than absolutely necessary. In most cases the seedlings should arrive in the packing shed within 15 minutes after their roots leave the soil.**

Careful handling after lifting prevents exposure.

Crew organization and supervision—It is essential that crews be trained for correct lifting. Do not assume that anyone understands the correct procedure for lifting seedlings until he or she has demonstrated the proper techniques.

If crews are not correctly supervised, harvesters are often operated too fast, roots and mycorrhizae are stripped and the cambium is bruised. Many months of good cultural practices and care can be lost in a careless moment during lifting!

Do:

- **Supervise the lifting operation very carefully.**
- **Insist that weather conditions and/or risk categories are followed.**

Do Not:

- **Permit a lifting crew to work without proper supervision.**

Packing

Pine seedlings are commonly packed in open-end bales, kraft-polyethylene (K/P) bags, or wax-coated boxes. These packages protect the seedlings during transport and storage. **Proper storage conditions must be provided from the time of lifting until planting to maintain seedling quality.** Good supervision is essential in the packing operation to ensure that the seedlings are handled carefully.

Important messages about seedling care can be printed on the seedling packages.

Some factors to consider in selecting seedling packages

Factor	Bales	K/P Bags	Boxes
Watering	Water must be added weekly unless roots are coated	No water needed	No water needed
	[Do not add water to seedlings with coated roots]		
Vulnerability to temperature buildup	Open-ends allow dissipation of heat	Rapid heat buildup	Better insulation than bales or bags
Protection from physical injury to seedlings	Open-ends lack protection	Good protection when properly packed and strapped	Best protection – although seedlings will shift inside box if not handled carefully
Relative cost	Least	Intermediate	Most expensive
Stacking	Use spacers if stacked more than two deep	Use spacers if stacked more than two deep	Can be stacked up to four deep
Printed care instructions	Difficult due to limited space	Adequate space	Best surface for instructions

In general, the K/P bags are ideal if cold storage can be provided from packing until planting. These bags are very vulnerable to heat buildup - both internal (heat of respiration) and external (sun + warm air). Seedlings in storage too long may ferment! When cold storage is not available, the seedlings in K/P bags should be planted immediately.

Bales are often used where cold storage is not available or where conditions are variable or unpredictable. Seedlings shipped to private landowners are often packed in bales due to the uncertainty of storage conditions. Bales can be safely stored in sheds or unheated buildings where they will be protected from freezing and the temperature will range from 35° to 50° F.

Root Coatings

Dipping or spraying seedling roots with several different materials improves storeability and field performance. Kaolin clay has been used for many years at rates of 3 to 3-1 /2 pounds of clay per gallon of water. The optimum mixture is thick enough to cause roots to barely stick together. Seedlings with kaolin-coated roots have consistently survived better than seedlings with untreated roots in a number of studies. The primary advantage of the clay appears to be in protecting against moisture loss when exposure occurs during planting.

PHOTO: BARRY NIHE

Packing with clay slurry.

PHOTO: AL STAUDER

Carefully packed K/P bag of seedlings.

Pesticides, such as benomyl, may be easily added to the clay slurry. A mixture of 5 percent (AI) benomyl in kaolin clay improves storability, brown-spot resistance, and planting survival of longleaf pine seedlings. Lower concentrations of benomyl should be used with other species.

In recent years, some "super-absorbent gels" have been applied to protect seedling roots. These materials are easier to mix and spray than clay and not nearly as messy to handle. Preliminary results indicate that the **synthetic** gels are effective.

REMEMBER

Do not add water to seedlings with coated roots as the clay/gel may be washed off the roots.