EASTERN WHITE PINE SEED SOURCE VARIATION IN A NORTHERN MINNESOTA PLANTING

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ABSTRACT

Survival, total height, and diameter growth of eastern white pine grown in a northern Minnesota planting from seed collected from 14 locations are summarized. Variation among sources in all three traits was significant. Trees from Ashland County, Ohio, had average survival and the greatest total height and diameter growth; those from Union County, Georgia, had the poorest survival and growth. Growth of trees from different sources was not significantly related to latitude of seed origin or survival. Height growth of trees from individual sources in the Minnesota planting were significantly correlated with the height growth of trees from the same sources grown at 2 of 16 'other locations in the North Central and Northeastern States. Results of this and other tests of eastern white pine seed sources indicate that trees from southern Appalachian seed sources, which have grown well in areas with relatively mild climates, have relatively poor survival and growth when grown in harsh continental climates such as in northern Minnesota, northern New York, and central Maine. These results add further evidence that there is a northern limit to the movement of southern Appalachian white pine seed.

In 1955, the Forest Service began a rangewide seed source study of eastern white pine (Pinus strobus L.). Some of the most recent results have been reported by cooperators in Ontario (Fowler and Heimburger 1969), Northeastern States (Garrett et al. 1973, Demeritt and Kettlewood 1976), Southeastern States (Sluder and Dorman 1971), Central States (Funk et al. 1975), and Lake States (King and Nienstaedt 1969, Wright 1970, Lee 1974). This paper presents data on survival, height, and diameter growth of eastern white pine planted in northern Minnesota.

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METHODS

Transplants (3-1) from 14 seed sources were grown in the Hugo Sauer State Nursery, Rhinelander, Wisconsin, and field planted on the Pike Bay Experimental Forest, Cass County, Minnesota (Lat. 47.4°N, Long. 94.5°W), in May 1963 (Table 1). The planting area previously consisted of a mixed sapling to pole-size stand of low-quality aspen, paper birch, and burr oak.

Table 1.--Survival, height, and diameter of eastern white pine from 14 seed sources planted in northern Minnesota[a]

Source number		Origin	Lati-tude	Survival	Height	Diam-eter
NE	NC				(m)	(cm)
			°N	%	% of local	
28	1650	Lake Co., Minnesota	48.0	61	108	117
23	1635	Pontiac Co., Quebec	47.5	66	94	92
19	1622	Cass Co., Minnesota[b]	47.4	61	100	100
29	1656	Houghton Co., Michigan	47.1	55	89	83
25	1636	Algoma Dist., Ontario	46.2	57	89	83
18	1623	Forest Co., Wisconsin	45.9	70	106	106
12	1639	Franklin Co., New York	44.4	50	101	104
20	1637	Lunenberg Co., Nova Scotia	44.4	50	85	75
31	1651	Sauk Co., Wisconsin	43.5	63	97	94
32	1670	Newaygo Co., Michigan	43.5	59	109	117
15	1624	Allamakee Co., Iowa	43.3	70	97	98
6	1640	Monroe Co., Pennsylvania	41.1	73	96	92
16	1632	Ashland Co., Ohio	40.8	62	112	117
1	1633	Union Co., Georgia	34.8	28	52	29
		Plantation Mean		59	3.40	4.5
		Local			3.57	4.8

[a] Planting located at Pike Bay, Cass Co., Minnesota (Lat. 47.4°N, Long. 94.5°W). Measurements at 16 yr. from seed (12 yr. from planting).
[b] Local Source.

The soil was a silt-loam and contained many rocks. Approximately one-half of the area was cleared and bulldozed in the fall of 1962 so that a mineral soil surface was present at the time of planting. This half of the planting was of slightly higher elevation than the rest of the area. The remaining half of the planting area was similarly prepared in 1961, and at the time of planting it had a light to medium cover of raspberry, birch, and aspen sprouts.

Trees were hand planted with a planting bar at a 7 by 7 foot spacing. A randomized, complete block design with 4 blocks and 81 trees per plot was used. The planting was evaluated for survival, total height, and diameter (d.b.h.) 12 years after planting. Height and diameter were determined for 16 trees selected at random from each source in each block.

RESULTS AND DISCUSSION

Mean plantation survival was 59 percent. Variation among sources in survival was statistically significant (1 percent level) and ranged from 73 percent for trees from the Pennsylvania source to 28 percent for the Georgia source (Table 1). Except for the Georgia source, survival of trees from different sources was not related to latitude of seed origin.

Average height and diameter of all trees was 3.40 m and 4.5 cm, respectively. Total height and diameter of trees from individual seed sources were significantly correlated (1 percent level). Analyses of variance showed that the differences among sources in both traits were significant (1 percent level). Trees from the four best seed sources, Ashland County, Ohio, Newaygo County, Michigan, Lake County, Minnesota, and Forest County, Wisconsin, exceeded the local Cass County, Minnesota, source by 6 to 12 percent for height and by 6 to 17 percent for diameter. Trees from the Georgia source were 48 percent shorter and had diameters 71 percent less than the local source. Seed sources are arranged in order from north to south in Table 1, and it is clear that neither height nor diameter of trees from different sources were correlated with latitude of seed origin or survival (except the Georgia source). Differences among blocks for height and diameter were significant. Trees planted in blocks receiving site preparation in 1962 were taller and had larger diameters than those planted in blocks treated in 1961 because the 1961 prepared site had a heavier competitive plant cover at time of planting.

Rank correlation coefficients for total height were used to compare the performance of the seed sources in this planting with the performance of the same seed sources grown at other locations using the data reported by Funk (1975) for Iowa, Funk et al. (1975) for the Lower Ohio Valley, and Demeritt and Kettlewood (1976) for the Northeast (Table 2). Total height of trees in the Minnesota planting were significantly correlated with height of trees from the same seed sources at only two of 16 locations. The lack of significant correlation for total height in Minnesota and height of the same sources at most of the other locations emphasizes the importance of seed source-environment interactions in white pine, particularly as it relates to the use of southern Appalachian seed sources.

Table 2.--Rank correlation coefficients for total height of sources common to Minnesota planting and plantings in central and northeast States at 16 to 17 years from seed

Planting Location	No. of Sources	r_s [a]
Iowa	11	+0.207
Illinois	11	+ .143
Indiana	11	+ .391
Kentucky	11	+ .061
Maine, central	11	+ .023
Maine, southern	11	+ .132
Maine, southern	9	+ .192
Maine, southern	12	+ .301
Vermont	11	- .145
New York	9	+ .683*
Pennsylvania, northwest	10	+ .197
Pennsylvania, central	13	- .150
Pennsylvania, southeast	13	- .340
West Virginia	12	- .420
Maryland, western	11	+ .073
Maryland, southern	13	- .624*

[a] * Significant at 5 percent; all others are nonsignificant.

Seeds collected from southern Appalachian sources grew well in several northeast plantings (Garrett et al. 1973) and have also performed well and are recommended for Lower Michian (Wright 1970), Iowa (Funk 1975), and the lower Ohio Valley (Funk et al. 1975). The only southern Appalachian source in our planting was from Georgia. The poor performance of this source in this planting and in others in Minnesota, Wisconsin, Upper Michigan (King and Nienstaedt 1969), Massachusetts, New York, and Maine (Garrett et al. 1973, Demeritt and Kettlewood 1976) shows that there is a northern limit to the movement of white pine seed above which southern sources will be inferior to local sources.

In general, trees from the best seed sources in this planting, Ashland County, Ohio, and Newaygo County, Michigan, have also performed well in northern Wisconsin, Michigan (King and Nienstaedt 1969), northeast Iowa (Funk 1975), lower Ohio Valley (Funk et al. 1975), and in several northeast States (Garrett et al. 1973, Demeritt and Kettlewood 1976). Thus, although northern Minnesota sources are among the best in northern Minnesota, sources from latitudes 5 to 7 ^{o} south of the planting site can grow as well as or better than local sources. However, more extensive seed source tests must be conducted before nonlocal sources are used in planting programs.

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