

Eighteen-Year Performance of an Eastern White Pine Genetic Test Plantation in Southern Indiana

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Introduction

Eastern white pine (*Pinus strobus* L.) is the best selling species at Indiana's two State tree nurseries. More than 1.7 million white pine seedlings and transplants were planted in Indiana during the spring of 1977. The possibility of improving the yield of white pine in Indiana by use of seed of optimum geographic origin prompted the establishment of a test of white pine from 16 seed sources.

Methods

Seeds were collected from 16 locations throughout the natural range of white pine. Seedlings from the 16 origins were grown for 2 years at the Edwards State Nursery, Morganton, North Carolina, and planted on a bottomland site in Perry County, Indiana, on the Hoosier National Forest in the spring of 1959. The planting site includes two soil series, Henshaw and Uniontown, and the topsoil of both soils is classed as silt loam. Both soils are suitable for planting white pine.

Twelve 4-tree row-plants of each provenance were planted with a mattock in a completely random design. Randomly assigned locations were saved for the seedlings from the Lower Michigan source, which were planted as 3-year-old transplants in 1961. Study trees were planted 7 feet apart in rows 14 feet apart. Intervening rows were planted with filler trees, which were cut in 1975.

First-year survival of the planting was poor — it ranged from 30 to 56 percent. Blank spots were replanted in 1960 and 1961, and in the fall of 1961 survival ranged from 85 to 100 percent. Only two seed sources, Maine and Quebec, had survival less than 92 percent.

In 1976 the two "best" (usually tallest) trees per plot were measured and their heights and diameters averaged for analysis. A few plots contained only one live tree and two of the plots contained no live trees; missing values were replaced. Average height, diameter, and "volume" (D^2H) of the 20-year-old trees (18-year-old plantation) were calculated and subjected to analysis of variance (table 1).

Results

Height, diameter, and D^2H differences attributable to seed source are highly significant; the probability of differences being due to chance is at the vanishing point.

TABLE 1. *Height, diameter, and D²H of eastern white pine trees in an 18-year-old southern Indiana plantation in relation to geographic origin.*

Origin				
Location	North latitude	Height	Diameter	D ² H
	Degrees	Feet	Inches	Feet ³
Union Co., GA	34.8	39.3	7.6	15.8
Transylvania Co., NC	35.2	37.4	7.4	14.2
Green Co., TN	36.0	40.6	8.3	19.4
Pulaski Co., VA	37.1	32.8	6.5	9.6
Greenbrier Co., WV	38.0	32.8	5.8	7.7
Ashland Co., OH	40.8	36.7	7.1	12.8
Monroe Co., PA	41.1	37.5	7.3	13.9
Allamakee Co., IA	43.5	25.8	4.6	3.8
Newaygo Co., MI	43.5	¹ /39.7	¹ /7.8	¹ /16.8
Lunenburg Co., N.S.	44.4	29.0	5.1	5.2
Franklin Co., NY	44.4	30.7	5.4	6.2
Penobscot Co., ME	44.9	26.7	4.4	3.6
Forest Co., WI	45.9	35.8	7.1	12.5
Algoma Dist., Ont.	46.2	30.7	5.1	5.5
Cass Co., MN	47.4	28.4	4.8	4.5
Pontiac Co., Quebec	47.5	23.2	3.7	2.2
Plantation mean		32.9	6.1	9.6

¹/Trees of Michigan origin are 1 year younger than the rest; height and diameter were adjusted by adding mean of past 3 years' increment.

The relative ranking of the provenances by height has remained remarkably consistent (table 2). The North Carolina, Tennessee, Pennsylvania, Georgia, and Ohio provenances were "good prospects" at age 5 (Funk 1964) and they are still

TABLE 2. *Height rank of white pine trees at five successive measurements according to geographic origin.*

Provenance location	Plantation age (years)				
	5	6	10	15	18
GA	4	4	6	4	3
NC	1	1	3	5	5
TN	2	2	2	3	1
VA	7	7	8	8	8.5
WV	9	9	9	9	8.5
OH	5	5	5	2	6
PA	3	3	4	6	4
IA	10	10	13	15	15
MI ¹	(6)	(6)	(1)	(1)	(2)
NS	11	11	10	11	12
NY	12	13	11	10	10
ME	15	15	15	14	14
WI	8	8	7	7	7
ON	13	12	12	12	11
MN	14	14	14	13	13
PQ	16	16	16	16	16

¹/Ranks for Michigan provenance based on adjusted heights.

among the top six. Age: age correlations of rankings for total height are good (table 3); no serious mistakes would have been made at age 5 in an attempt to select the provenances containing the tallest trees at age 18.

TABLE 3. Age: age Spearman rank correlations for height.

Plantation age	Age			
	6	10	15	18
5	.998	.92	.84	.87
6	—	.92	.84	.87
10	—	—	.95	.95
15	—	—	—	.95

D²H, an indicator of volume, was calculated for the different provenances. "Volume" of the Tennessee trees is 9 times that of the Quebec trees and more

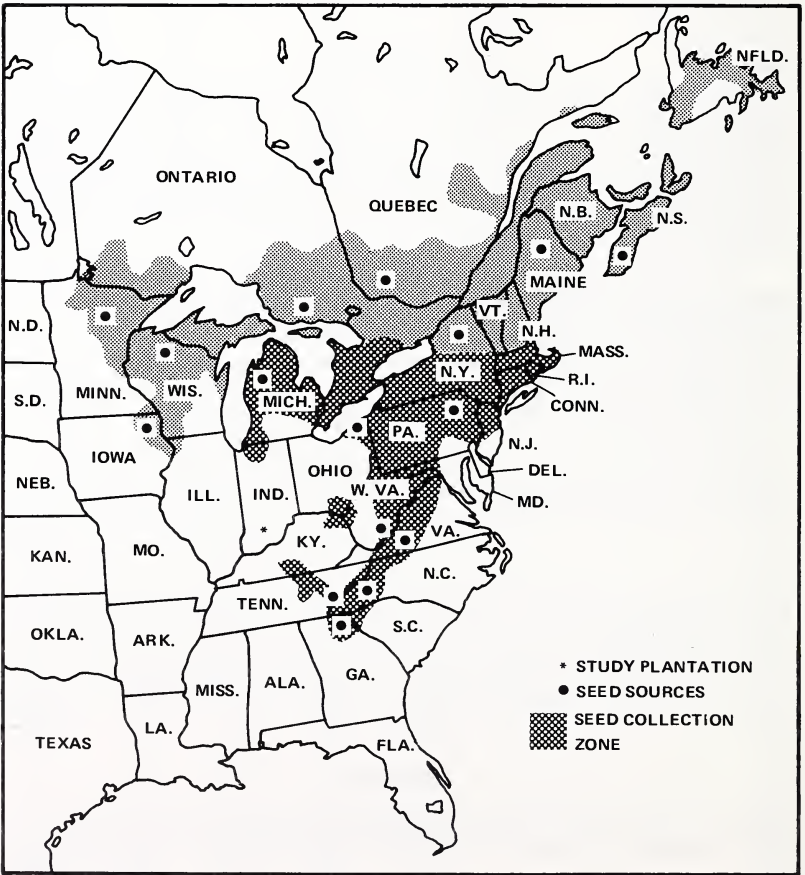


FIGURE 1.

than 5.5 times the "volume" of the trees from Maine (table 1). It is plain that failure to consider origin of white pine seed could result in serious economic loss.

A comparison of the D^2H values indicates the superiority of the more southern provenances. Three-fourths of the southern sources (lower latitude) rank in the top half, and three-fourths of the northern sources fall in the lower half.

Trees from about one-fourth the seed sources do not fit a geographic origin pattern. Trees from lower Michigan and Wisconsin have grown faster, and trees from Iowa, Virginia, and West Virginia have grown slower than would have been expected from the latitude of their provenance.

Recommendations

We continue to recommend an extensive collection zone for white pine seed to be planted in Indiana (figure 1). Because of the poor performance of the Virginia and West Virginia seedlings, however, we recommend caution in obtaining seed from these two States for use in Indiana. Our confidence in these recommendations is increased by previous similar findings in southern Illinois and eastern Kentucky (Funk, Allen, and Williams 1975).

To establish fast growing but genetically diverse stands in Indiana, nurseries should furnish white pine seedlings using a mixture of seed from several stands in the "top 6" States. Subsequent research based on more intensive collections within the southern Appalachian Mountains may provide the opportunity to further refine recommended seed procurement zones.

Literature Cited

1. FUNK, DAVID T., 1964. Southern Appalachian white pine off to a good start in the midwest. Cent. States For. Tree Improv. Conf. Proc. 4:26-28.
2. FUNK, DAVID T., RUFUS ALLEN, and ROBERT D. WILLIAMS., 1975. Fifteen-year performance of eastern white pine seed sources tests in the lower Ohio Valley. Cent. States For. Tree Improv. Conf. Proc. 9:153-158, illus.