HANDLING PINE SEEDLINGS

by

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Abstract.--Major findings of studies are presented on ways to maximize survival of pine seedlings in the nursery, in cold storage, in transit, as well as on the planting site. Culling of seedlings is discussed, together with optimum and detrimental storage temperatures, humidity, packaging, pruning, storage duration, planting dates, and related requirements for optimum success with pine seedlings.

Keywords: Nursery, planting, pines, seedlings, cold storage.

Almost everyone is cost conscious today as they well should be. But are we penny wise and dollar foolish? A seedling worth a little more than a penny at the nursery has more than 10 cents invested in it by the time it is planted. Indeed, superior seedlings planted on heavily prepared sites may be worth 25 cents each. Many dead seedlings are being planted. When less than 250 to 300 well-distributed pine seedlings per acre survive, that acre must be replanted. It may be necessary to repeat the site preparation. And a years' growth on that acre has been lost. Here are some thoughts on how to increase field survival through improved handling.

HANDLING SEEDLINGS IN THE NURSERY

Several years ago I visited a nursery and found the floor of the packing shed littered with plantable seedlings. The 12 girls along the table appeared to do little other than position the seedlings for weighing and treatment with slurry. I heard the foreman say, "When you bundle 200,000 you are through for the day." I discussed this with the responsible assistant state forester, pointing out that every plantable seedling on the floor was worth a penny and that the labor was highly ineffective. His response was, "We can't pay enough to get good supervision and we have to give the girls some incentive to work." A good tree grower must first of all be a good people manager and must recognize that it is more important to be respected than loved.

State nurseries have almost entirely abandoned the grading of seedlings. Some industrial nurseries cull seedlings. Frankly, I want, and am willing to pay more for, seedlings that have been culled and counted at the nursery. No one can afford to plant seedlings that have a poor chance of survival nor can we permit tree planters to cull in the field--that is an invitation to waste seedlings and slow down production.

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COLD STORAGE

Temperature

Cold storage facilities are virtually mandatory today, both at the nursery and at field headquarters. Seedlings must not be lifted until they are dormant, to successfully withstand long term storage. The temperature in cold storage should not fluctuate. Variations in temperature result in condensation of water on the foliage or packing materials, forming favorable spots for mold development. The temperature should be maintained as close as possible at 28° to 34° F. (-2.2° to 1.1° C.). Temperatures above 36° F. (2.2° C.) are critical for mold development (Navratil 1973).

Some poor field performance has been attributed to loss of starch content in the tops and buds because of respiration while in cold storage. This problem indicates inadequate cooling (Hocking and Nyland 1971). After chilling requirements to break bud dormancy are satisfied, seedlings of many species become physiologically active in response to temperatures above 35.6° F. (2° C.) (Jenkinson 1975).

Humidity

Ideally the humidity should be maintained at 90 to 95 percent in cold storage to prevent unprotected seedlings from drying out. It helps to sprinkle water on the walls and floor. Another solution is to package the seedlings in moisture-proof film as in a K-P bag (Kraft-polyethylene).

Packaging

Packaging in Forest Service bales is still acceptable but is being phased out because of the high cost and shortage of sphagnum moss and because it is necessary to water the bales when not held in cold storage. K-P bags with and without moss or with the seedling roots dipped in a clay slurry have proven to be entirely satisfactory. These bags should be strapped with a stick in the rolled top to make them easier to handle. Bags that are strapped take only about two-thirds as much room as those that are unstrapped and enable you to increase cold storage capacity, which is often at a premium, by 50 percent.

Duration of Storage

Loblolly pine seedlings in K-P bags can be held in cold storage for 3 months without adverse effect on first-year survival (Williston 1965). But if they are stored in a warehouse for more than 4 weeks or after March 15, put a pound of wet moss in the package. Do not store them more than 8 weeks nor water the bags in the warehouse.

Forest Service bales packed with moss can also be held in cold storage for 3 months without special attention if the temperature is

held at 28° to 34° F. (-2.2° to 1.1° C.) and the humidity is 90 percent plus. Warehouse storage should be limited to 8 weeks during which time the seedlings should be watered every 2 or 3 days (Ursic 1956).

Freezing

Storage must protect seedlings from freezing as well as heating. Instances have been reported where loblolly and slash pine in North Carolina did not suffer from freezing at 20° F. (-6.7° C.) for 24 hours (Hodges 1961) or for 48 hours in Louisiana at the same temperature (Byrd and Peevy 1963), but in Tennessee, freezing for 36 hours and longer resulted in total mortality for both loblolly and shortleaf pine seedlings. In two studies (Garner and Dierauf 1974) a single, short period of freezing (2 and 3 days down to 12° and 14° F.)[-11° and -10° C.], followed by complete thawing before handling, did not reduce the survival of loblolly pine. However, in two other studies conducted by the same research team, storage at approximately 20° F. (-6.7° C.) for 1 month resulted in almost complete mortality.

Most of the evidence is anti-freezing. If the seedlings do freeze and the decision is to plant them, allow them to thaw before moving. Longleaf pine seedlings do not store well under any circumstances and should be planted within a day or two of lifting.

Brown (1977) has reported that the various tree species differ in their capacity to withstand below freezing temperatures. Trees that are not cold hardy can withstand temperatures a few degrees below freezing because ice must form to kill the cells. Trees that are cold hardy owe this capacity to three factors: a glycoprotein that binds the water in cells and keeps it from turning into ice; a special type of membrane that tends to keep ice out of the plant cells and also allows water to move out of the cells more quickly; and a "super cooling" phenomenon which tends to keep ice crystals from forming. Researchers are attempting to select hardy varieties within species and to cross them for cold hardiness. They are also identifying and applying chemicals that are capable of inducing cold hardiness.

TRANSPORTATION

A timber management assistant called me to say, "We just got a truck load of hot trees. What do we do?" I suspect that this is a situation that frequently goes unreported. There is no easy answer. Ursic (1961) determined that temperatures of 118° F. (47.8° C.) for 2 hours are lethal to loblolly pine seedlings. We have no reliable information on the effects of various temperature-time combinations lower than this.

If you do receive a load of hot trees, separate the hot bundles from the cool bundles. Check sample seedlings from deep within the hot bundles with a Rykerscope (if available) to determine whether or not they are still living. Otherwise hold the hot bundles in a cool place for at least

a week to see if the bark will begin to slip on the seedlings. Haste to plant hot trees results in waste. We learned the hard way from outplanting a rail car of hot trees.

Shipment in refrigerated trucks is the ideal means of preventing seedlings from heating, but a cheaper alternative is to use slat sided trucks with a tarpaulin top (Balmer and Williston 1974). The slat sides allow some air circulation and can accommodate cross slats for stickers, providing additional circulation. In warm weather, haul seedlings at night when possible.

HANDLING AT THE PLANTING SITE

Slurry

When we first began to get slurry-treated seedlings, one of my foremen proudly took me over to an old-fashioned washtub full of water. "See! I wash the mud off all the roots," he said, "because the men don't like to get their hands messed up when it is cold." The slurry in this case was so thick that the seedlings stuck together, making separation difficult.

Pruning

On another planting chance, the foreman pulled out some large scissors and said, "The roots of these seedlings are too long so I cut them all back to six inches." Seedlings with 6-inch (15.2 cm.) roots will survive and grow well. Indeed, seedlings with 4-inch (10.2 cm.) roots will survive (Ursic 1963). In Virginia, Dierauf and Garner (1978) found that pruning the roots of loblolly pine seedlings to 3 inches (7.6 cm.) reduced survival by 6 to 8 percent.

Studies on the correct top:root ratio have generally been inconclusive, but the best seedlings in my opinion have a balanced top:root ratio. Some characteristics of ideal planting stock are given in table 1 (Williston 1974). Extra large seedlings are hard to plant and will wind whip. I cite these two incidents to point out that when seedlings are shipped from the nursery they should be in an easy-to-plant condition.

Table 1.--Ideal Planting stock[1/]

Species	Planting Site	Top Length	Minimum diameter of stem
		----------Inches----------	
Loblolly	Moist	9-12	3/16
	Dry	5-9	1/8
Shortleaf	Moist	8-12	3/16
	Dry	4-7	1/8
Slash	Moist	10-14	3/16
	Dry	6-9	1/8

1/ Roots: 7 to 8 inches (213.3 to 243.8 cm.).

Carriers

On the second planting job mentioned, the men carried the seedlings in buckets. We have found that the use of planting bags increased production by approximately 25 percent and was less fatiguing because it reduced the number of "stoops." Keep a handful of wet sphagnum moss or granulated peat in the bottom of the bag Take care not to stuff too many seedlings into the bag because it is easy to strip off rootlets as the seedlings are removed from the bag.

Timing

Last winter a woodlands manager called me and said, "We lost 1,000 acres (404.7 ha.) that we planted in January. Dug up a number of them and they were correctly planted. Other seedlings from the same shipment planted later lived. What is your explanation?" I asked him if he had had a week or 10 days immediately following planting in which it was cold enough for the ground to freeze. "Affirmative! How did you know?" Twenty years ago I lost 20,000 seedlings heeled in a bed of sand. The answer was desiccation. So if an extended "blue norther" is forecast in areas where the ground freezes, keep the seedlings in storage.

Seedlings planted in the coldest part of the winter, when the soil is too cold for root growth, are merely stored in the ground. Chances of a disastrous cold spell occurring are greatly increased by planting in December and early January. In the Oxford, Mississippi area, first year survival of loblolly pine over a 10-year period increased progressively for planting in December (72 percent), January (74 percent), and February (78 percent) (Ursic, Williston, and Burns 1966). Survival and growth of March and April plantings consistently ranked the highest. Nurseries with large cold storage facilities can continue to lift during the dormant season and still gear seedling delivery times to those landowners desirous of planting late to improve survival.

You have probably all heard stories similar to the following. A tree planter said, "A dozen seedlings lay on the floor board of my truck for a week. I planted them in my yard and 11 of them lived." Don't you believe it. Pine seedlings are extremely sensitive to drying of the roots even though they can be surprisingly tough. We really know very little about what Wakeley called physiologic quality.

CONCLUSION

Seedlings take constant care through every step of the nursery, shipping, and planting operations to insure a living tree. A nurseryman's objective should be to produce a tree that is living at the end of the first growing season. (Second-year mortality is usually slight). True, it is not all in your hands, but the field force will just naturally take greater pains with a quality product. If there is one characteristic that distinguishes the true professional from the would-be professional, it is constant attention to quality control.

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