PROGRESS REPORT ON TESTING PITCH X LOBLOLLY PINE HYBRIDS AND ON PROVIDING HYBRID SEED FOR MASS PLANTINGS[1]

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ABSTRACT

Recent test plantings of hybrids between selected clones of pitch and loblolly pines are briefly described, and results from some of the 1971-74 test plantings are discussed. Not only do certain hybrids combine loblolly pine's rate of growth and form with pitch pine's winter hardiness, but their fibrous root systems apparently permit rapid growth on droughty sites or strip-mined areas. Hybrids in the early test plantings have so sttracted the attention of practicing foresters that there are demands for stock for mass plantings. These demands have forced decisions and action on procedures for supplying needed seed, and the procedures, plans, and actions are also briefly described.

INTRODUCTION

As mentioned in more detail in last year's paper (Little and Trew 1976), pitch pine (*Pinus rigida* Mill.) is a hardy yellow pine that grows as far north as Maine, with outlying stands in Quebec and Ontario. However, its rate of growth and form are poorer than loblolly pine (*P. taeda* L.), so foresters have been interested in the possibility of combining loblolly pine's rate of growth and form with pitch pine's winter hardiness.

Last year's paper described the study started in 1963 by the Northeastern Forest Experiment Station and Westvaco--with the help of state foresters and other interested people in several states. Selection of ortets, establishment of the breeding orchard at New Lisbon, N. J., controlled pollinations between clones of the two species, and progeny trials established through 1975 are all discussed in that paper.

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In this paper we will briefly describe the 1976 test plantings, 1975 results from some of the 1971-1974 test plantings, and the steps that have been taken toward providing desirable hybrid seed for mass plantings.

1976 TEST PLANTINGS

Five test plantings were established in 1976. The following tabulation shows the location, planter or principal cooperator, and number of stocks in these plantings.

Location	Planter or Principal Cooperator	Number of Stocks
Hampshire County, West Virginia	Westvaco Corporation	30 hybrids + 4 checks
Patrick County, Virginia	Virginia Polytechnic Institute and State University	55 hybrids + 8 checks
Sussex County, New Jersey	N.J. Div. Parks and Forestry, NE Station	55 hybrids + 8 checks
Saratoga County, New York	N.Y. Div. Lands and Forests, NE Station	55 hybrids + 8 checks
Merrimack County, New Hampshire	University of New Hampshire	59 hybrids + 7 checks

For the most part plantings included a 10-tree row of each stock in each of three blocks. However, in the West Virginia planting 5-tree rows were used because of an insufficient number of trees in several stocks.

The plantings so far established provide a test of several to many clonal crosses in different geographic areas. The number of clonal crosses now in test plantings are by areas: 37 in Kentucky, 137 in West Virginia, 103 in Virginia, 140 in central Maryland, 134 in southern New Jersey, 83 in central Pennsylvania, 88 in northern New Jersey, 95 in upstate New York, 80 on Martha's Vineyard, and 85 in central New England (central Massachusetts and southern New Hampshire).

The last seeds from controlled crosses in the New Lisbon orchard were sown in the Maryland Forest Service nursery last spring. They should provide stock for five more test plantings--probably in Virginia, West Virginia, Maryland, central Pennsylvania, and New Hampshire. After they are established, the number of clonal crosses being tested within geographic areas will still be less than 200, but often about 100 or more. Even though clones now within the New Lisbon orchard might provide over 1,000 crosses between clones of the two species, the number of crosses in test plantings should permit sound appraisal of the local potential of such hybrids, and may provide enough good crosses for starting small F_1 orchards.

RESULTS

Differences among stocks in the test plantings continue to increase with age. For example, the difference in average height between the tallest and shortest stocks was:

(1) in Monroe County, W. Va., 3.4 ft. after 4 growing seasons and 4.1 ft. after 5 growing seasons,

(2) in Greenbrier County, W. Va., 2.4 ft. after 3 growing seasons and 3.3 ft. after 4 growing seasons,

(3) in Cecil County, Md., 2,3 ft. after 3 growing seasons and 3.5 ft. after 4 growing seasons, and

(4) in Ocean County, N. J., 1.0 ft. after 2 growing seasons and 2.0 ft. after 3 growing seasons. (See tables in last year's paper and tables 1-4,)

Differences among stocks are becoming very noticeable. For example, after 5 growing seasons the average and maximum heights of one hybrid, 66 X 15A, are about 50 percent more than those of the pitch pine check from wind-pollinated orchard clones (table 1). On some sites where growth is relatively slow, the relative differences are even greater: for example, at an elevation of 3,250 ft. in West Virginia the best hybrids are twice as tall as the loblolly check stock after 4 growing seasons (table 2). In the Maryland Barrens the best hybrids are twice as tall as the pitch Check stock after the same interval (table 3).

Differences between the best hybrids and the loblolly check stocks vary with climatic and site conditions. In Monroe County, W. Va., regular loblolly has been gradually losing rank--dropping from the ninth tallest in 1974 to twenty-ninth in 1975 (table 1). At a higher elevation in West Virginia regular loblolly was the shortest stock after 3 or 4 growing seasons (table 2). In Cecil County, Md., regular loblolly grows well, although certain hybrid stocks equal or exceed it (tables 3 and 5). In Ritchie County, W. Va., loblolly's growth is somewhat better than pitch pine during the first 3 years, but already several hybrid stocks are taller (table 6). In southern New Jersey regular loblolly grows well on Evesboro soils, as in the 1973 planting (table 4), but after only 2 growing seasons it is back with pitch pine on a Lakewood soil (table 7). There the poor growth of regular loblolly is similar to that observed in a 1945 planting on Lakewood soil (Little et al. 1967).

Relative ranks of stocks in the older test plantings are apparently becoming stabilized.

(1) In the 1971 West Virginia plantings, the tallest four stocks after the 1975 growing season were among the tallest five stocks in 1974. One stock tied for third in 1974 slid to seventh place, and the two tied for fifth in 1975 came up from seventh and seventeenth. The bottom four stocks remained the same.

(2) In the 1972 West Virginia planting the lowest four stocks are the same as a year earlier, although the order changed slightly--the pitch check from the New Lisbon orchard falling back. The top three stocks are the same and in the same order in both years, while the next three stocks that were tied in 1975 were in fourth, fifth, and ninth places in 1974.

(3) In the 1972 Maryland planting the bottom two and the top six stocks are the same in 1975 as in 1974, and are in the same order.

(4) In the 1973 New Jersey planting the bottom five and the top four stocks are the same in both years, although there are some changes in relative rank.

The pitch X loblolly seedlings have very extensive, very fibrous root systems that apparently permit rapid growth on droughty or disturbed sites. In certain crosses the roots of 1-0 seedlings approach 2 feet in length before they are pruned to permit planting without appreciable distortion in the slits made by planting bars.

The extensive, very fibrous root systems of pitch X loblolly hybrids were also noted in the 1945 test plantings (Little and Somes 1951). Root systems of the hybrids far exceed those of both parent species, but especially loblolly in length aid branchiness. Probably because of their root systems, the hybrids apparently grow well on droughty sites--as the deeply leached, coarse-sand Lakewood soil of the 1974 test planting in southern New Jersey. There the best hybrids had average heights of about 3 feet (table 7), or taller than the 2.4 feet of the best hybrid included in the 1973 test planting on Evesboro soil, at the end of two growing seasons.

The Maryland Forest Service planted Korean pitch X loblolly hybrids of unknown source (assumed F_1 X wind) in 1971, along with red pine, Scotch pine, and Norway spruce on bare shale of an old strip-mined area near Frostburg at an elevation of about 2,200 feet. The area had been bare of vegetation for many years, and was leveled with a bulldozer prior to planting. At the end of the fifth growing season the hybrids had an estimated average height of 5 feet, with some stems up to 9 feet tall, while the other conifers were 1 to 2 feet tall.

The hybrids near Frostburg bore mature cones in the fall of 1975, and about one bushel was gathered. The cones opened well and produced about 9 ounces of seed per bushel, averaging 32,000 seeds per pound. The seeds were sown on February 18, 1976, in the Buckingham State Forest Tree Nursery. As of July, one ounce of seed has produced 953 seedlings.

SUPPLYING SEED FOR MASS PLANTINGS

REQUESTS

Because the initial growth of some of our pitch X loblolly hybrids has been so rapid, practicing foresters started a year ago to ask for seed for mass plantings. Initial requests came from woodland managers employed by Westvaco, a company that has holdings in the Piedmont and western sections of Virginia, in West Virginia, southern Ohio, Kentucky, and Tennessee. These areas are outside of loblolly pine's natural range, and even in the portions where loblolly pine grows well, certain hybrids seem more desirable because so far they have grown just as rapidly and have more resistance to wet snows and winter injury than does loblolly.

Two other industrial companies, certain state forestry departments, and one national forest have expressed interest in obtaining seeds of desirable crosses for mass plantings--particularly if test plantings continue to show that certain crosses do produce rapid-growing, well-formed, winter-hardy trees.

PROCEDURES

As a result of such requests, Dr. P. W. Garrett of the Northeastern Station and Dr. S. K. Hyun of the College of Agriculture, Seoul National University, Korea, met with the authors last September. Decisions were made then on procedures for supplying hybrid seeds in bulk.

The only procedure available for providing seeds in bulk during the next few years seemed to be that suggested by the work of Dr. E. C. Franklin of the Southeastern Forest Experiment Station--mistblowing pollen of desirable clones of one species on female flowers of the other species just as soon as flowers are receptive (see, for example, Woessner and Franklin 1973). Trew investigated this possible procedure.

For the period after 6 to 8 years reliance might be placed on seed produced by wind pollination of selected F_1 clones--provided orchards are established in places where contamination from other sources of pitch or loblolly pollen is low. Hyun's (1974) work suggests that the F2 hybrids from wind pollination of F_1 trees might be fully as desirable as the F_1 crosses from controlled pollinations. Even if there were more segregation than Hyun observed, more than 50 percent of the offspring might be highly desirable. Suggested steps in this procedure are as follows:

(1) As soon as plantings within a state or geographic area are 4 to 5 years old, select the crosses that are outstanding in height and form. Screen the selected crosses to eliminate parents whose offspring are generally average or below, and excellent in only one or two crosses. Strive for a minimum of 30 crosses in the orchard. At a spacing of 15 by 15 feet, a 30-cross orchard should have no more than 5 half-sibs, and these have to be properly separated in the orchard (verbal statement by J. B. Jett, N. C. State University Cooperative Tree Improvement Program). However, for small orchards that would permit early production without additional screening and would also test their value, 20 crosses involving 30 or more parents might be the procedure followed by certain states, and present test plantings may be sufficient in areas having about 100 clonal crosses.

(2) Establish the F_1 orchard by grafting to carry the genetic traits of the selected crosses.

(3) Use pitch X loblolly pine hybrids as rootstock, because Dr. Hyun verbally stated that the success of grafting is higher (because of less incompatibility) on such rootstock than on pitch or loblolly seedlings.

(4) Collect scion material of a cross from progeny graded for height and form in the test plantings.

(5) If feasible, establish seed orchards farther south than the areas to be planted, because trees in southern orchards start flowering earlier and flower more profusely than those in northern orchards.

(6) If later results from test plantings show the need, rogue the orchards.

Seedlings from the cones collected by the Maryland Forest Service last fall near Frostburg should give us an early indication of the value of F_1 orchards in mass-producing pitch X loblolly hybrids.

ACTIONS TO DATE

Westvaco's short-range plans for providing pitch X loblolly hybrids to its woodlands operations were started in the spring of 1976, because the Corporation's observation and evaluation of existing progeny tests indicate the hybrids can survive and grow well under adverse site and climatic conditions. The extensive, fibrous root systems are undoubtedly responsible for an excellent survival rate, even on the barren surface of mine spoil. The contribution from the pitch side of the cross makes some crosses capable of withstanding temperatures below 0° F., as well as fluctuating temperatures, without the terminal dieback that loblolly has under the same conditions. The hybrids have also withstood heavy snow and ice without breaking, so they seem resistant to wet-snow and ice damage.

Therefore, Westvaco purchased a back-pack mistblower and had a 10-foot tube extension built for applying pollen into the crowns of pitch ramets in the New Lisbon orchard. Pollen from four selected clones of loblolly pine was applied last spring to ten selected clones of pitch pine, or a total of 71 ramets. Procedures followed were guided by advice from Dr. E. C. Franklin and others. Application of loblolly pollen to pitch pine seemed advisable, because hybrid seedlings have loblolly-like needles and can be separated from pitch seedlings at the time of grading--if such separation seems desirable.

Westvaco also established three acres of pitch pine seedlings at a spacing of 25 by 25 feet in its Summerville, S. C,, seed-orchard complex for grafting of 30 select pitch clones in the spring of 1977. About 20 of the select pitch clones will come from cooperators in the North Carolina State University Cooperative Tree Improvement Program. About 1980 controlled pollinations will begin, using pollen from select loblollies of the Virginia Piedmont, South Carolina, and Kentucky-Tennessee seed orchards, The hybrid seedlings from these crosses will be tested on Westvaco lands where it seems desirable to introduce the hybrid: i.e., Virginia Piedmont, West Virginia, Ohio Valley, and the Kentucky-Tennessee area. Mass pollination will be used in the 3-acre orchard to provide interim operational-planting stock,

Westvaco's long-range plans are aimed toward developing an F1 seed orchard. When the progeny tests are 4 years old, intensive selections of F_1 crosses will be made. We estimate that about 1987 at least 30 F_1 crosses will be available for grafting into the F1 orchard.

Westvaco reali-es that it is taking a calculated risk, but its plans are predicated upon the outstanding performance of existing pitch X loblolly hybrids in progeny tests up to 5 years old and on the experience of Dr. S. K. Hyun in Korea. Dr. Hyun stated in September 1975 that he will soon complete a 40-hectare, F_1 pitch X loblolly orchard for stock to use in the cold, high-elevation lands of South Korea, We assume that, if the procedure works in South Korea, it should also work in the United States.

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Table 1.--Survival, aver a ge and maximum heights of surviving growing seasons after 1971 planting in Monroe County, West Virginia

Stock	Geographic source	Survival	Average height	Maximum height
		Percent	Feet (meters)	Feet (Meters)
New Lisbon pitch	Mixed orchard clones	100	7.9 (2.41)	9.2 (2.80)
West Virginia pitch	White Sulphur Springs	87	8.5 (2.59)	10.0 (3.05)
Korean pitch X loblolly	Unknown	87	9.3 (2.83)	12.0 (3.66)
62 x 23[1/]	N. J. X Md.	92	9.9 (3.02)	11.9 (3.63)
78 X 19	Maine X Md.	80	10.0 (3.05)	12.8 (3.90)
72 X 18	Mass. X Md.	100	10.0 (3.05)	11.1 (3.38)
76 X 18	N. H. X Md.	100	10.1 (3.08)	11.7 (3.57)
Loblolly	Maryland	53	10.2 (3.11)[2/]	12.9 (3.93)
	(etc. through 20 more clonal crosses)			
78 X 15A	Maine X Md.	73	11.7 (3,57)	12.8 (3.90)
58 X 15A	W. Va. X Md.	93	11.7 (3.57)	13.3 (4.05)
77 X 23	N. H. X Md.	100	11.8 (3.60)	12.7 (3.87)
70 X 15A	Pa. X Md.	73	11.8 (3.60)[2/]	13.0 (3.96)
62 X 22	N. **Y**. **X** Md.	73	11.9 (3.63)	13.2 (4.02)
62 X 15A	N. Y. X Md.	100	11.9 (3.63)	13.8 (4.21)
65 X 22	N. J. X Md.	100	12.0 (3.66)[2/]	13.2 (4.02)
66 X 15A	N. J. X Md.	100	12.0 (3.66)	13.6 (4.15)

[1/] Erroneously listed as 62 X 23 in last year's paper.
[2/] Excluding one tree either broken or otherwise damaged.

Table 2.--Survival, average and maximum heights of surviving trees growing seasons after 1972 planting in Greenbrier County, West Virginia

Stock	Geographic source	Survival	Average height	Maximum height
		Percent	feet (meters)	Feet (meters)
Maryland loblolly	Maryland	38	2.5 (0.76)	4.7 (1.43)
New Lisbon pitch	Mixed orchard clones	95	3.1 (0.94)	6.6 (2.01)
63 X 23	N. J. X Md.	88	3.1 (0.94)	5.7 (1.74)
65 X 11-20	N. J. X S. C.	62	3.2 (0.98)	5.6 (1.71)
65 X 11-10	N. J. X S. C.	87	3.4 (1.04)	6.0 (1.83)
64 X 11-10	N. J. X S. C.	77	3.5 (1.07)	7.0 (2.13)
54 X 11-20	Va. X S. C.	78	3.6 (1.10)	5.7 (1.74)
58 X 11-20	W. Va. X S. C.	90	3.6 (1.10)	5.4 (1.65)
	(etc. through 24 clonal crosses)			
75 X 23	N. H. X Md.	97	4.8 (1.46)	6.5 (1.98)
60 X 7-56	Pa. X S. C.	83	4.9 (1.49)	7.0 (2.13)
71 X 15A	Mass. X Md.	98	5.0 (1.52)	7.5 (2.29)
70 X 23	Pa. X Md.	100	5.0 (1.52)	6.8 (2.07)
62 X 11-9	N. Y. X S. C.	98	5.0 (1.52)	6.6 (2.01)
77 X 22	N. H. X Md.	98	5.2 (1.58)	7.7 (2.35)
62 X 7-56	N. Y. X S. C.	97	5.4 (1.65)	7.6 (2.32)
77 X 4-32	N. H. X Md.	97	5.8 (1.77)	9.4 (2.86)

Table 3.---Survival, average and maximum heights of surviving trees 4 growing seasons after 1972 planting in Cecil County, Maryland

Stock	Geographic source	Survival	Average height	Maximum height
		Percent	Feet (Meters)	Feet (Meters)
New Lisbon pitch	Mixed orchard clones	87	2.90 (0.88)	5.1 (1.55)
71 X 4-32	Mass. X Md.	87	3.63 (1.11)	5.5 (1.68)
58 X 11-20	W. Va. X S. C.	90	3.87 (1.18)	6.4 (1.95)
67 X 23	N. J. X Md.	83	3.97 (1.21)	6.2 (1.89)
54 X 11-20	Va. X S. C.	70	4.00 (1.22)	6.3 (1.92)
78 X 22	Maine X Md.	87	4.10 (1.25)	6.3 (1.92)
54 X 7-56	Va. X S. C.	53	4.26 (1.30)	6.9 (2.10)
58 X 11-10	W. Va. X S. C.	97	4.29 (1.31)	7.6 (2.32)
78 X 23	Maine X Md.	80	4.31 (1.31)	6.3 (1.92)
58 X 11-9	W. Va. X S. C.	80	4.35 (1.33)	5.9 (1.80)
54 X 11-9	Va. X S. C.	80	4.58 (1.40)	8.0 (2.44)
71 X 23	Mass. X Md.	93	4.71 (1.44)	6.8 (2.07)
54 X 11-10	Va. X S. C.	77	4.91 (1.50)	7.8 (2.38)
70 X 23	Pa. X Md.	97	5.03 (1.53)	7.1 (2.16)
71 X 22	Mass. X Md.	93	5.09 (1.55)	7.1 (2.16)
67 X 22	N. J. X Md.	90	5.17 (1.59)	7.3 (2.22)
77 X 4-32	N. H. X Md.	100	5.33 (1.62)	8.1 (2.47)
Loblolly	Maryland	93	5.37 (1.64)	7.7 (2.35)
62 X 11-10	N. Y. X S. C.	93	6.20 (1.89)	7.9 (2.41)
62 X 11-9	N Y. X S. C.	97	6.23 (1.90)	8.4 (2.56)
62 X 7-56	N. Y. X S.C.	100	6.38	9.3 (2.83)

Table 4.--Survival, average and maximum heights of surviving trees 3 growing seasons after 1973 planting in Ocean County, New Jersey

Stock	Geographic source	Survival	Average height	Maximum height
		Percent	(Meters)	Feet (Meters)
54 X 7-56	Va. X S. C.	52	2.68 (0.82)	5.0 (1.52)
New Lisbon pitch	Mixed orchard clones	100	2.87 (0.87)	4.7 (1.43)
56 + 57 OP[1/]	W. Va. X ?	100	2.90 (0.88)	4.1 (1.25)
Korean pitch X loblolly	Unknown	95	3.07 (0.94)	5.9 (1.80)
76 X 23	N. H. X Md.	100	3.25 (0.99)	5.4 (1.65)
54 X 11-9	Va. X S. C.	98	3.26 (0.99)	5.1 (1.55)
(etc. through 14 more clonal crosses and loblolly 24 OP)				
78 X 15A	Maine X Md.	100	4.35 (1.33)	6.5 (1.98)
65 X 23	N. J. X Md.	92	4.43 (1.35)	6.2 (1.89)
62 X 11-10	N. Y. X S. C.	96	4.50 (1.37)	6.1 (1.86)
VDF loblolly	Virginia	95	4.53 (1.38)	7.0 (2.13)
62 X 7-56	N.Y. X S. C.	97	4.66 (1.42)	7.3 (2.22)
Loblolly	Maryland	100	4.72 (1.44)	6.9 (2.10)

[1/] Open- or wind-pollinated pitch clones in orchard.

Table 5.--Survival,average and maximum heights of surviving trees

3 growing seasons after 1973 planting in Cecil County

, Maryland

Stock	Geographic source	Survival	Average height	Maximum height
		Percent	feet (Meters)	feet (meters)
68 X 23	Pa. X Md.	100	1.94 (0.59)	5.8 (1.77)
58 X 4-32	W. Va. X Md.	100	2.17 (0.66)	4.5 (1.37)
54 X 11-10	Va. X S. C.	70	2.53 (0.77)	5.1 (1.55)
VDF--/pitch	Virginia	98	2.59 (0.79)	4.5 (1.37)
58 X 11-20	W. Va. X S. C.	100	2.85 (0.87)	6.6 (2.01)
New Lisbon pitch	Mixed orchard clones	97	2.85 (0.87)	5.3 (1.62)
56 + 57 OP	W. Va. X ?	95	3.34 (1.02)	4.8 (1.16)
78 X 22	Maine X Md.	93	3.37 (1.03)	5.7 (1.74)
Korean pitch X loblolly	Unknown	100	3.43 (1.05)	5.9 (1.80)
(etc. through 28 more clonal crosses?4				
62 X 7-56	N. Y. X S. C.	100	4.81 (1.47)	8.0 (2.44)
76 X 4-32	N. H. X Md.	100	4.82 (1.47)	8.0 (2.44)
78 X 19	Maine X Md.	100	4.86 (1.48)	6.9 (2.10)
VDF[1/] loblolly	Virginia	100	4.88 (1.49)	7.1 (2,16)
65 X 22	N. 3. X Md.	100	5.05 (1.54)	7.6 (2.32)
76 X 22	N. H, X Md.	100	5.07 (1.55)	7.2 (2.19)
54 X 7-56	Va. X S. C.	97	5.14 (1.57)	8.6 (2.62)
Loblolly 24 OP	Md. X ?	100	5.30 (1.62)	7.3 (2.2?)

[1/] Supplied by Virginia Division of Forestry.

[2/] And Maryland loblolly, last had average height of 4.28 ft.--25th from the tallest stock.

Table 6.--Survival, average and maximum heights of surviving trees 3 growing seasons after 1973 planting in Ritchie County, WV

West Virginia

Stock	Geographic source	Survival	Average height	Maximum height
		Percent	Feet (meters)	Feet (Meters)
New Lisbon pitch	Mixed orchard clones	72	2.2 (0.67)	3.7 (1.13)
VDF Pitch	Virginia	78	2.5 (0.76)	4.4 (1.34)
67 X 23	N. J. X Md.	70	2.5 (0.76)	3.9 (1.19)
76 X 23	N. H. X Md.	77	2.6 (0.79)	3.9 (1.19)
65 X 23	N. J. X Md.	78	2.6 (0.79)	4.4 (1.34)
Korean pitch X loblolly	Unknown	80	2.6 (0.79)	4.3 (1.31)
(etc. through 30 more clonal crosses and 4 checks[1/])				
62 X 15A	N.Y. X Md.	83	3.2 (0.98)	5.0 (1.52)
78 X 15A	Maine X Md.	78	3.2 (0.98)	5.1 (1.55)
62 X 19	N. Y. X Md.	90	3.3 (1.01)	4.7 (1.43)
77 X 4-32	N. H. X Md.	73	3.4 (1.04)	5.8 (1.77)
54 X 7-56	Va. X S. C.	77	3.4 (1.04)	6.3 (1.92)
62 X 22	N. Y. X Md.	77	3.4 (1:04)	5.7 (1.74)
77 X 15A	N. H. X Md.	82	3.4 (1.04)	5.1 (1.55)
62 X 11-20	N. Y. X S. C.	67	3.5 (1.07)	6.0 (1.83)
76 X 22	N. H. X Md.	77	3.5 (1.07)	6.0 (1.83)
65 X 15A	N. 3. X Md.	75	3.6 (1.10)	6.3 (1.92)

[1/] Best pitch check C56 + 57 OP) had an average height of 2.9 ft.; best loblolly check (VDF) had an average height of 3.0 ft.

Table 7.--Survival, average, and maximum heighs of surviving trees

2 growing seasons after 1974 planting in Ocean County,

New Jersey

Stock	Geographic source	Survival	Average height		Maximum height	
		Percent	Feet	(Meters)	Feet	(Meters)
58 X 11-9	W. Va. X S. C.	88	1.73	(0.53)	3.5	(1.07)
Loblolly	Maryland	92	1.89	(0.58)	3.2	(0.93)
62 OP pitch	N. Y. X ?	98	1.95	(0.59)	3.1	(0.94)
Korean pitch X loblolly	Unknown	100	1.96	(0.60)	2.9	(0.88)
New Lisbon pitch	Mixed orchard clones	100	2.00	(0.61)	3.7	(1.13)
66 OP pitch	N. J. X S. C.	100	2.22	(0.68)	3.7	(1.13)
	(etc. through 26 more clonal crosses)					
62 X 22	N. Y. X Md.	100	2.76	(0.84)	3.9	(1.19)
62 X 7-56	N. Y. X S. C.	98	2.76	(0.84)	4.1	(1.25)
71 X 11-10	Mass. X S. C.	100	2.80	(0.83)	4.4	(1.34)
67 X 22	N. J. X Md.	100	2.80	(0.85)	4.3	(1.31)
65 X 11-10	N. J. X S. C.	100	2.85	(0.87)	4.2	(1.28)
77 X 15A	N. H. X Md.	100	2.87	(0.87)	4.4	(1.34)
66 X 15A	N. J. X Md.	98	2.88	(0.88)	4.5	(1.37)
62 X 11-10	N. Y. X S. C.	100	2.90	(0.88)	4.0	(1.22)
78 X 4-32	Maine X Md.	97	2.90	(0.88)	4.6	(1.40)
24 X 72	Md. X Hass.	100	3.07	(0.94)	4.5	(1.37)