LOBLOLLY PINE SEEDLING SURVIVAL STUDY, 1979-80 AND 1980-81 PLANTING SEASONS

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Abstract.-- For two consecutive, survival-study test years, loblolly pine seedlings that were conventionally lifted, graded, and packed attained an average survival rate of 86 percent when planted operationally by field crews. Similar seedlings that were hand planted with maximum care had a 91-percent survival rate at the same, site-prepared locations. At a second location where site conditions for planting were nearly optimum, the seedlings achieved 96 percent survival. In an auxiliary study, seedlings were taken directly from the nursery beds by hand and immediately planted with maximum care at an old-field site; their survival was increased to 99 percent.

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INTRODUCTION

Securing acceptable seedling survival in forest plantations should be of the utmost importance to all industrial reforestation programs for many obvious economic reasons. The concern for the successful establishment of loblolly pine plantations influenced Hammermill Paper Company to initiate an operational survival study in the fall of 1979. Periodic inspections were made during the first and second outplanting years. The test was replicated in 1980. The final inspections of the second year installations will be completed in November 1982. The overall objective of these studies is to critically appraise the various factors affecting seedling survival, and identify those most relevent to the Company's planting program. Future efforts to increase seedling survival and reduce the risk for re-planting will be directed toward those factors which are determined to be controllable. Records of the complete procedures, results, and miscellaneous observations are on file at the Southern Timberlands Division office in Selma, Alabama and are available to all interested Foresters.

The tests and procedures used for installing this study will be covered in the following segments of this report.

TEST I METHODS

The first test method consisted of controlled operational type outplantings of randomly selected seedling bales. For each 150,000 loblolly pine seedlings processed for the Company's planting program, paired samples were drawn. The pairs consisted of a lot of "1,000" seedlings and a lot of "250" seedlings taken simultaneously from the nursery packing station conveyor. These seedlings had been previously lifted, graded, counted, and treated with kaolin clay slurry in the standard nursery manner. The lots of 1,000 seedlings each were packed in standard open-end paper bales. The smaller "250" count samples, were completely enclosed in plastic bags and tied with twine. The bales were marked for identification and were shipped either immediately with other seedlings consigned to a forest district, or they were moved into cold storage and held as dictated by distribution schedules. Every movement of the study bales was recorded until the field planting sites were reached and the sample trees were planted. These bales were planted by district crews, using the techniques best suited to the tract.

The "250" seedling groups were handled with maximum care throughout the duration of the cold storage period. They were transported to the operational sites and hand

planted with maximum care by the study manager. The sample was planted adjacent to the districts paired operational planting from the marked bale. The planting site conditions were observed and recorded. Individual sample seedlings from each of the paired plots were flagged and numbered to facilitate later observations. These plots were staked and mapped and inspections were made in April, July, and November during the first growing season. Second year observations were conducted in November. The second phase of Test I was to compare the performance of the plantings previously described with tests established on an optimum old field planting chance. To accomplish this, sample seedlings from the maximum care "250" bag were carefully hand planted in a favorable field site characterized by a fertile loamy sand soil of excellent tilth.

TEST I RESULTS

As indicated in Table 1 the average survival rate for the paired plots installed at the site prepared tracts was 86% for the operational planting methods and 91% for the seedlings handled and planted with maximum care procedures by the study manager. Survival was increased by another 5% increment to 96%, when sample maximum care seedlings were hand planted at the more favorable old field site. The record of causes of mortality observed at the operationally planted plots, as summarized in Table 2 provides a basis for future improvements in planting efficiency. The implementation of selected corrective measures as disclosed by this study should increase initial survival and growth on operational forest plantings. The survival figure of 91% is suggested as a goal for future Company reforestation efforts. The 96% survival attained with operationally lifted and normally stressed nursery stock, indicates the degree to which a favorably textured soil free of clods and debris assisted root regeneration and seedling survival.

The predominant factors contributing to 82% of the observed causes of mortality were as follows:

1. Planting efficiency was hindered by variances in seedling top dimensions and the configuration, volume, and spread of the root systems.
2. Survival was hindered by the use of nursery stock

TEST I RESULTS

Table 1

Summary: Loblolly Pine Seedling Survival Percentages

Combined Results for Two Survival Test Years (1979-80 & 1980-81)

Basis: Trees Surviving at End of First Growing Season

	No. of Plots	Operational Planting At Tract	Maximum Care Handling & Hand Plant. At Tract	At Old Field Site
Company Hand Crews:	29	87%	92%	95%
Contract Hand Crews:	11	81%	93%	98%
Sub-Total:	40	85%	92%	96%
Company Machines:	35	88%	90%	96%
Totals:	75	86%	91%	96%

Table 2

TEST I RESULTS

1980-81 Study Year-First Year Mortality Causes

Operational Planting Techniques

Controllable Causes:	25%	
Unacceptable Planting Depth Roots not Packed Firmly Insufficient Lateral Roots Roots injured with Packing Wheels & Dibbles Seedling Top Injury		
Partly Controllable:	57%	
Low Vigor: Physiological Stresses Vegetative Competition Soil Erosion		
Sub-Total:		82%
Uncontrollable:	13%	
Drought Rabbit & Rat Deer		
Undeterminable:	5%	
Total:		100%

Basis: 1750 Seedlings

Techniques: Machine, Dibble & Planting Hoe.

under phyliological stress. These stresses were caused by shocks accumulated between lifting and planting.

3. Difficulties encountered with backfilling and packing soil for adequate root contact adversely impacted survival.

4. Adverse affects on planting in rough terrain with residual debris also was a major problem.

5. Improper selection of the most favorable spot in which to locate the transplant was also a major problem, especially with minimum site treatments.

The inferred consequences of these five factors were (1) reduced root regeneration and (2) impaired moisture absorption and therefore nutrient uptake. The combination of these two factors probably was the major cause of mortality for this study.

TEST II METHODS

Th second major test method used in the study was to appraise the physiological condition of the Company's nursery stock throughout the two installation years, and thereby establish a bench mark for potential seedling survival. All of the normal nursery handling methods were intentionally by-passed. At bi-weekly intervals from mid-November to mid-March, sample seedlings were carefully hand-dug, lifted, graded, and immediately planted on the old field site where planting conditions were nearly optimum.

Survival observations were made at this site simultaneously with those made on the district study plots.

TEST II RESULTS

Test II achieved an overall survival rate of 99% as shown in Table 3. It is suggested that this high survival rate can be attributed to the following factors.

1. The excellent physiological condition of the nursery stock when planted.

2. The favorable soil texture at the optimum field site.

3. The conservation of ample fibrous root masses.

4. The placement of root systems to achieve firm physical contact with the soil.

The seedling survival of early lifted and planted seedlings (November 19), and the survival of late lifted and planted seedlings (March 10), were both nearly 100%. However, all the bi-weekly plantings made prior to December 20 experienced severe needle burn following the first freeze. Later growth and shoot elongation were not adversely affected. Subsequent plantings had noticeably less foliage burn and retained a thrifty color throughout the transplanting season. The excellent performance of bi-weekly plantings which were hand-dug and set, illustrates the maximum survival potential.

Table 3

TEST II RESULTS

Summary of Loblolly Pine Seedling Survival Percentages-At Optimum Field Site

Combined Results For The Two Test Year Installations: 1979-80 & 1980-81

Basis: Trees Surviving At End Of First Growing Season

Seedlings Hand Dug & Immediately Hand Planted With Maximum Care At Bi-Weekly Intervals

From: November 19 to March 10

Total Number of Seedlings: 2829

Survival Percentage: 99%

CONCLUSION

Based on the results of this survival study and related observations made during two transplanting seasons, it is reasonable to assume that the greatest opportunities to lower seedling mortality originate in the tree nursery. It is here that an optimum prescribed type seedling may be cultured, a useable one that matches the planting site and requires no alteration by field workers. Seedling size and shoot to root ratio should be controlled at the nursery and not at the planting site. The morphological and physiological attributes of a seedling crop can be enhanced by the proper timing of the effective cultural activities. The configuration of the root system must accomodate site conditions and planting methods.

The controllable mortality factors are widespread and overlapping. The selection of the proper site preparation treatments and its consequences upon debris removal, vegetative competition, and soil erosion, and soil moisture have a direct bearing on survival. Tree planting equipment must be selected according to the planting opportunity and maintained in suitable condition. The manner in which seedling bales are transported, stored, and handled after leaving the nursery must preserve the good physiological condition of the seedlings.

Dedicated supervision of all hand and machine planting crews is essential. The many administrative and supervisory details that benefit seedling survival, should be the primary objective of an annual pre-planting training session for reforestation personnel. It is at these meetings that participating nurserymen can emphasize the importance of proper handling of bare-root seedlings to conserve physiological vigor. Tree planters must often be reminded that seedling vigor varies throughout the season and that nursery workers can not altogether refrain from occasionally stressing lots of seedlings by lifting them under adverse conditions. Shipping committments at times dominate the best nursery practice. Since these pre-stressed lots are not recognizable, it is essential that all seedlings be given maximum affordable care.

The goal of acceptable loblolly pine seedling survival in plantations is highly dependent upon the dedicated joint efforts of all nursery and reforestation personnel to follow the best known practices as provided by cooperating research workers.