# WHAT THE PLANTER EXPECTS IN THE WAY OF SEEDLING QUALITY

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Thank you for the invitation to be on this program. It gives me an opportunity to publicly express my appreciation to tree nurserymen. Through their production of high quality seedlings, they've kept the Y-LT Project in business for over 15 years. I doubt if the general public, in fact I doubt if many of our own Forest Service people, have much idea of the many trials and tribulations which beset you men almost every day in producing those grades 1 and 2 seedlings that the field accepts so casually. Of course, I'm painfully aware of the many hazards which threaten seedlings from the time we receive them from the nursery until we make that first survival check in November. Fire, drought, poor planting, rabbits, cattle grazing, rats, and exposure all represent real possibilities of poor survival on our end of the line. After reviewing the many hazards found at the nursery in producing seedlings which have a high capacity to survive and grow, I'm amazed that our planting programs have been so generally successful. These successes are a real tribute to you men in your ability to produce high quality seedlings. I suppose these successes are also a tribute to the trees themselves.

My topic is WHAT THE PLANTER EXPECTS IN THE WAY OF SEEDLING QUALITY. Before we go into this, let's brainstorm a bit and describe the kind of seedlings we'd like to receive and the kind of seedlings, I'm sure, you would like to send us. How about a seedling which will survive no matter how its planted or how long its exposed -- one which will survive onslaught of drought, freezing temperature, fire, and floods - will sprout back vigorously when nipped off by rabbits or rats - is obnoxious to stock - can survive trampling - grows rapidly on any site (say pulpwood size in 5 years). With such a superior seedling, perhaps forestry and planting in particular might be easier to sell to landowners. We certainly wouldn't be faced with such an economic gap between improved pastures and trees.

I know our research people and some of you are already working on seedlings which have many of these super characteristics through your superior tree program. I'm sure these efforts will bear fruits in the future which will make our production of timber today look small by comparison. Agriculturists have done this sort of thing with cattle, corn, cotton, and I think the same kind of results can be achieved with trees. Of course, our *big* handicap with trees is the length of time it takes to fully determine the characteristics of the species we're working with.

It's easy enough to describe the kind of seedlings we expect to receive from the nursery. Right now I'm referring to loblolly pine

seedlings and *Mr.* Wakeley has well described the grades which we generally consider acceptable.

The whole concept of nursery stock grades is based upon seedling capacities for survival and growth after planting. Nursery stock grades developed to date have attempted to judge these capacities by visible characteristics, including size. But mere bigness or presumably desirable form of seedlings has not always assured plantation success. Evidently, the effects of nonvisible characteristics within seedlings may be as important as the effects of size and external form. These nonvisible, internal differences are termed PHYSIOLOGICAL QUALITIES.

This matter of physiological qualities admittedly is an area in which there is still considerable groping. This same problem, of course, confronts breeders of practically all animals and, especially, those in which qualities other than mere size and conformation is called for. Breeders of race horses, for instance, obviously don't get a Man O' War every time they breed a pair of horses. The dam and sire of Man O' War were doubtless bred many times but there was only one super horse like "Big Red." To get a little closer to home, breeders of field trial dogs run into the same thing. A given litter of pups may produce 1 or 2 champions -- subsequent litters may or may not produce any. We know children of the same parents vary in size, ability, and intelligence, so I suppose its not surprising that we find these physiological differences in our seedlings. I'm sure this matter of improving the physiological qualities will be a problem of foresters and nurserymen for many years to come.

Wakeley summarizes the known facts concerning the physiological qualities of southern pines about as follows:

1. In a great majority of cases, physiological qualities and capability to survive and grow probably are about the same for all practical purposes.

2. Morphological grades and physiological qualities may or may not coincide.

3. High physiological quality of southern pine seedlings seems to improve survival principally by insuring that the water intake of the seedlings immediately after planting equals or exceeds their water loss.

4. Mineral nutrition, which is governed largely by the natural fertility level or the fertilizer treatment of the nursery soil, may greatly affect the physiological quality of southern pine nursery stock.

5. Variation in stored food reserves seems to be another important source of variation in the physiological quality of southern pine seedlings.

6. The relative difficulty with which plants obtain an abundance of moisture from the soil is referred to as the 'water tension" under which they are grown. Although the subject has not been investigated systemically in southern pine seedbeds, it seems probable that water tension, particularly toward the end of the nursery growing season, greatly affects the physiological quality of the seedlings.

Some results of studies conducted by the Forest Hydrology Laboratory at Oxford gives an indication of the type of seedlings we need for planting on these severely eroded sites:

As eroding sites can rarely be direct-seeded, loblolly must almost always be established on them by planting. Research has shown that planting is most successful with stock from suitable geographic seed sources, of acceptable size, and in a dormant condition.

Geographic seed source

Survival, growth, disease resistance, and litter production of loblolly pine vary with geographic strain. Since loblolly is an introduced species, it is not possible to follow the usual recommendation to use local seed.

One attempt to locate a source of stock that would perform well on severe sites in north Mississippi compared seedlings grown from seed native to southeast Arkansas, northwest Georgia, and Caldwell and Cherokee Counties, Texas. After 5 years on compact coastal plain materials, the Caldwell loblolly trees averaged 8.1 feet in height; those from Cherokee County, 6.2 feet; those from Georgia, 6.4 feet; and those from Arkansas, 5.7 feet. Litter production varied with height, being least for the Arkansas seed source. Seed from the Texas sources is available only in very limited amounts.

Ten-year results of a TVA seed source study with plantings inside and outside the natural range indicated that loblolly pines from inland sources survive better than those from the Atlantic Coastal Plain, but there were no significant differences in height between seed sources. Of the inland sources, northwest Georgia, north and south Alabama, and Tennessee survived best and appeared most suitable for planting outside the natural loblolly range.

Five-year results of the southwide pine seed source study indicate that it is better to obtain seed from the east or west of the planting sites rather than from the north or south.

In the lack of a proven seed source for north Mississippi, it would appear that seed from northwest Georgia, north Alabama, and northeast Mississippi should be used where available. The next best source probably is central Mississippi.

## Grades

Only seedlings meeting Wakeley's specifications for grades 1 and 2 should be planted for erosion control in north Mississippi.

In test plantings made in 1956-58 on eroding loess and Coastal Plain soils, grades 1 and 2 seedlings survived better and grew faster than grade 3 (cull) seedlings. Although differences were not always statistically significant, they were consistent. Survival at the end of the third growing season averaged 10 percent higher for grades 1 and 2 than for grade 3. Grade 1 seedlings grew 18 to 41 percent more in height than grade 3 seedlings during the first 3 years, and grade 2 seedlings 6 to 31 percent more. Differences in growth were still increasing after 5 years. In associated studies, seedlings with roots pruned to 4 inches grew as well as seedlings with 6 to 8-inch roots, regardless of stem characteristics, but they seemed slightly less able to survive extended soil freezing after planting.

When clipped 1-inch above the groundline, in a manner simulating rabbit damage, grade 1 seedlings also had a higher recovery rate than grade 3 trees. Twenty-six percent of the grade 1 trees survived the first growing season, as compared with 10 percent of the clipped grade 3's. Sprouts were more numerous and vigorous on the large seedlings.

Loblolly seedlings can be quickly and accurately graded by stem diameter alone. For eroded sites, their diameter should be at least 1/8-inch. Those that have smaller stems but otherwise meet grade 2 specifications should be reserved for easier planting chances.

## Dormancy

Loblolly is most successfully planted while dormant. A special difficulty in north Mississippi is that most planting stock comes from nurseries south of the area. The longer growing seasons at the nurseries delay hardening in the fall and induce top growth in spring at times when conditions are otherwise suitable for planting.

Seedlings lifted before they are sufficiently hardened are apt to heat in shipment, do not store well, and are subject to winter kill after being planted. Those lifted and planted in February, at the peak of dormancy, have consistently survived better than those planted earlier, regardless of subsequent temperatures. December plantings have incurred heavy losses from winter freezes.

Seedlings planted after they have resumed top growth may survive well, but the tender new shoots are easily broken in handling and killed back by frosts.

Unless they show actively growing roots or shoots, it is difficult to determine whether loblolly seedlings are dormant. Tight bark, i.e., not readily separable from the wood, has been suggested as an indication. Generally, seedlings from nurseries in southern Mississippi and Louisiana are not fully dormant until late in. December.

Special nursery treatments

Special nursery practices have not improved the capacity of loblolly seedlings to survive on eroded soils.

Prelifting pruning at the Ashe Nursery in Mississippi depressed initial survival and early growth and did not improve root morphology. Seedlings were pruned in the beds at the 6- to 7-inch depth 4, 6, 8, and 10 weeks prior to a second undercut, to a depth of 10 inches, at lifting time. The treatments reduced first-year survival 7 percentage points below the 80 percent for unpruned controls, and lessened 3-year height growth by 0.25-foot. Similar tests in Louisiana also led to a recommendation against prelifting pruning.

Until special nursery practices of definite value have been demonstrated, standard graded stock from proven nurseries is most suitable.

Let's summarize for a moment - in the absence of any surefire method of selecting seedlings with the desirable physiological characteristics, we'll have to go with the morphological grades 1 and 2 seedlings. Some of the factors other than the physiological qualities which may result in these seedlings not surviving or growing well are:

1. The density at which they are grown in the nursery. At one nursery where we do business, this used to be 35 to 40 per square foot. The density has now been reduced to 28, resulting in some pretty big seedlings.

2. Lifting - according to Wakeley - one of the greatest responsibilities is to lift these seedlings without injurying them and particularly without breaking off many lateral roots. Operating lifters on heavy soils when the ground is too wet or too dry, or at too great speed under any conditions, breaks many seedling roots with consequent mortality after planting.

3. Grading and culling are integral parts of lifting and packing pine nursery stock. Culling usually eliminates 10 to 20 percent of the seedlings as below plantable grade, and an additional percentage of higher grade seedlings which have suffered mechanical injury or certain fungus infections or insect infestations.

4. Root exposure - from the time the seedlings are first undercut by the lifter blade until they are planted, there is constant

danger that the stock may be injured by exposure (especially of the roots) to sun and wind by heating or drying during shipment or temporary storage, or by other causes, such as freezing. The principal safeguard against such injuries up to and during shipment is the nurseryman's skill and care in lifting, handling, and packing the stock.

5. Heating of the stock in bales, as a result of the physiological activity of the seedlings is another source of danger. Packing in a cool, shady place, moistening the stock with cool water during packing, leaving the bales in piles for as little time as possible. Of course, ideally the bundles or bales are placed in cold storage immediately after packing. Cold, moist storage at temperature just above freezing is ideal. Seedlings packed in bales and in Kraft Polyethylene bags have been kept in prime condition for 6 to 9 weeks with attention.

6. Dates of planting can also have an affect on initial survival. On the Y—LT Project, we've found that seedling survival is progressively improved by later planting, with the highest survival coming from seedlings planted in February or early March. In any event, planting is delayed until soils are wet to a depth of at least 10 inches.

And now a few random thoughts while I have the opportunity:

1. In future years, we can be expected to produce more wood on fewer acres. For one reason we won't have the forest land; another is to concentrate the quantity and quality of our commercial species. Your superior tree program appears to be the answer here.

2. I'm not convinced we've done all we reasonably can to reduce the chances of mortality in seedlings before they ever- reach the field. When we're dealing with millions of seedlings even a 2 percent improvement can be big money.

3. Continue research and demonstrations with direct seeding. There is an opportunity here to cut the cost of regeneration in half.

4. We need a National — or at least a Regional program — to subsidize the small landowner until his trees become merchantable. We have counties where 70 percent of the wage earners make less than $3,000 per year.

5. And finally, not only encourage more field men to visit your nurseries, but how many of you visit the field and become familiar with the problems there?

6. A specific aspect of safety which also affects the field is the weight of the bundles. Every year we had back injuries from lifting and handling bales containing 2,000 seedlings. These weighed up to 130 pounds. We now get our seedlings in 1,000 packages and have had no injuries since we made the change.

## Discussion

Where is the Y-LT Project?

A. (MacNaughton) The Y-LT watersheds are in northwest Mississippi and deal entirely with upland sections of the watershed projects. These are 2 of the 11 authorized flood control projects which were originated in 1944. The Yazoo and Little Tallahatchie have had more forestry practiced on them than any of the other 9 watersheds.