

INTENSIFIED NURSERY PRACTICES--THE KEY TO HIGH-QUALITY,
CUSTOM-GROWN FIELD-GRADED FOREST TREE SEEDLINGS

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Nurserymen can, by using correct cultural methods, grow plants that will not have to be culled or graded in the conventional manner. This will result in considerable savings of time and cost in the packing process.

A second advantage in planting this type seedling is that less root exposure results during packaging. When custom-grown field-graded seedlings are planted, landowners will receive trees that are more vigorous initially because exposure due to grading is eliminated.

With such a large number of variables, how can a nurseryman grow planting stock of a quality that can be shipped without being hand graded at the packing shed? Techniques for accomplishing this are exacting. They have been carefully tested by the Georgia Forestry Commission. The Commission has produced 150 million custom-grown fieldgraded seedlings.

The initial step in producing this type stock is drainage. Seedbeds must be established in such a manner that adequate drainage is maintained at all times. Excessive culls will result in compartments having low areas where water puddles. Runoff must be removed by correctly constructed grassed waterways to avoid damage from erosion. Internal as well as surface drainage must be considered.

Following field layout, soil samples should be obtained from all nursery compartments. Fertility standards, based on soil test results, must be set up for each compartment (table 1). It is important that correct nutrient levels be established to insure proper plant development. Once determined, it is relatively easy for a nurseryman to select fertilizers that will be compatible with his soil management program.

Proper distribution of fertilizer is most important. Seedbeds receiving uneven or inadequate amounts of fertilizer will produce plants that are not uniform. When this situation exists growth varies and both very small and extra large trees will be produced. Plants of this type are not suitable for shipment as custom-grown field-graded stock. Careful supervision should prevent double applications of fertilizer on any seedbeds and insure proper distribution.

TABLE 1.--Desirable nutrient levels for Compartment 1,¹ Page Memorial Nursery, Georgia Forestry Commission

Variable	Level ²	Variable	Level ²
Organic matter.....percent..	1.5-2.0	Potassium.....ppm..	40-50
pH.....	5.0-5.5	Calcium.....ppm..	300-400
Nitrogen.....ppm..	400-500	Magnesium.....ppm..	35-45
Phosphorus.....ppm..	40-60		

¹ Soil type: Tifton sandy loam.

² Obtained from personal communication with Dr. J. T. May, School of Forestry, University of Georgia, 5-13-59.

Areas to be planted should be tilled when soil moisture conditions are correct. A very light harrowing should follow turning and only the upper 2 inches of surface soil should be free of large clods. Large lumps below the immediate seedbed surface are desirable. This method of cultivation, as described by Pein (3), improves soil aeration, percolation, and internal drainage.

Seedbeds scheduled for seedling production in Georgia nurseries are fumigated biennially with methyl bromide. Fumigation is mandatory if severe infestations of disease (such as black root rot), nematodes, weeds, or grasses are present. This operation appears to be expensive; however, the cost per thousand for fumigation is small when seedlings are grown on the same area for two consecutive years.

High-quality forest tree seedlings cannot be grown unless good seed is available. It is essential that only mature cones from well-formed, selected trees be used.

Slash and loblolly pine seed should be sized prior to planting. This can be accomplished with any standard three-screen fanning mill or scalper. Three sizes (large, medium, and small) appear to be adequate. Table 2 gives the various screens used in sizing seed, the resulting number of seed per pound, and the germination percents for slash. Experience has shown that it is not essential to run a germination test on each size. Unsized seed of the same lot germinate about the same as the sized (4).

Seedlings produced from small seed are smaller and more delicate at germination than seedlings produced from larger seed (fig. 1) (4). Many nurserymen have felt that a large percentage of culls resulted from small seed. Sizing seed is one means of eliminating variability in plants. When seed are sized and planted, each lot can be handled individually. This factor justifies cost involved in sizing. If nursery management is practiced properly, however, no difference should exist at lifting time in seedlings produced from either size (table 3). Small seed may require additional applications of nitrogen and/or more frequent irrigation of seedbeds.

Choosing a favorable seedbed density is essential in producing high-quality customgrown field-graded trees. Unusually high densities will produce excessive culls as well as tall, spindly, unbalanced plants. In Georgia we feel that a density of 27 shippable seedlings per square foot, which will yield approximately 700,000 trees per acre, is

TABLE 2.--Average number of slash and loblolly pine seed per pound,¹ by size class, and average germination of slash²

Species and seed size ³	Seed per pound	Germination
	<i>Number</i>	<i>Percent</i>
Slash pine:		
Large.....	11,500	75
Medium.....	14,500	78
Small.....	18,500	74
Unsize.....	--	75
Loblolly pine:		
Large.....	14,600	--
Medium.....	18,000	--
Small.....	24,000	--

¹ Based on averages obtained from 50 samples when 50,000 pounds of seed were sized.

² Based on data obtained from 40 germination tests involving 10 seed lots which weighed 10,000 pounds.

³ Screens used in sizing seed, arranged with large at top and small at bottom, were as follows (in inches): Large, 11/64; medium, slash 8/64 x 3/4, loblolly 6/64 x 3/4; small, slash 7/64 x 3/4, loblolly 5/64.

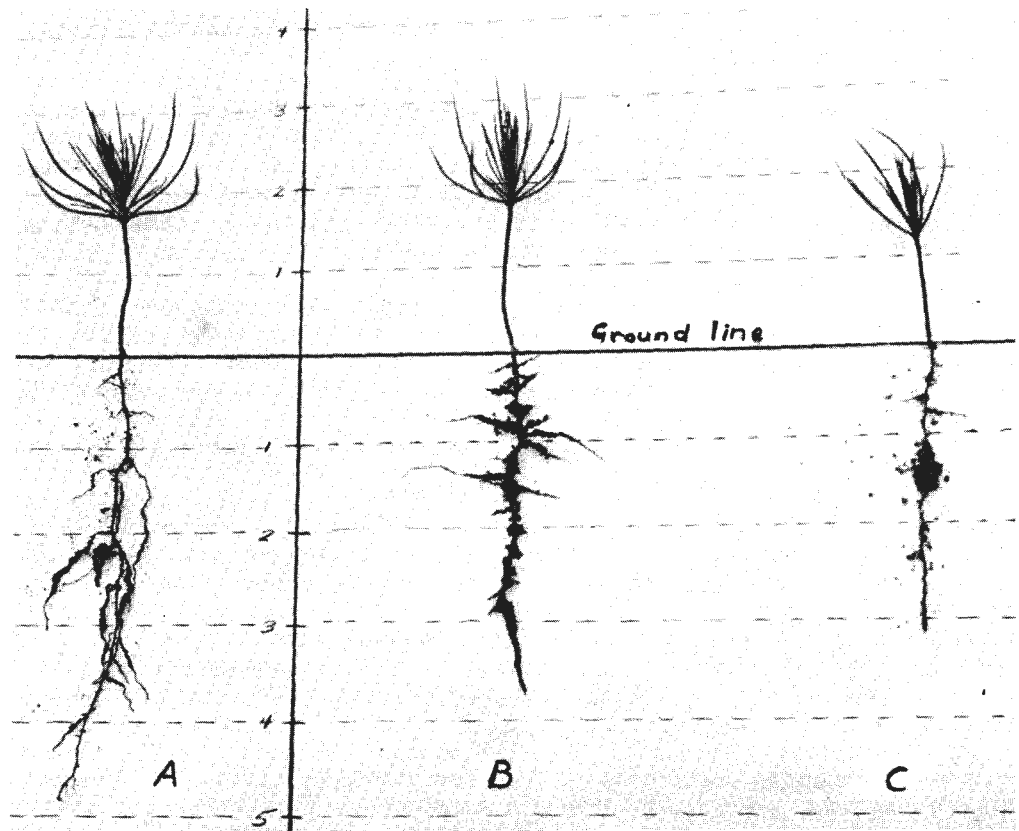


Figure 1.--Typical slash pine seedlings 8 weeks old showing initial variation due to seed size of (A) large, (B) medium, and (C) small.

TABLE 3.--Average top height, root length, and stem diameter for loblolly seedlings, by seed size, May-November¹

Month	Top height when seed size is--			Root length when seed size is--			Stem diameter when seed size is--		
	Large	Medium	Small	Large	Medium	Small	Large	Medium	Small
	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>	<i>Inches</i>
May.....	3-1/2	3	1-3/4	3-1/2	3	3	1/16	1/16	1/32
June.....	3-3/4	4-1/16	3	3-1/2	4-1/2	3-1/2	1/16	1/16	1/32
July.....	4-1/2	5-3/4	3-7/8	4-7/8	5-1/4	3-3/4	1/8	3/32	3/32
August.....	7	7	6	6-1/2	6-3/4	6	1/8	1/8	1/8
September ²	9	9	8	7	7-1/2	8-3/4	5/32	5/32	5/32
October.....	9-1/8	9	8-1/2	7-1/2	7-1/2	7-1/2	3/16	3/16	3/16
November.....	9-1/8	9	8-1/2	7-1/2	7-1/2	7-1/2	1/4	1/4	1/4

¹ Seedlings grown at Morgan Memorial Nursery, Byron, Ga. Seeded 4-13-60. Measurements taken 15th each month.

² Stock root pruned in beds.

most desirable for slash and loblolly pine. The density for a specific nursery may vary, depending on local weather and soil conditions.

Seeders must be calibrated in order to produce the desired number of trees per square foot. Each nurseryman should establish a seedling mortality factor which he expects to encounter from planting to lifting time. This is derived from local experience. Life history plots should be established so that nurserymen not familiar with a particular soil or area can determine this factor. Frequent checks must be made during planting to insure that the correct number of seed are being sown.

Correct mulching also is essential. If seedbed mulches are applied too thick, over one-fourth inch, germination is reduced, seedlings are depressed, damping off organisms are encouraged, and injury results when mulch is removed. It is most important that pine straw be chopped when used as a mulch so that uniform distribution can be obtained.

During the initial germination period it is important to keep seedbed areas moist with light applications of water. Excessive irrigation can result in considerable loss from damping off. After seedlings have become established, applications of water can be made at less frequent intervals. Only enough water should be applied to thoroughly saturate the zone that is occupied by seedling roots. This zone will vary as the season progresses. Nurserymen should dig sample plots to determine the depth of seedling roots prior to irrigating. Heavy and infrequent applications of water are preferred to light frequent ones, after initial germination is obtained. Pine seedlings such as slash and loblolly can survive much longer periods without water than is generally assumed (2). Irrigation during August, September, and October should not be made unless a prolonged drought has existed.

A well-planned nursery spray program for disease and insects is essential in producing high-quality custom-grown field-graded stock. The spraying of Ferbam to control southern fusiform rust is a must. This is the nurseryman's insurance that his program will not be upset by excessive Cronartium fusiforme infection. Seedlings subject to this disease should be sprayed twice a week and before and after each rain. Ferbam should be applied at the rate of 3 pounds per acre. Care must be taken that spray rigs are calibrated properly and that correct practices are used during spraying operations to insure correct applications of material. Periodic inspections should be made for tip moth or other insect damage and corrective measures taken immediately. Constant care and attention is required as it is possible for either disease or insect to damage or ruin a crop, thereby making grading necessary.

Correctly balanced plants may be produced by controlling irrigation and root pruning of seedbeds during August, September, and October. It is standard practice in Georgia nurseries to root prune all seedlings at a depth of from 7 to 9 inches. Local weather conditions determine the number of times stock is pruned. Seedbeds are first undercut during late August, or at a time when seedlings have reached the desired height. Should excessive rains occur, plants are undercut as often as necessary to prevent additional height growth. Root pruning has a definite depressing effect on height growth and at the same time produces a more fibrous root system. A better balanced plant results from this operation (table 3).

Nurserymen usually weed seedbeds for the last time during August or September. At this time seedbeds should be inspected to determine if undesirable trees exist. If it is decided that any trees are of a quality that cannot be shipped ungraded, then they should be field culled during these months when workloads are light rather than during shipping season when the demand for plants is heavy. Beds containing undersized plants in excess of 5 percent should receive this cultural treatment. During the past 6 years Georgia nurseries have shipped more than one billion seedlings and data obtained from approximately one thousand bales, which were randomly inspected, indicate that graded bales frequently contain 5 percent culls. It is most difficult to obtain graded bales that contain less than 5 percent culls when several hundred workers are involved. The task of grading

is routine and workers experience fatigue easily. Work becomes mechanical and efficiency drops.

If a nurseryman has performed his job well, the amount of field culling will be small. Workers will not tire as easily, as work involved in this operation permits more freedom of movement than conventional grading. Each plant does not have to be handled as only undesirable seedlings are removed in the field culling operation. This cultural operation is another form of insurance that only high-quality trees are harvested when custom-grown field-graded trees are packed for shipment to planters.

Prior to lifting, seedbeds are inventoried. Once the beds are inventoried, it is simple to calculate the number of square feet necessary to produce one thousand seedlings. The seedbed is then undercut and the appropriate length staked off to yield the desired number of plants. Lifting crews are instructed to place the seedlings between specific stakes in a given tub. Each container used then contains a predetermined number of plants. Individuals preparing packages for shipment are familiar with the number of plants contained in each tub. If a bale of one thousand is being prepared, one tub of trees is used. Experience has shown this method provides bales equal to graded bales in number of trees. In most cases, seedlings shipped in this manner yield approximately 5 percent overrun. Two other methods of determining the number of plants per package are seedling weight and container volume. Each has been used successfully and some nurserymen may prefer to use one of these methods rather than the one outlined above.

Wraparound seedling crates are desirable for use in packaging seedlings when custom-grown field-graded nursery stock is shipped (1). These wire bound boxes require a minimum amount of labor to pack. In addition, expensive strapping equipment and skilled labor are not required in securing packages. Nursery operations can be set up in such a manner that daily output during shipping season is flexible. Planters and nurserymen can take advantage of weather conditions. During good planting periods, planters desire a large number of trees. When properly grown seedlings exist, nurserymen can ship large numbers of plants in relatively short periods of time. Every nursery worker can pack trees for shipment if required. Nurserymen could fill all orders as requested since they need only to lift and package plants. This flexibility in shipping is another reason why shipping custom-grown field-graded seedlings is desirable.

In conclusion, I feel that quality controls as outlined are adequate for producing high-quality plants. In reality this method of nursery management yields a graded plant, even though it is not graded in today's customary manner. One can safely say that custom-grown field-graded trees are superior to graded nursery stock in that they can be supplied to landowners in a more vigorous condition, at a faster rate, and at a reduced cost. These factors substantiate a firm case for supplying custom-grown field-graded trees to planters and for adopting highly intensive nursery practices which are the key to producing quality seedlings.

References

1. Darby, S. P. 1961. Georgia's wraparound seedling crate. *Tree Planters' Notes* 45: 7.
2. Johnson, H. H. August 1960. Effects of irrigation, fertilization, and plant density on growth and chemical composition of slash pine seedlings. Unpublished Master's thesis, University of Georgia, Athens, Ga.
3. Pein, Ernst. 1953. *Forstsamen-Gewinnung und Forstpflanzen-Anzucht in den U.S.A. and in Deutschland*. Verlag M. & H. Schaper, Hannover, p. 86.
4. Shoulders, Eugene. 1961. Effects of seed size on germination, growth and survival of slash pine. *Jour. Forestry* 59: 363-365.