

FOUR NATIVE SPECIES AND TWO HYBRID PINES

COMPARED IN WESTERN MARYLAND¹

John B. Genys

Professor of Dendrogenetics, Appalachian Environmental Laboratory,
CEES, University of Maryland, Frostburg, MD 21532

Abstract.--The growth rates and survival of four pines native to Maryland (Pinus taeda, P. strobus, P. rigida and P. virginiana) and two hybrid pines (P. rigida x taeda F₁ and P. virginiana x clausa F) were studied in the nursery and in two plantations in western Maryland. At ten years after planting in Allegany County (elevation 350 m), all sources showed an outstanding survival (80% to 100%), and P. taeda, P. rigida x taeda and P. virginiana were the tallest (4.53 m to 4.81m high). In Garrett County (elevation 730 m and only 135 frost-free days per annum), P. taeda failed (only 11% of trees survived) and its height was only 1.71 m when P. rigida x taeda trees were 3.80 m high. P. virginiana x clausa showed only an average growth rate (3.51 m) and a poor survival (26%).

Additional keywords: tree improvement, site x plant interaction

INTRODUCTION

Maryland is a home of six species of pines (genus Pinus). The most important and most planted is loblolly pine (P. taeda L.). It is native in the southern parts of the State. The second most planted tree is eastern white pine (P. strobus L.). It is native in the western counties, but only a few natural stands are left after it was harvested during the turn of the century. Virginia pine (P. virginiana Mill.) and pitch pine (P. rigida Mill.) are found in all counties of the state and are important because of abundance. However, they are less desirable for lumber production because of their small size and are not preferred for planting. Also, not used for planting are shortleaf pine (P. echinata Mill.) and pond pine [Pinus rigida serotina (Michx.) Loud.].

¹Scientific Contribution No. 1913 of the Appalachian Environmental Laboratory, CEES, University of Maryland, Frostburg, MD 21532. The completion of this study was partially supported by the McIntire-Stennis Cooperative Forestry Research Program.

There is no problem in the selection of species for planting in the southern parts of the State. Loblolly pine is outstanding in its growth rate and in excellence of its timber. In Western Maryland, much more promising are the loblolly x pitch pine hybrids (P. rigida x taeda) (Little and Somes 1962, Genys 1972). The first crosses of P. rigida x taeda were made in California (Righter and Duffield, 1951) but the interest in growing these hybrids in a cold climate was initiated in South Korea where they are planted on a large scale (Hyun 1961).

Also, there is an interest in the improvement of Virginia pine and in the production of its hybrids with other species (Genys, 1966; Critchfield, 1963). One of its artificial crosses is with sand pine (P. virginiana x clausa). In southern Maryland these hybrids showed some desirable characteristics (Genys 1972).

This present experiment was designed to compare the growth rates of four native pines and the two above-mentioned hybrids in the Appalachian region of Maryland.

MATERIALS AND METHODS

Origin of the sources of pines included in this experiment is described in Table 1. Seed of P. rigida x taeda was received from Dr. S. K. Hyun of the Institute of Forest Genetics at Suwon, South Korea. This was a 1961 crop of a cross of P. rigida (origin not known), pollinated by P. taeda (pollen from Georgia). Seed of P. virginiana x clausa was collected from F hybrid trees planted in Smallwood State Park, Charles County, Maryland. Past research showed that these hybrids shed pollen two weeks earlier than Virginia pine (Genys, 1971). Consequently, it is reasonable to assume that a progeny from F₁ hybrids included no back-crosses with Virginia pine, but were F₂ hybrids.

Table 1. Species and hybrids of Pinus included in this experiment, and their provenance.

Seed ID	Species or hybrid of <u>Pinus</u>	Provenance
919	Loblolly pine, <u>P. taeda</u>	Maryland (uncertain location)
918	Hybrids (F ₂), <u>P. rigida x taeda</u>	Received from Korea (pollen: GA)
119	Pitch pine, <u>P. rigida</u>	Maryland, Anne Arundel County
636	Pitch pine, <u>P. rigida</u>	Maryland, Allegany County
921	Virginia pine, <u>P. virginiana</u>	Maryland, (uncertain location)
920	Hybrids (F ₂), <u>P. virginiana x clausa</u>	Seed from F ₁ hybrids (918)
950	E. white pine, <u>P. strobus</u>	Maryland, nursery seedlings '71

The described sources (except *P. strobus*) were grown and studied for one year (1970) at the Maryland State Forest Tree Nursery in Harmans, Maryland. The specimens were arranged in four complete randomized blocks with plots consisting of four feet long rows of seedlings. On October 13 (1970) these specimens were studied with respect to the setting of their terminal buds. Heights were also measured, and counts were made of seedlings which had wavy or crooked stems.

In the Spring of 1971, the six experimental sources and one source of nursery-grown *P. strobus* were planted in three locations of Maryland. In each plantation the specimens were arranged in four or eight complete randomized blocks. Plots consisted of five-tree rows with individual trees within rows spaced at 1.2 m, and distances between the rows and between the plots were 2.4 m. Trees in a plantation on the grounds of the Prettyboy Reservoir in Baltimore County were cut before they were measured. The two other plantations, subjects of this report, were as follows:

A. Located in the Green Ridge State Forest, near Flintstone, Allegany County, at an elevation of about 350 m. The studied sources were arranged in four randomized blocks.

B. Located in the Negro Mountain State Forest, near Bittinger, Garrett County, at an elevation of about 730 m. Initially, this plantation included eight randomized blocks.

Measurements of heights and diameters (DBH), and counts of survival in the above plantations were made in October 1980, following ten seasons of growth after planting.

Analysis of variance of data from the nursery and from the Allegany County plantation were based on degrees of freedom as follows: total-23, sources-5, blocks-3, interaction-15; and total-27, sources-6, blocks-3, interaction-18, respectively. Because of poor survival and missing plots in the Garrett County plantation, the height and diameter data were treated as coming from a single completely randomized block, and one-way analysis of variance was used to determine the F-value. In all instances, Student's multiple ranges were used to estimate the least significant differences, based on $n-1$ (n = number of sources compared).

RESULTS

Variations in one-year old trees

When in the nursery the studied specimens varied in number of seedlings with crooked or curved stems. The highest percentage of such seedlings were among Virginia pine (80%) and hybrids *P. rigida* x *taeda* (Table 2). In *P. virginiana* x *clausa* all trees had straight stems. Also one-year old trees varied in bud setting habits. On October 13 (1965), *P. virginiana* and *P. virginiana* x *clausa* included only 5% and 0% of trees with buds, respectively, while other sources had terminal buds on about 40% of seedlings. Heights of

one-year old trees ranged from 8.6 cm (*P. rigida* and *P. virginiana* x *clausa*) to 14.7 cm (*P. taeda*).

Survival rates

In the Allegany County plantation, all studied specimens showed satisfactory survival, ranging from 80% (*P. taeda*) to 100% (*P. rigida* #636, a local source). There was an unusual relationship between the heights of planting stock and the rate of survival, $r = -.91$. This inverse correlation appeared primarily because the largest seedlings (*P. taeda*), showed the poorest survival and vice versa (*P. rigida*).

In the Garrett County plantation, survival rates ranged from 11% (*P. taeda*) to 77% (*P. strobus*). In addition to *P. taeda*, relatively poor survival occurred among the specimens of *P. rigida* #119 (from Central Maryland) and *P. virginiana* x *clausa*).

Table 2.-Growth rates and other characteristics of four species and two hybrids of pines (*Pinus*) studied one year in the nursery and ten years in two plantations, at Allegany and Garrett counties in Maryland.

Data code:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
ID	Species or hybrid of <i>Pinus</i>	Seedlings, first year			Trees, 10 years after planting			
		Curved Stems	Budset 10/13/65	Height cm	Allegany		Garrett	
		%	%	cm	%	m	%	m
919	<i>taeda</i>	10	40	14.7	80	4.81	11	1.71
918	<i>rigida</i> x <i>taeda</i> F ₁	70	43	10.9	95	4.53	51	3.80
119	<i>rigida</i>	80	35	8.9	95	4.29	20	2.54
636	<i>rigida</i>	80	40	8.6	100	3.99	46	2.63
921	<i>virginiana</i> (=v.)F ₂	5	5	8.6	95	4.76	40	3.69
920	<i>v. x clausa</i>	0	3	10.2	90	3.80	26	3.51
950	<i>strobus</i>	-	-	-	95	3.23	77	3.39
F-value					2.0	2.98*	4.3**	2.34*-
LSD (n=7, 0.05 level)		18	18	2.2	-	1.49	46	-

*- Significant at 0.06 level (the extreme values are different at that level).
 * Significant at 0.05 level.
 ** Significant at 0.01 level.

Heights

The variation in 10-year heights of the studied specimens is shown in Table 2 and Figure 1. In the Allegany plantation, heights of different sources ranged from 3.2 m (*P. strobus*) to 4.8 m (*P. taeda*). This result was unexpected because *P. taeda* was planted far north of its natural range. *Pinus strobus* was nearly equal in height to the hard pines, *P. rigida* and *P. virginiana*. The *P. rigida* x *taeda* hybrids ranked among the three most rapidly growing sources, while *P. virginiana* x *clausa* grew slower than *P. virginiana*.

In the Garrett County plantation the rank of heights was entirely different than in Allegany County ($r = -.26$). The different sources ranged in height from 1.7 m (*P. taeda*) to 3.8 m (*P. rigida* x *taeda*). These extreme values were significantly different at the 0.06 level, while the growth rates of other sources were average and about similar. The *P. virginiana* x *clausa* hybrids were nearly equal to *P. virginiana*.

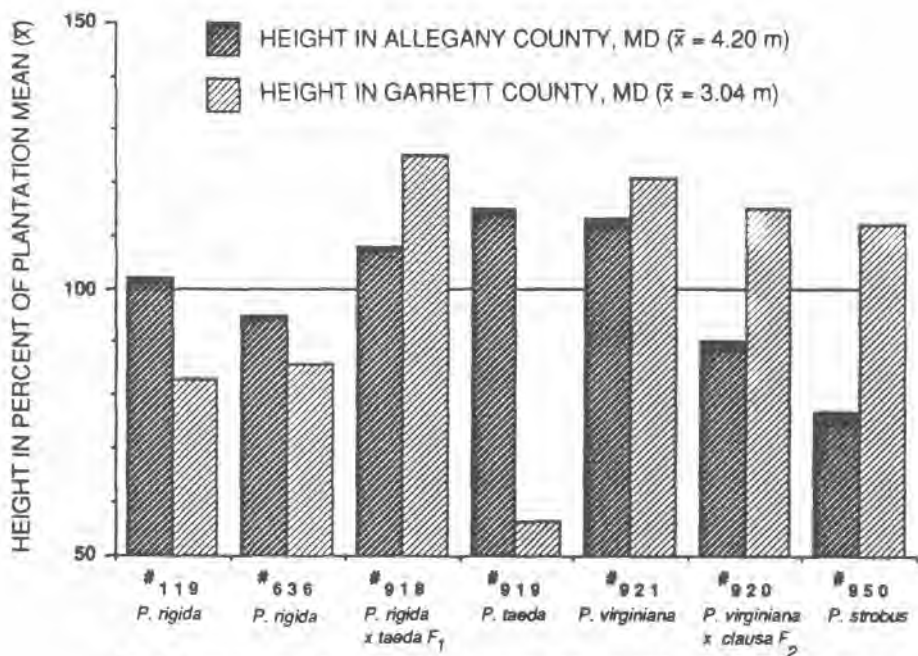


Fig.1. Twelve-year heights of four native species and two hybrids of pines (*Pinus*) studied in two counties of Western Maryland.

DISCUSSION

Among the unexpected results was the relatively good growth rate of *P. taeda* at the Green Ridge State Forest, Allegany County which location is about 150 km northwest of its nearest natural range. This information is yet inadequate to recommend planting of *P. taeda* far north of its range. However, it can be considered as one of the cases suggesting such possibility.

The hybrid seeds of *P. rigida* x *taeda* used in Maryland experiments came from South Korea. Their mother trees (*P. rigida*) were of unknown origin while pollen (*P. taeda*) were brought from Georgia. In 1965, one set of plantations with this seed source of hybrids was established in all regions of Maryland. At seven years, in southern and central counties of Maryland, where the climate is relatively mild, the hybrids were intermediate between the slow growing *P. rigida* and rapidly growing *P. taeda*. In the coldest region (Garrett County), the hybrids grew larger than loblolly pines (30%), had shorter needles, and were more firm against bending by wet snow. This current experiment showed similar results suggesting that *P. rigida* x *taeda* hybrids may offer a good alternative for planting them in colder Appalachian regions where *P. taeda* fails. Further research is needed to select the most desirable sources of parent species, such as one of the most northern sources of *P. taeda* and one of the most rapidly growing sources of *P. rigida*.

Virginia pine and sand pine were successfully crossed by the Institute of Forest Genetics in California in 1953. In 1971, 47 specimens of these hybrids were made available for studies in southern Maryland. At the age of ten years they had an average height of 5.4 meters (Genys, 1971). Compared to the same aged Virginia pines, the hybrids had larger pollen, shed pollen two weeks earlier, had larger heights (14%) and larger diameters (22%). In western Maryland, *P. virginiana* x *clausa* hybrids were similar in growth rate to *P. virginiana*, but showed a poor survival. It is possible that they may be less adapted to the northern climate; their paternal parent *P. clausa* is a southern tree, native to Florida and adjacent Mississippi (Burns, 1968). Consequently, planting *P. virginiana* x *clausa* in western Maryland or similar climatic regions may not contribute any silvicultural advantages.

LITERATURE CITED

- Burns, R. M.
1968. Sand pine: a tree for West Florida's sandhills. *Jour. of Forestry* 66(7):561-562.
- Critchfield, W. B.
1963. Hybridization of southern pines in California. Repr. from Forest Genetics Workshop Proc., So. Forest Tree Improvement Conf. Pub. 22.
- Genys, J. B.
1966. Geographic variation in Virginia pine. Results of the first trial in Pennsylvania, Maryland and Tennessee. *Silvae Genetica* 15(3):72-75.
- Genys, J. B.
1970. Hybrids of pitch pine x loblolly pine, *Pinus rigida* x *taeda*, studied in Maryland. *Chesapeake Science* 11(3):191-198.
- Genys, J. B.
1971. Hybrids of Virginia pine x sand pine, *Pinus Virginian* x *clausa*, in Maryland. *Chesapeake Science* 12(3):188-191.
- Hyun, S. K.

1956. Forest tree breeding work in Korea. Institute of Forest Genetics, Suwon, Korea. Institute Paper No. 1. 16 p.

Little, E. L., and F. I. Righter.

1965. Botanical descriptions of forty artificial pine hybrids. U.S. Dept. of Agric. Forest Service Tech. Bull. No. 1345. 47 p.

Little, S., and H. A. Somes.

1962. 1961 results from the 1955 planting of hybrid pines and ordinary nursery stock. Northeastern Forest Experiment Station. New Lisbon (N.J.) Research Center's Report 4110. 6 p.

Righter, R. I., and J. W. Duffield.

1951. Interspecies hybrids in pines. Jour . Heredity 42: 75-80.