

### Regional Jack Pine Seed Source Study

Tour Guides: Thomas D. Rudolph, Paul O. Rudolf, and Hans Nienstaedt 1/

In 1951 the Lake States Forest Experiment Station and the University of Minnesota jointly drew up plans for a regional jack pine seed source study to complement two such studies already underway, one in Minnesota and one in Michigan. The primary objective was to study racial differences in jack pine within the Lake States.

Cooperating federal, state, and private forestry agencies collected cones from 29 jack pine stands in the three Lake States during 1951 and 1952 (table 1). Each collection was made from dominant and codominant trees in a stand considered good for its locality. Seedlings were grown for 2 years in the General Andrews State Nursery at Willow River, Minn., and in the Hugo Sauer State Nursery at Rhinelander, Wis.

The 2-0 stock was set out in 17 plantations in the Lake States (table 2), one of which is the plantation on the Argonne Experimental Forest. This plantation was established in May 1954 and contains all of the 29 sources, plus a source designated as "local" and selected from stock grown at the Tourney Nursery, Watersmeet, Mich., for general distribution. A 2-row isolation strip of this "local" stock surrounds the plantation.

A randomized block design with four replications was used in all the plantations. Each seed origin was represented in each block by a 64-tree plot arranged in 8 rows of 8 trees. The trees were planted 5 feet apart with 5 feet between rows.

Survival counts made at the end of the first growing period in the field showed considerable variation between seed sources, but no definite patterns of differences were apparent. First-year losses were replaced in the spring of 1955, and stocking averaged about 98 percent at the end of the second year in the field. Small differences in height between seed sources were found in the second-year measurements, but no trends were evident.

The average heights obtained at the end of the fifth year in the Argonne plantation showed a wider range between seed sources than was found in earlier measurements. The greatest average height, 6.03 feet, was

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Table 1.--Information on seed collections used in regional jack pine seed source study

Collection number	Date collected	Collection area			Stand	
		Unit <sup>1/</sup>	County	Legal description	Average age	Site quality <sup>2/</sup>
<u>MINNESOTA</u>						
1589	3-29-51	Chippewa N. F.	Cass	SE SW, Sec. 8, T. 145 N., R. 29 W.	46	II
1590	4-12-51	Chippewa N. F.	Cass	W $\frac{1}{2}$ SW, Sec. 17, T. 141 N., R. 31 W.	50	I
1591	3-15-51	Cutfoot E. F.	Itasca	S $\frac{1}{2}$ NW, Sec. 26, T. 147 N., R. 27 W.	76	II
1592	4-10-51	Superior N. F.	Lake	Sec. 32, T. 61 N., R. 7 W.	85	III
1593	4- 4-51	Superior N. F.	Cook	NE NE, Sec. 14, T. 63 N., R. 1 E.	65	IV
1594	3-27-51	Superior N. F.	St. Louis	E $\frac{1}{2}$ SE, Sec. 26, T. 65 N., R. 16 W.	75	III
1595	9- 3-51	St. Croix S. P.	Pine	SE SE, Sec. 36, T. 41 N., R. 18 W.	55	V
1596	1- ?-52	Gen. Andrews E. F.	Pine	SW SW, Sec. 25, T. 45 N., R. 20 W.	33	IV
1597	4- 5-51	White Earth S. F.	Becker	SE NE, Sec. 4, T. 142 N., R. 37 W.	50	I
1600	4- 5-51	Crow Wing S. F.	Cass	N $\frac{1}{2}$ NW, Sec. 28, T. 138 N., R. 29 W.	52	II
1601	4- 3-51	Miss. Hdwtrs. S. F.	Beltrami	NE SE, Sec. 16, T. 147 N., R. 34 W.	38	V
1602	4-11-51	Geo. Wash. S. F.	Itasca	NW SW, Sec. 2, T. 61 N., R. 23 W.	52	II
<u>WISCONSIN</u>						
1604	4-23-51	Mosinee I. F.	Douglas	SW $\frac{1}{4}$ , Sec. 20, T. 45 N., R. 11 W.	39	III
1605	3-29-51	Chequamegon N. F.	Bayfield	NW NW, Sec. 18, T. 49 N., R. 5 W.	50	II
1606	6- 4-51	Nicolet N. F.	Forest	NE $\frac{1}{4}$ , Sec. 11, T. 41 N., R. 13 E.	38	II
1607	6- 5-51	Nicolet N. F.	Oneida	SE NW, Sec. 24, T. 39 N., R. 11 E.	32	III
1608	3-22-51	Burnett C. F.	Burnett	NE SE, Sec. 18, T. 39 N., R. 14 W.	50	III
1609	3-23-51	Marinette C. F.	Marinette	NE SW, Sec. 21, T. 32 N., R. 18 W.	50	III
1610	4-10-51	Nepco I. F.	Oneida	NE SE, Sec. 13, T. 38 N., R. 5 E.	39	I
1611	11- 7-51	Nepco Lake area	Wood	SW NE, Sec. 6, T. 21 N., R. 6 E.	60	IV
<u>MICHIGAN</u>						
1612	3-22-51	Ottawa N. F.	Gogebic	SW SW, Sec. 26, T. 44 N., R. 39 W.	35	II
1613	3-16-51	Ottawa N. F.	Ontonagon	NW NW, Sec. 14, T. 48 N., R. 38 W.	39	II
1614	4- 6-51	Hiawatha N. F.	Alger	NW SW, Sec. 22, T. 45 N., R. 19 W.	70	IV
1615	3-30-51	Marquette N. F.	Chippewa	NW SE, Sec. 7, T. 45 N., R. 4 W.	62	V
1616	1- 2-52	Manistee N. F.	Manistee	SW NE, Sec. 12, T. 21 N., R. 16 W.	52	V
1617	5-22-51	Ogemaw S. F.	Ogemaw	NE SE, Sec. 7, T. 21 N., R. 3 E.	48	IV
1618	5-24-51	Alpena S. F.	Alpena	NW SW, Sec. 12, T. 30 N., R. 7 E.	35	III
1620	6-11-51	Fife Lake S. F.	Grand Trav.	SE SW, Sec. 34, T. 25 N., R. 9 W.	60	V
1621	5-12-51	Lake Superior S. F.	Luce	SW SW, Sec. 21, T. 49 N., R. 9 W.	65	V

<sup>1/</sup> N. F. = National Forest; S. F. = State Forest; C. F. = County Forest; E. F. = Experimental Forest; I. F. = Industrial Forest; S. P. = State Park.

<sup>2/</sup> Adjective descriptions of site qualities are as follows: I = Excellent; II = Good; III = Medium; IV = Poor; V = Very Poor.

Table 2.--Information on plantations established in the regional jack pine seed source study

Plantation number	Date planted (1954)	Ground preparation	Agency by which established	Location			Average first year survival
				Forest	County	Legal description	
1	5/26-27	Disked	U. S. Forest Service	Superior N. F. <sup>1/</sup>	Lake	E $\frac{1}{2}$ NW $\frac{1}{4}$ , S. 29, T. 60 N., R. 6 W.	95
2	5/18-19	"	"	Chippewa N. F.	Beltrami	SW $\frac{1}{4}$ NW $\frac{1}{4}$ , S. 35, T. 146 N., R. 30 W.	70
3	5/18-19	Furrowed	Minnesota Cons. Dept.	Pillsbury S. F.	Cass	NW $\frac{1}{4}$ SE $\frac{1}{4}$ , S. 3, T. 134 N., R. 30 W.	91
4	5/ 3- 4	"	"	Sand Dunes S. F.	Sherburne	SW $\frac{1}{4}$ NE $\frac{1}{4}$ , S. 21, T. 34 N., R. 27 W.	86
5	9/9-10/53	"	"	Gen. Andrews E. F.	Pine	NW $\frac{1}{4}$ NE $\frac{1}{4}$ , S. 24, T. 45 N., R. 20 W.	68
6	5/18	Disked	University of Minnesota	Cloquet E. F.	Carlton	E $\frac{1}{2}$ NE $\frac{1}{4}$ , S. 29, T. 45 N., R. 17 W.	94
7	5/10	Furrowed	Burnett County	Burnett C. F.	Burnett	W $\frac{1}{2}$ SE $\frac{1}{4}$ , S. 31, T. 37 N., R. 19 W.	93
8	5/ 1	"	Mosinee Pulp & Paper Mills Co.	Mosinee I. F.	Washburn	SE $\frac{1}{4}$ SE $\frac{1}{4}$ , S. 10, T. 42 N., R. 13 W.	98
9	5/18-20	"	U. S. Forest Service	Chequamegon N. F.	Bayfield	S $\frac{1}{2}$ N $\frac{1}{2}$ NW $\frac{1}{4}$ , S. 16, T. 45 N., R. 8 W.	89
10	5/ 6- 7	"	Nekoosa-Edwards Paper Co.	Nepco I. F.	Wood	SW $\frac{1}{4}$ SE $\frac{1}{4}$ , S. 31, T. 21 N., R. 6 E.	90
11	5/ 5- 6	"	U. S. Forest Service	Argonne E. F.	Forest	NE $\frac{1}{4}$ NE $\frac{1}{4}$ , S. 21, T. 38 N., R. 12 E.	97
12	4/29-5/5	"	Marinette County	Marinette C. F.	Marinette	NE $\frac{1}{4}$ SW $\frac{1}{4}$ , S. 14, T. 37 N., R. 20 E.	95
13	5/18-20	Disked	U. S. Forest Service	Ottawa N. F.	Ontonagon	SW $\frac{1}{4}$ SW $\frac{1}{4}$ , S. 27, T. 46 N., R. 39 W.	85
14	5/ 6,10	"	"	"	"	"	"
15	5/ 3- 5	Furrowed	Michigan Cons. Dept.	Lake Superior S.F.	Luce	SW $\frac{1}{4}$ SW $\frac{1}{4}$ , S. 8, T. 49 N., R. 10 W.	85
16	5/ 3- 5	"	University of Michigan	Biological Station	Emmet	NE $\frac{1}{4}$ NW $\frac{1}{4}$ , S. 1, T. 36 N., R. 4 W.	95
17	5/ 3- 5	"	Michigan Cons. Dept.	Au Sable S. F.	Crawford	NW $\frac{1}{4}$ NW $\frac{1}{4}$ , S. 31, T. 25 N., R. 3 W.	96
17	4/29-30	"	"	Fife Lake S. F.	Grand Trav.	NE $\frac{1}{4}$ NE $\frac{1}{4}$ , S. 29, T. 25 N., R. 9 W.	96
							90

<sup>1/</sup> N. F. = National Forest; S. F. = State Forest; C. F. = County Forest; E. F. = Experimental Forest; I. F. = Industrial Forest.

attained by source 1618 from Alpena County, Michigan, and the poorest height growth was found in sources 1591 and 1593 from northeastern Minnesota, and in the "local" source, originating on the Ottawa National Forest (and 1 year younger from seed than the other sources). These three sources were approximately a foot shorter on the average than source 1618 (table 3). Survival showed wide differences between sources in the fifth year. The lowest stocking was found in source 1611, the southernmost collection in Wisconsin with 77.7 percent, and the best in source 1600 with 96.9 percent (table 3).

In addition to measurements of height and survival, other measurements and observations have been made in this and the other plantations. Differences between seed sources have been noted in susceptibility to the white-pine weevil and other injurious agents, and in winter foliage color.

A recently completed study revealed highly significant differences in the occurrence of lammas growth and prolepsis <sup>3/</sup> between seed sources in six of the seed source plantations studied in 3 successive years, indicating that the tendency to form these late shoots is inherited.

The occurrence frequency of late shoots varies significantly between plantations and from year to year, suggesting that, although the late-shoot formation is under genetic influence, it has a wide range of reaction to environmental conditions. Regression analyses showed that the frequency of all late-shoot types, with the exception of prolepsis, increases predictably (1) with more southerly latitude of seed origin, (2) with an increase in degree days over 50° F. of the origin, and (3) with higher average July temperatures of the origin. Proleptic shoot occurrence showed no relationship to latitude but was related to temperature conditions prevailing in the seed source locality.

The variation in late-shoot occurrences between sources showed a clinal-pattern, indicating that formation of lammas and proleptic shoots is controlled by more than a single pair of genes.

Trees with lammas growth did not grow significantly less the following season than those with normal growth the previous season.

Tree form was found to be influenced by lammas growth and prolepsis, the seriousness of the deformation depending upon the type of late-shoot development and on the size of such shoots. In total, the results of the study of lammas growth and prolepsis pointed to the conclusion that seed collection from trees with late shoots or in stands with a high frequency of these growth types should be avoided.

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2/ Elongation of the terminal bud after normal seasonal height growth is completed.

3/ Elongation of lateral buds after normal seasonal height growth is completed.



Table 3.--Summary of survival and height development at the end of 5  
years in the field, jack pine in the seed source  
plantation on the Argonne Experimental Forest,  
northeastern Wisconsin

Seed source	Survival	Average height
	<u>Percent</u>	<u>Feet</u>
	<u>MINNESOTA</u>	
1589	93.8	5.93
1590	91.8	5.62
1591	91.4	5.16
1592	95.7	5.53
1593	96.1	5.06
1594	94.9	5.28
1595	89.1	5.84
1596	95.3	5.80
1597	95.7	5.94
1600	96.9	5.68
1601	93.4	5.80
1602	96.5	5.86
	<u>WISCONSIN</u>	
1604	87.5	5.70
1605	91.8	5.32
1606	92.6	5.53
1607	92.2	5.64
1608	91.0	5.67
1609	87.9	5.85
1610	91.8	5.94
1611	77.7	5.22
	<u>MICHIGAN</u>	
1612	95.3	5.86
1613	91.0	5.47
1614	95.7	5.41
1615	94.9	5.44
1616	80.5	5.93
1617	82.0	5.82
1618	89.1	6.03
1620	88.7	5.82
1621	96.5	5.40
LOCAL	91.4	5.08

Early results of the jack pine seed source study have been presented in the following publications:

- Arend, John L.; Smith, Norman F.; Spurr, Stephen H.; and Wright, Jonathan W.  
1961. Jack pine geographic variation--five-year results from Lower Michigan. Mich. Acad. Science, Arts, and Letters Papers 46: 219-238.
- Batzer, H. O.  
1961. Jack pine from Lake States seed sources differ in susceptibility to attack by white-pine weevil. U. S. Forest Serv., Lake States Forest Expt. Sta. Tech. Note 595, 2 pp. (Processed.)
- Jensen, Raymond A.; Schantz-Hansen, T.; and Rudolf, Paul O.  
1960. A study of jack pine seed source in the Lake Stites. Minn. Forestry Notes No. 88, 2 pp. (Processed.)
- Stoeckeler, J. H., and Rudolf, Paul O.  
1956. Winter coloration and growth of jack pine in the nursery as affected by seed source. Ztschr. Forstgen. Forstpflanzenzuchtung 5: 161-165.