

Storage

Between lifting and planting in the field, seedlings may be stored, moved, and re-stored one or more times. Methods of storage and treatment during storage can vitally affect the physiological condition of the seedlings and their subsequent survival.

Storage Facilities

Temporary storage of seedlings between lifting and packing should be inside a packing shed where temperatures can be controlled so that seedlings will not freeze, become heated, or dry out.

Warehouses or storage sheds are subject to temperatures ranging from subfreezing to about 80° F or higher. Sheds should be equipped with racks to provide good air circulation around all packages of seedlings. Racks for baled seedlings should be slanted so that water supplied to the upper end of the bale can move through the bale, and excess water can drain from the bale. A water supply must be available for the entire storage area.

Refrigerated storage rooms or coolers should be kept at 33° to 40° F. The high relative humidity in most cold storage units is beneficial for seedlings. Relative humidity of 85 to 95 percent is probably about normal for these coolers. When relative humidity is low, the walls of the cooler can be sprayed periodically with water. Automatic humidity controls are also available, but the relative humidity is difficult to control at the low temperatures maintained in the coolers. Because of the trend toward packaging

seedlings in waterproof, sealed containers, precise humidity control is important only when exposed seedlings or seedlings in bales are stored.

Bale Storage

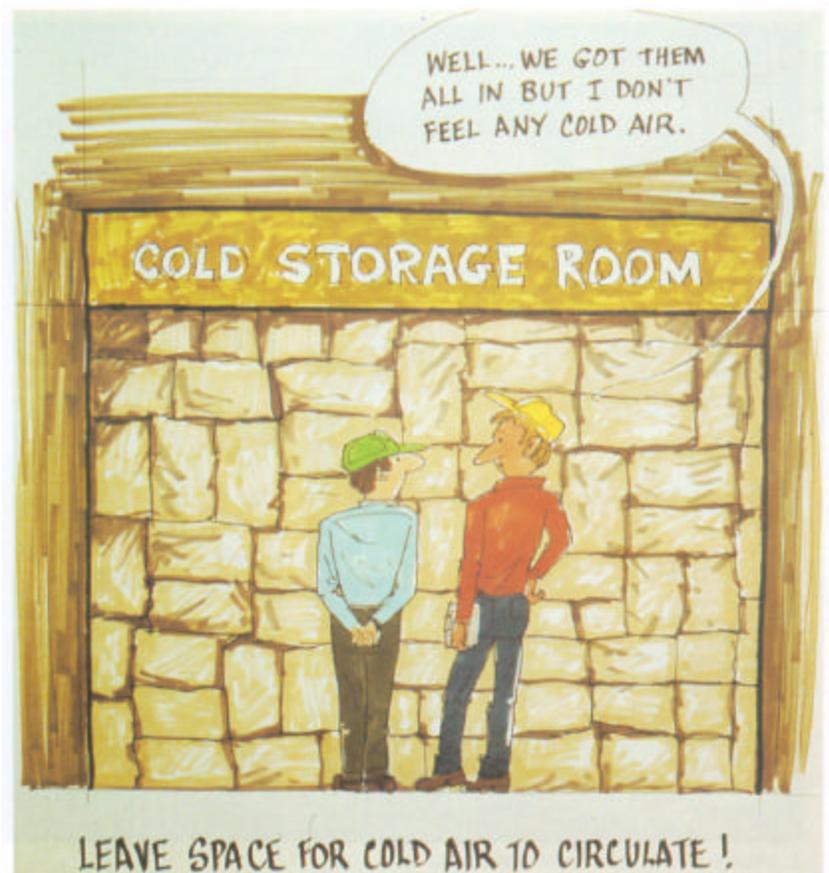
Pine seedling tops in open-end bales transpire continuously, translocating moisture from the roots and often the packing material. Water is also lost directly by evaporation from the packing media of bales. The rate of transpiration and evaporation is strongly affected by the air temperature and relative

humidity surrounding the bale and by the rate of air movement. Bales packed with moss or similar material must be watered every week.

After storage of about 1 week in bales, the survival rate of the seedlings may decline, and the decline will increase with time. Baled seedlings stored without refrigeration should be planted within 1 to 4 weeks after lifting. Clay-packed bales in shaded, ventilated storage generally require no watering for at least 3 weeks, as roots of clay-treated seedlings do not dry as quickly as seedlings in moss-packed bales.

Other Considerations in Nursery Storage

Seedling handling and storage requires considerable space to ensure good air movement around packages and to ensure that the seedlings in storage for the longest time are shipped first ("first in = first out"). Storage areas must be



equipped with racks or pallets to provide air circulation. Packages not stored on pallets or racks should be separated by spacers to allow air circulation. Most large storage operations are mechanized with forklifts to handle packages of seedlings on pallets or racks.

The season of lifting and the physiological condition of the seedlings strongly affect the storability of pine seedlings. Nondormant seedlings lifted in the fall do not store well. If seedlings are planted immediately after lifting, their survival may be satisfactory, but storage of even 2 weeks can cause survival to drop below satisfactory levels. In contrast, seedlings that have made the first flush of growth in early spring before lifting have been stored in bags in cold storage, with subsequent adequate survival.

Package temperatures should be monitored in all storage facilities. These temperatures should be checked in several packages in well-distributed locations. Seedlings will heat, particularly if packages are placed too close together. In one cold storage study, the internal temperatures of bags with poor air circulation averaged 22° F higher than those with good air circulation. In this study piling bags more than two deep resulted in a 10° F increase in internal bag temperatures.

No machine is free of trouble, and a cold storage unit is no exception. Refrigerated units should be equipped with warning devices such as a bell or flashing light to inform the nursery staff that a malfunction has occurred. In enclosed areas, the heat produced by seedlings can quickly change a cold storage facility into a warm storage facility. Frequent inspections are necessary to ensure that temperature controls are functioning properly. Constant attention to all factors involved in the storage operation will pay off in healthy seedlings for planting.



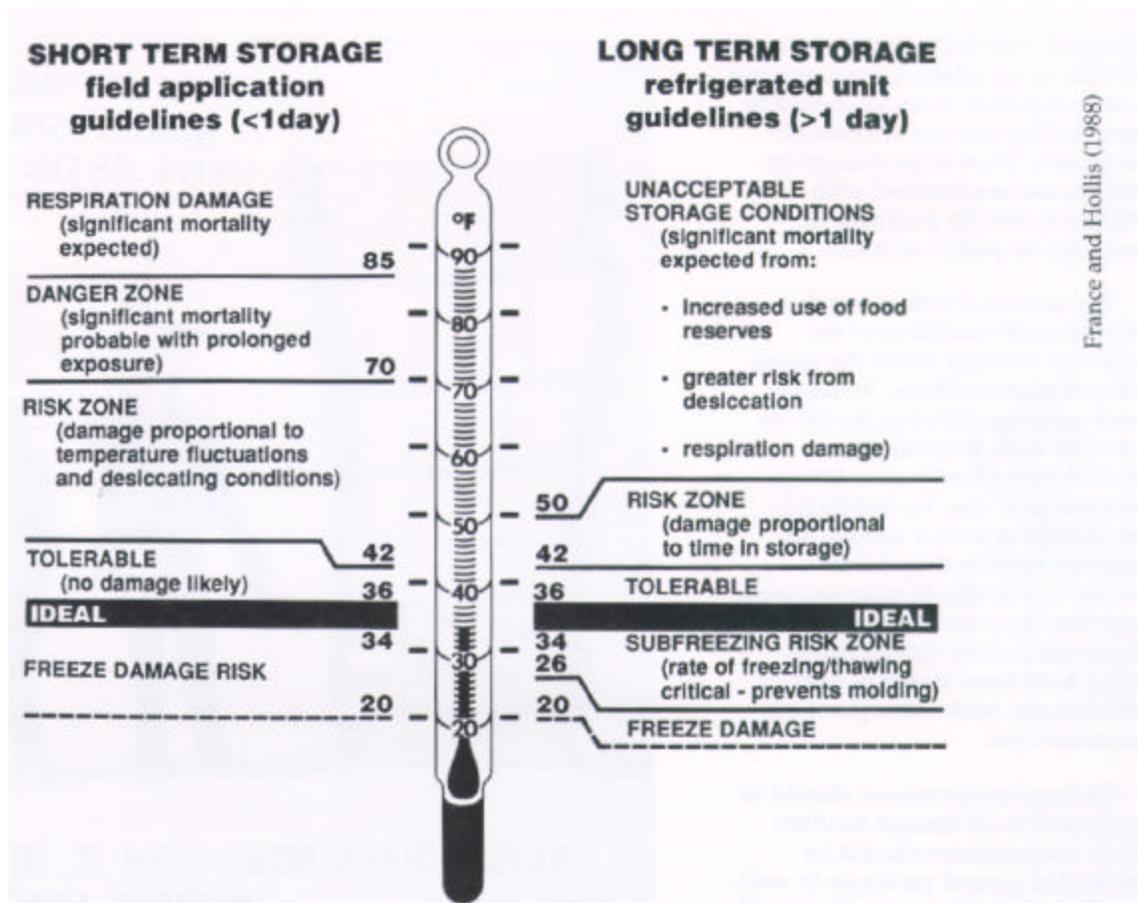
Do:
 // Stack seedling packages no more than 2 deep and use spacers to provide air flow between packages.

// Inspect for torn bags, dry roots, and high temperature.

Do Not:
 // Assume that cold storage units operate properly without regular inspections.

Storage Guidelines		
Bales	Bags	Boxes
Optimum temperature: ←	33° - 40° F →	
Relative humidity: 90 percent +	Not critical when bags are sealed and intact.	Not critical when boxes are sealed, waxed, or lined.

REMEMBER
 Seedlings deteriorate in storage—even under the best of conditions. Plant them as soon as possible!



France and Hollis (1988)

TEMPERATURE (°F)

Temperature guidelines for dormant bareroot pine seedlings

Maximum storage duration and recommended care for dormant loblolly and slash pine seedlings

Storage facilities ¹	Package	
	K/P bag Box	Bale
Refrigerated 33 - 40° F	8 weeks from lifting – repair damaged bags	8 weeks from lifting – water as needed ² (do not water seedlings with coated roots), allow drainage
Shed 33 - 50° F	3-4 weeks from lifting – repair damaged bags	4-6 weeks from lifting – water every week (do not water seedlings with coated roots), allow drainage

¹With either type facility, store in racks and stack bags or bales only two high.

²Frequency of watering is dependent on moisture conditions in cold storage. Always use water under low pressure.

(Modified from Williston 1974.)

REMEMBER
Seedlings must be protected from high temperatures, direct sun, wind, and freezing conditions.