TREE IMPROVEMENT RESEARCH

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Abstract.---Open pollinated seed from five clones was sown in both "pure" plots (clones kept separate) or "random" plots (a random sowing of all five clones together). Average root collar diameter of 1-0 seedlings varied by clone and sowing method. For clones with seed that germinated rapidly, random sowing produced larger seedlings than pure sowing. But for clones with seed that germinated slowly, pure sowing produced larger seedlings than random sowing.

General collections on all tested clones can begin at least three weeks earlier than normal for loblolly pine with no significant decrease in seed yield or quality.

Slash pine cones stored in one bushel sacks had 30 percent greater seed yield and the required opening time was reduced by 40 percent compared to cones stored in 20 bushel boxes.

Key Words.---Progeny testing, germination, cone collection, seed yields, cone storage.

PURE VS. RANDOM SOWING STUDY

Introduction

Seed for progeny tests is sown in small plots by family, but for operational sowing, in most cases, a random mixture of the seed from all clones in a seed orchard will be sown in the nursery. The objective of this study was to observe any differences in seedling size and field performance that might occur as a result of sowing clonal seed lots either separately or in random mixture. If orchard seed harvesting becomes mechanized using either vacuum harvesters or seed net, separate sowing of clonal seed lots will be impossible.

Methods

Five of our Piedmont loblolly pine (*Pinus taeda*) clones were selected to give a range in speed of germination and size of seedlings produced in the seedbed. Of the five clones, three (506, 508, 512) were Virginia Division of Forestry trees, one (14-15) was a Continental Forest Industries tree, and one (6-10) was a Hoerner Waldorf (now Champion International) tree. The seed used was

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open pollinated seed from the 1972 harvest. The seed from these five clones was sown both in "pure" plots (clonal seed lots separate) and in "random" plots (a random sowing of all five clones together). Each clone was color coded in the nursery bed using colored toothpicks, and all were hand sown in rows six inches apart with two seeds placed every 2/3-inch within rows. The desired density was 36 seedlings per square foot. Where both seeds germinated in a spot one of the seedlings was removed. Sowing treatments were replicated four times. Final density was 29.8 per square foot in the pure plots and 28.4 in the random plots.

Seedbed Results

As expected, the five clones varied considerably in speed of germination (Figure 1). Clone 508 was the most rapid, followed closely by 512. Considerably slower was clone 14-15, then 506, with 6-10 by far the slowest.

In the pure sown plots there was little difference in average root collar diameter when the 1-0 seedlings were lifted in February (Figure 2). The slightly larger diameter of clone 6-10 seedlings was probably due to lower density in the pure plots of this clone (20 seedlings per square foot vs. a range of 28 to 30 for the other four clones). Clone 6-10 was a very slow germinator with the final or total germination of less than 40 percent (Figure 1).

In the random sown plots, on the other hand, there were considerable differences in average root collar diameter when the seedlings were lifted. (Figure 2) These differences seem to be related to speed of germination, with clones 508 and 512 being the fastest germinators and being the largest. Apparently they were able to get a head start on their slower germinating neighbors and gain a dominant position in the seedbed. This is reflected in the differences in percent of undersized (cull) seedlings produced (Table 1). In the pure sown plots the percent of undersized cull seedlings ranged from a low of 11 percent for clones 508 and 14-15 to a high of 19 percent for 512.

Field Planting

After lifting and measuring, the seedlings were planted in the field. The seedlings from the randomly sown plots were placed in racks so that in the field each seedling had the same neighbors it had in the nursery bed. Where missing spots occurred in the seedbed plots, commercial check seedlings were planted in the field. Seedling heights have been measured annually.

Height growth differences in the field reflect seedbed differences, and have gradually increased over the five years since the study was outplanted. After five years in the field, for clones 508 and 512, the two fastest germinators, seedlings from random sown plots are .5 foot taller than seedlings from pure sown plots. Apparently the competitive advantage they had in the random seedbed has carried over to the field. For clone 6-10, the slowest germinator, seedlings from random sown plots are .8 feet shorter than seedlings from pure sown plots. Here the competitive disadvantage in the random seedbed has apparently carried over to the field.

F I G U R E 1

1973 LOBLOLLY RANDOM SEED SOWING STUDY GERMINATION DATA FROM PURE SOWN PLOTS

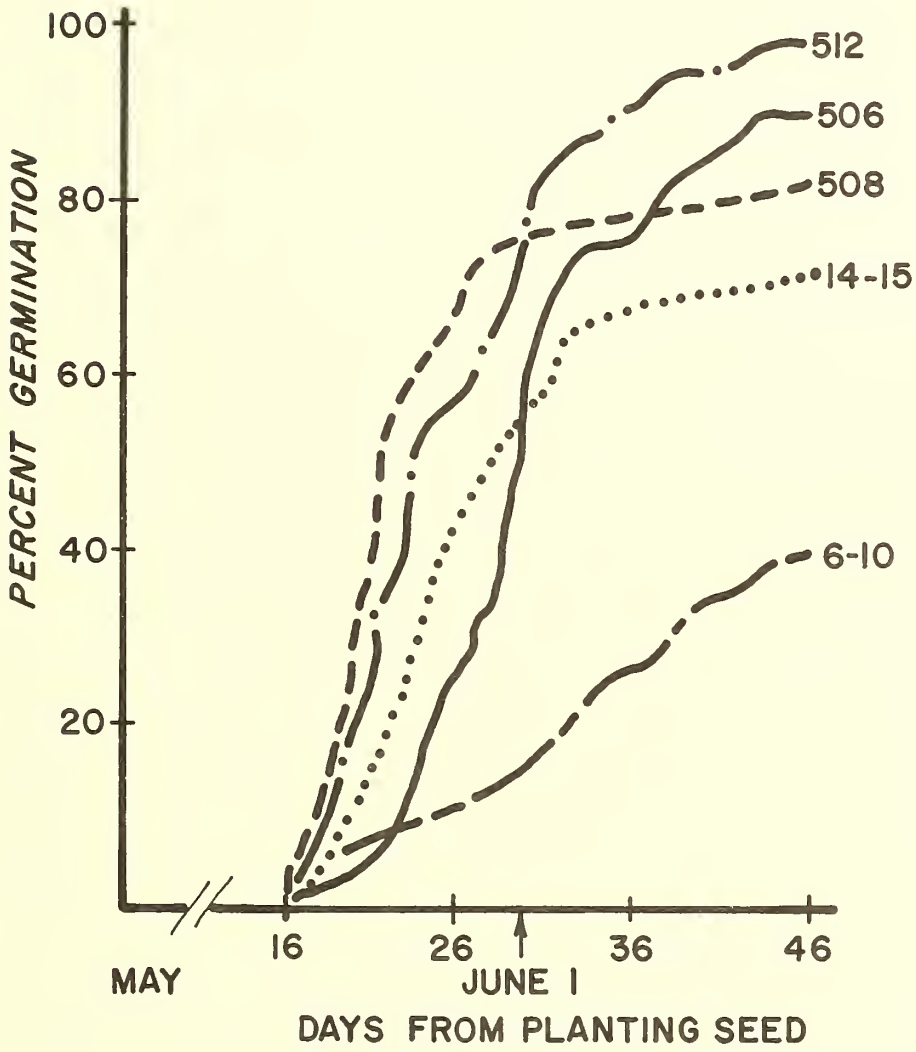
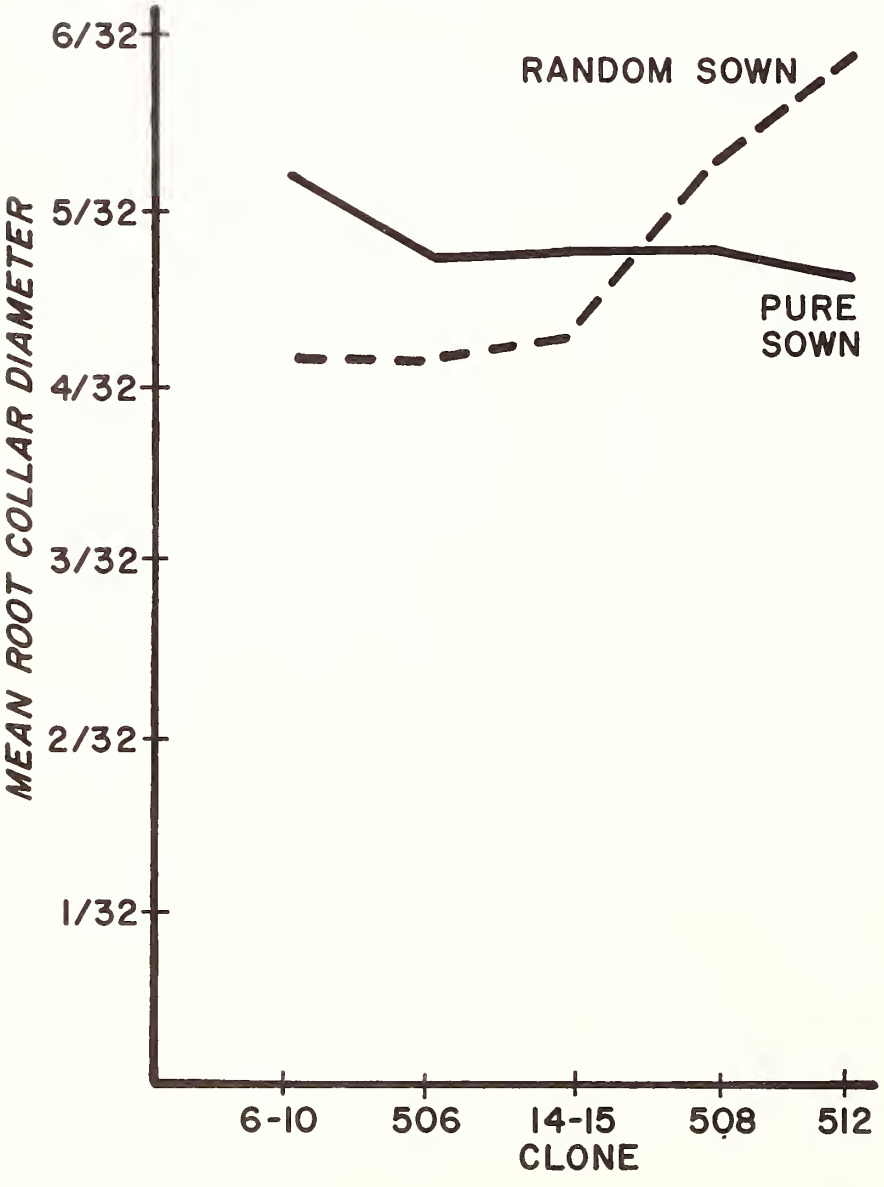


FIGURE 2

1973 LOBLOLLY RANDOM SEED SOWING STUDY
CLONAL MEAN ROOT COLLAR DIAMETERS



1973 LOBLOLLY RANDOM SEED SOWING STUDY - ROOT COLLAR DIAMETERS (1/32")

OF 1-0 RANDOMLY SOWN SEEDLINGS WHEN LIFTED

FAMILY	MEAN DIAMETER	% OF 2 & 3/32"
512	5.88	7
508	5.37	4
14-15	4.26	19
506	4.17	22
6-10	4.14	37

Table 1

LOBLOLLY EARLY CONE COLLECTION STUDY

Introduction

The objective of this study was to determine which of the seed orchard clones, if any, could be harvested early in the season with both acceptable seed yields and germination. With the normal collection season usually beginning about October 1, the identification of early ripening clones (even though the cones may not float in SAE 20 motor oil) could possibly extend our hand collection period by 20 percent or more.

1975 Test

The study was initiated in September 1975 when five loblolly clones (two Piedmont and three Coastal Plain) were selected. These clones were some of the heaviest cone producing clones at the time. Three typical ramets per clone were selected in the oldest orchards (approximately 14 years of age). With the normal collection period based on past experience beginning during early October, we decided to collect six healthy cones per ramet weekly beginning during early September and continuing through early October, for a total collection period of six weeks.

Procedure

Immediately after each collection, the six cones per ramet were bagged in small burlap sacks, labeled by ramet and date of collection, and placed in a lath shade house covered with 50 percent shade cloth. All sacks were wet down daily and turned weekly in an effort to artificially mature the collected cones and seed.

After the last collection date (normal collection time of early October), the frequency of watering decreased to about once a week in an effort to dry the cones slowly at ambient temperatures. During late October, the cone sacks were placed in the nursery cone drying wagons and dried for 48 hours. Each lot was then hand extracted, collecting those seeds which were easily "bumped" from the cones. The cones were then bagged again, soaked down, redried, and a second extraction (difficult) was made in an effort to determine if the second seed yields were really worth the effort. Finally each cone was manually dissected and a count made of the number of seed remaining in the cones. Seed yields, seed size, and total seed germination percentages were calculated and reported by the Virginia Seed Test Laboratory.

Results of 1975 Test (Table 2)

1. Mold problems occurred on some of the earliest collections and contributes to the reduced germination.

1975 EARLY CONE COLLECTION STUDY - LOBLOLLY

FIRST AND SECOND SEED EXTRACTION

Hill/Clone	Seed Extract	Test	Cone Collection Dates 9/4	9/11	9/18	9/25	10/2	10/9
G 506	1st	# Seed	1126	1537	1188	1305	685	812
	"	Germ %	7	31	100+	89	90	99
	"	Seed/lb	17,503	17,945	16,602	15,666	15,542	16,368
	2nd	# Seed	359	134	305	330	555	523
	"	Germ %	1.25	21.76	46.33	70.25	100+	100+
	"	Seed/lb	19,034	18,313	17,326	16,122	15,664	17,646
R 523	1st	# Seed	939	1255	1110	1210	1433	1251
	"	Germ %	94	87	80	91	100+	100+
	"	Seed/lb	20,345	18,224	17,766	18,211	16,631	17,000
	2nd	# Seed	421	330	219	182	112	66
	"	Germ %	45.50	63.33	55.50	59.00	78.00	60.60
	"	Seed/lb	21,662	19,997	19,067	19,295	16,757	19,069
J 2-8	1st	# Seed	1292	973	1074	965	900	1093
	"	Germ %	46	82	95	98	100+	95
	"	Seed/lb	20,571	19,126	19,428	18,403	17,652	18,068
	2nd	# Seed	161	262	427	405	594	241
	"	Germ %	43.50	74.67	75.25	82.50	100+	79.50
	"	Seed/lb	19,854	19,126	19,089	18,694	17,878	19,649
R 525	1st	# Seed	846	789	689	524	822	700
	"	Germ %	98	91	100+	100+	100	99
	"	Seed/lb	17,371	16,162	15,451	16,851	15,996	16,010
	2nd	# Seed	41	87	108	153	118	37
	"	Germ %	63.41	59.77	79.00	80.50	66.00	64.86
	"	Seed/lb	17,545	18,161	16,074	17,641	16,254	16,987
S 529	1st	# Seed	856	870	841	877	671	1230
	"	Germ %	75	91	89	91.72	99	100
	"	Seed/lb	16,441	15,544	14,619	15,190	13,683	14,144
	2nd	# Seed	453	425	477	273	642	281
	"	Germ %	58.52	75.25	96.13	76.00	100+	82.66
	"	Seed/lb	16,303	16,808	15,069	15,292	13,781	14,498

Table 2

2. All collections on tested clones could begin at least 3-4 weeks earlier than normal.

3. It appears that clones 523 and 525 could safely be collected as much as five weeks earlier than normal.

4. The smaller, more difficult seed to extract germinated quite well and would probably justify extraction costs. The average percent recovery for the first extraction for all five clones combined was 81.8 percent. An additional 17.9 percent was recovered in the second extraction.

1976 Test

A similar study was repeated in the fall of 1976 to include seven new clones. Clone 506 was included as a check against the previous years study. All procedures were identical to 1975.

Results of 1976 Test (Table 3)

1. Scattered mold problems again occurred primarily on the August 31 and September 7 collections.

2. All collections on tested clones could begin at least three weeks earlier than normal with some new clones 4-6 weeks earlier than normal.

3. Clone 506 performed as in the 1975 test. That is, in both years tests showed this clone could only be picked 2-3 weeks earlier than normal.

4. The smaller seed again appeared to be good enough to justify second extraction costs.

Overall Results of Both Tests

1. Twelve of the heaviest producing loblolly clones have been screened for early collections. Of these, four clones canbe collected as early as September 1, or five weeks earlier than normal.

2. General collections on all tested clones can begin at least three weeks earlier than normal.

3. Our general collection period has been increased from five weeks to eight weeks for the majority of the clones, with no significant decrease in seed quality.

1976 EARLY CONE COLLECTION STUDY - LOBLOLLY

FIRST AND SECOND SEED EXTRACTION

Hill/Clone	Seed Extract	Test	Cone Collection Dates 8/31	9/7	9/14	9/21	9/28	10/5
B 6-13	1st	# Seed	2110	1908	2000	1973	2377	2296
	"	Germ %	45.4	66.8	83.0	87.6	86.3	95.8
	2nd	# Seed	441	363	354	486	369	362
	"	Germ %	40.30	46.13	76.69	90.0	70.88	79.40
D 4-18	1st	# Seed	1823	1934	1812	2044	1955	1922
	"	Germ %	39.2	57.5	70.3	77.9	65.2	85.9
	2nd	# Seed	43	39	136	72	54	111
	"	Germ %	27.91	38.64	46.33	54.93	32.73	46.2
D 14-15	1st	# Seed	1345	1313	1423	1270	1478	1783
	"	Germ %	68.3	68.3	72.2	81.0	90.9	80.1
	2nd	# Seed	659	716	649	767	608	432
	"	Germ %	42.1	46.5	74.4	82.2	86.1	76.2
S 526	1st	# Seed	1917	1821	1600	1709	1469	1586
	"	Germ %	100+	89.5	79.3	77.7	78.8	93.3
	2nd	# Seed	198	163	347	167	442	248
	"	Germ %	64.14	78.53	78.96	75.31	62.50	83.81
G 506	1st	# Seed	2122	1776	1664	1835	2045	1930
	"	Germ %	10.7	56.2	58.7	85.6	87.1	80.6
	2nd	# Seed	167	339	448	390	622	355
	"	Germ %	2.35	44.41	69.3	69.39	84.6	100+
C 532	1st	# Seed	2071	2167	2001	1834	2155	1918
	"	Germ %	67.4	73.9	84.7	83.4	91.1	95.0
	2nd	# Seed	130	165	101	219	196	139
	"	Germ %	45.39	53.99	71.0	56.83	76.02	66.19
B 6-10	1st	# Seed	1859	1894	1924	1831	1678	1832
	"	Germ %	0	23.9	37.4	62.3	57.5	86.7
	2nd	# Seed	226	198	472	328	139	200
	"	Germ %	27.76	52.13	36.64	46.50	49.75	29.12
H 508	1st	# Seed	1269	841	435	271	488	648
	"	Germ %	62.0	91.7	83.1	70.8	90.1	91.2
	2nd	# Seed	389	699	1204	1018	1355	1193
	"	Germ %	96.5	29.12	89.0	91.4	94.2	95.7

Table 3

CONE STORAGE AND EXTRACTION STUDY

Large cone crops put pressure on extraction facilities. Several organizations produced cone crops far in excess of their extractory capacity. Cone storage then becomes more critical. Several methods of cone storage are being used; one commonly suggested is large bulk crates or boxes. Recently St. Regis compared the bulk storage method with the standard burlap sack system. Homer Gresham (The NC State Annual Report) collected two bushels of slash pine cones from each of several ramets of numerous clones. One bushel from each ramet was placed in a burlap bag and the other placed in a 20 bushel cone box. Eighty bushels of cones were collected and stored by each method.

The resulting and quite dramatic differences in seed yields from the two methods after storage to the first week of December are shown in Table 4. Cones stored in sacks had 30 percent greater seed yield and the required opening time was reduced by 40 percent. Homer reported that 5 percent of the cones in crates were case-hardened while virtually no case-hardening was observed among cones stored in sacks.

Processing the cones through the drying kilns and tumblers a second or third time sometimes provides meaningful increases in seed yield. The seed from follow-up runs is sometimes of lower quality, with lower germination percentages, but the increased overall yield of up to 15 percent can be of great value. (Virginia Division of Forestry study was 17.9 percent). Significant quantities of high-value seed can be lost if care is not taken in the cone storage and seed extraction.

COMPARISON OF YIELDS FROM CONES STORED IN BULK

AND BURLAP CONTAINERS BY ST. REGIS

NUMBER OF BUSHELS	TYPE OF CONTAINERS	TIME TO OPEN 1/	LBS. OF SEED PER BUSHEL
80	20 bu./crate	13 ½ hrs.	1.04
80	1 bu./bag	8 hrs.	1.35

1/ Extraction was done in their new seed plant.

Table 4