GROWTH COMPARISONS OF TAMARACK AND EUROPEAN LARCH IN UPPER MICHIGAN

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Abstract.--A tamarack plantation of a number of seed sources was established in 1967 using 2-1 stock near South Range, Michigan. In 1982, the average and maximum heights of trees from the provenance with the greatest height growth were 27.3 and 39.0 feet, respectively. The ,provenance with the greatest diameter had an average of 4.7 inches d.b.h. and a maximum of 5.3 inches. In 1968, a second plantation was established nearby on a similar site using 2-0 stock. In 1982, the trees from the tallest seed source averaged 24.2 feet in height with the tallest measuring 30.2 feet. The same seed source also produced the greatest diameter growth with an average of 4.0 inches d.b.h. and a maximum of 5.5 inches. There were no strong relationships in either plantation between diameter or height growth and latitude, longitude, or elevation of the original seed source. Each plantation had also been measured in 1970 and 1974. There were considerable differences in relative performance of the seed sources between measurement periods. A European larch plantation was also established on a similar site nearby in 1970. At 12 years of age, these European larch trees averaged 4.6 inches d.b.h. and 24.7 feet in height. The largest tree was 8.9 inches in diameter and 35.0 feet tall. These twelve year old European larch were essentially the same size as the best growing 16 and 18 year old tamarack on similar sites nearby.

Additional Keywords: Height growth, diameter growth, Larix laricina, L. decidua, Tamarack

(Larix laricina) is one of the most widespread of the North American conifers and is adapted to a wide range of climatic conditions, indicating large degree of genetic variation within the species. This characteristic is shared with other members of the genus Larix including European larch (L. decidua). Genetic variation, along with a shared resistance to Scleroderris canker and a typical good form with rapid juvenile growth, has led to renewed interest in the genus Larix as a commercial fiber species in the United States (Jeffers and Isebrands, 1972).

This interest led to the establishment of two tamarack plantations at the Michigan Technological University Tree Improvement Arboretum near South Range, Michigan. The establishment of these plantations, the first in 1967 and the second in 1968, was followed by the establishment nearby of a European larch plantation in 1970. This report is concerned with the growth of these plantations, comparisons between the species, and comparisons of growth between the tamarack seed sources.

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PLANTATION DATA

Tamarack

The first tamarack plantation was established in 1967 using 2-1 stock. Twenty-seven seed sources were represented.— Twenty-two seed sources were represented in the 2-0 stock utilized in the 1968 planting. Both plantations were hand-planted at an 8'x8' spacing in a randomized block design. The site, 11 located near South Range, Michigan (47 05' North Latitude, 88 39' West Longitude, with an elevation of 1120 feet above sea level) was an abandoned field which had been treated with chlordane prior to planting. The soil is a spodic/alfic bisequeem type, developed on lacustrine sands. The site represents an Acer-tsuga-dryopteris habitat-type which ranks on the lower end of the productivity scale for hardwoods and on the high end for pines. Four tree row plots of each seed source were established. Due to unequal replication at planting, only 22 of the 27 sources in the 1967 plantation are utilized in this report. There were four replications of the planting in the 1967 plantation and seven replications in the 1968 plantation. Height and diameter measurements on the surviving trees were made in 1970, 1974, and 1982. Results from the 1970 and 1974 measurements were described by Wotten (1976). This report is primarily concerned with the results of the 1982 measurements where the plantations were 18 and 16 years old, respectively. 2/

European Larch

The European larch plantation is located near the tamarack plantations on 41 a similar site. The trees are all from a common seed source (Austrian) and are planted at an 8'x8' spacing. Two one-tenth acre measurement plots were established in the plantation in 1981 when the trees were 12 years old. 3/ and diameter measurements were made on each tree on the measurement plots.

GROWTH COMPARISONS BETWEEN SPECIES

Height and Diameter

Average height and diameter of the trees in each stand are given in Table 1. There were significant ($p < 0.001$) differences between seed sources in diameter and height growth in each of the tamarack plantations. The 12 year old European larch were essentially the same size as the fastest growing seed sources in the 18 year old tamarack plantation and slightly larger than the fastest growing seed sources in the 16 year old tamarack plantation. The European larch were equal to or slightly greater in height than those reported in New York by Morrow (1978) but were slightly smaller in diameter.

1/ The tamarack plantations were part of an NC 51 study initiated by the late Scott S. Pauley of the University of Minnesota. Seedlings were grown by Michigan State University.

2/ Tamarack measurements were provided by S. G. Ernst of Michigan State University.

3/ The 1981 measurements of the European larch trees were taken by Gail Roberts and Robert Slater as part of a graduate-level independent study course under the direction of John Kotar.

Table 1.--Summary statistics for two tamarack plantations and a European larch plantation located near South Range, Michigan.

Characteristic	Tamarack 1967 Plantation	Tamarack 1968 Plantation	European Larch
Total Age	18	16	12
Diameter (inches)			
Average	3.3	2.8	4.6
Average of Largest Seed Source	4.7	4.0	
Largest Individual	6.7	5.5	8.9
Height (feet)			
Average	22.4	18.9	24.7
Average of Largest Seed Source	27.3	24.2	
Largest Individual	39.0	31.2	35.0

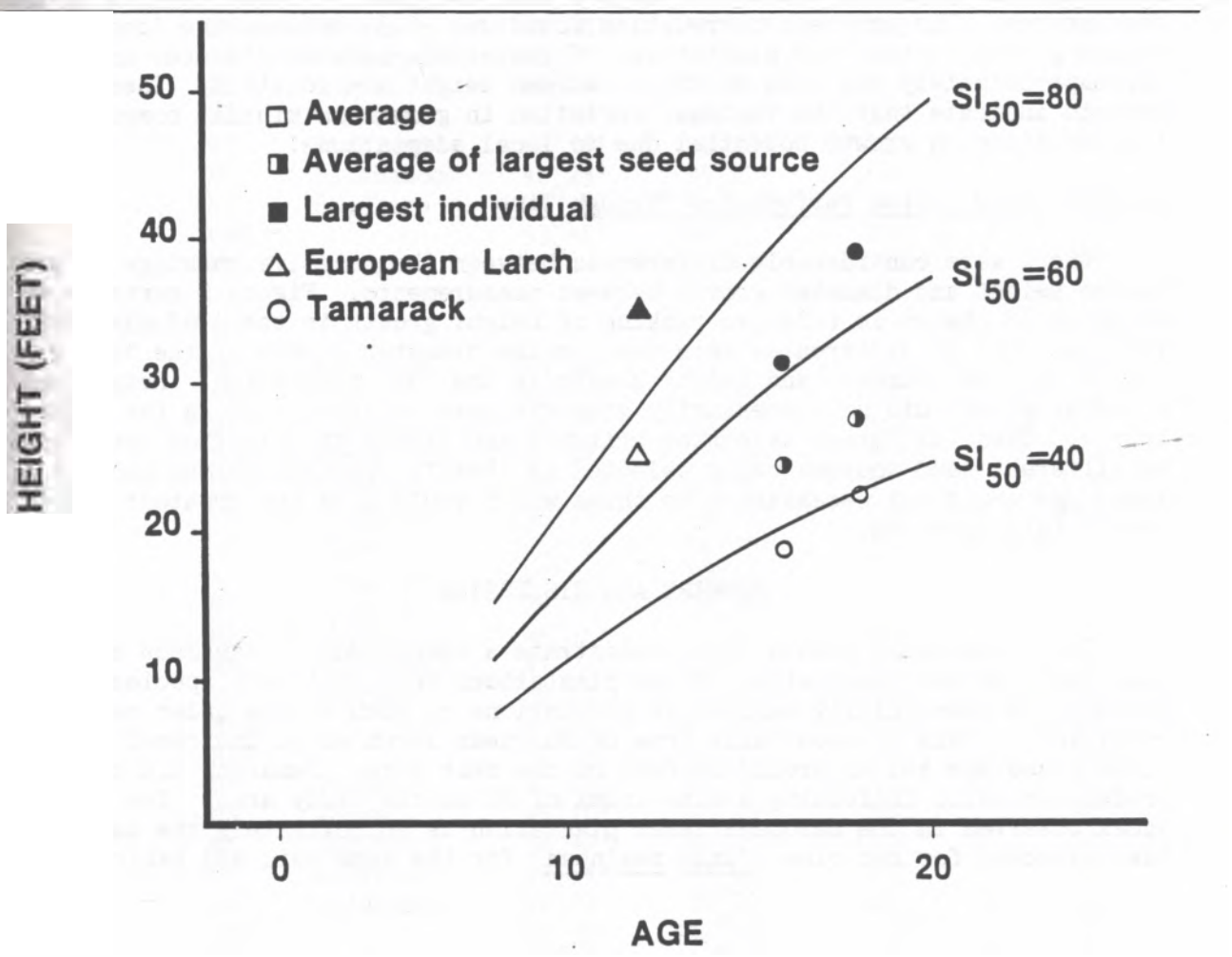

Figure 1.--Height/age observations from the South Range plantations compared with European larch site index curves given by Aird and Stone (1955).

Site Index

Site index curves for European and Japanese (L. leptolepsis) larch in New York were given by Aird and Stone (1955). In Figure 1, the height/age measurements from the European larch and tamarack plantations used in this study are plotted against the European larch site index curves given by Aird and Stone (1955). The European larch show an apparent site index (base age 50) of near 80 feet while the two tamarack plantations show apparent site indices of near 50. These results indicate that the growth of European larch, and possibly tamarack on certain sites, can certainly justify interest in commercial plantations.

COMPARISONS BETWEEN TAMARACK SEED SOURCES

Relationships Between Growth and Seed Source Location

Information regarding the original location, latitude, longitude, and elevation of each tamarack seed source is given in Table 2. The relative rankings (based on height growth) of the seed sources in the 1982 measurements are also included in Table 2. As shown in Table 3, only very low level correlations were found between seed source growth and the original location of the seed source. The greatest correlation found was -0.34 between the longitude and height growth in the 1968 plantation. Correlations between diameter and location were approximately the same as those between height and location. These results seem to indicate that the regional variation in growth is minimal compared to the variation in growth potential due to local adaptations.

Relative Seed Source Performance Through Time

There were considerable differences between the relative rankings of seed source height and diameter growth between measurements. Figure 2 contains some examples of change in relative ranking of height growth in the 1967 plantation. The same type of differences were seen in the diameter growth of the 1967 plantation and the diameter and height growth in the 1963 plantation. Height and diameter growth did not necessarily give the same relative ranking for a seed source. Thus, different selection criteria and timing of selection could lead to different seed sources being selected as 'best'. The selections made at a young age would not necessarily be those which would give the greatest growth over a full rotation.

SUMMARY AND DISCUSSION

The South Range plantations demonstrate a comparison of tamarack and European larch on an upland site. These plantations show that both species can probably be commercially managed in plantations on such a site under certain conditions. This is especially true of European larch which indicated a site index (base age 50) of around 80 feet on the test site. Tamarack did not produce as well, indicating a site index of 50 on the study area. The site index observed in the European larch plantation is approximately the same as that expected for red pine (Pinus resinosa) for the same soil and habitat-type.

Table 2.--Locations and relative performances in height growth of the seed sources in the South Range tamarack plantations.

Source Number	State/ Prov.	County	Lat. (North)	Lon. (West)	Elev.	% Plantation Mean Height
1967 Plantation						
26	MI	Livingston	42°30'	83°50'	700	122
48	ME	Somerset	45°40'	70°15'	1185	118
55	MI	Clare	44° -	85° -	-	112
53	MI	Clare	44° -	85° -	-	110
41	MI	Schoolcraft	46°21'	86°20'	800	110
11	WI	Washington	43°10'	88° -	980	110
20	MN	St. Louis	47°53'	91°51'	420	108
21	MN	Anoka	45°05'	93°05'	800	107
56	MI	Shiawasee	42°29'	84°21'	-	106
12	WI	Washburn	46° -	91°45'	1100	103
64	ONT		49°28'	82°16'	750	103
52	MI	Cass	41°52'	85°57'	840	101
17	WI	Waukesha	43° -	88°15'	820	99
22	MN	Itaska	47°10'	93°20'	1400	96
19	IL	McHenry	42°27'	88°02'	800	94
47	WI	Sawyer	46° -	91°30'	1250	94
50	MI	VanBuran	42°10'	86°08'	775	92
24	WI	Richland	43°15'	90°20'	1100	91
65	MI	Kalamazoo	42°23'	85°22'	840	88
27	WI	EauClare	44°45'	91° -	-	81
63	ONT		53°45'	89°50'	770	72
13	MN	Carver	45° -	93°45'	750	70
1968 Plantation						
127	ME	Somerset	45°38'	70°16'	800	128
124	ONT		46°00'	77°26'	480	119
120	MI	Alger	46°21'	86°20'	800	119
131	N.S.	Annapolis	44°48'	65°03'	750	114
129	ONT	Oxford	43°13'	80°35'	975	110
122	MI	Chippewa	46°19'	84°14'	600	110
153	MI	Alger	46°21'	86°20'	800	106
128	MI	Houghton	47°01'	88°25'	660	101
106	MD	Garrett	39°42'	78°56'	2690	101
160	MI	Gogebic	46°15'	89°10'	1600	97
101	MN	St. Louis	47° -	93° -	1270	95
105	MD	Garrett	39°42'	78°56'	2690	94
109	MAN		53°55'	101°15'	855	93
117	MAN		50°05'	95°25'	750	91
159	MN	Itaska	47°22'	93°35'	1350	90
100	MN	Anoka	45°10'	93°05'	800	90
102	MN	Carlton	46°42'	92°31'	1100	89
157	WI	LaCrosse	43°51'	91°08'	855	88
115	MI	Kalamazoo	42°23'	85°22'	840	85
110	ALTA		56°39'	111°14'	1100	82
118	NWT		58°58'	111°40'	750	75

Table 3.--Correlations between seed source latitude, longitude, and elevation and height and diameter growth in the South Range tamarack plantations.

	1967 Plantation		1968 Plantation	
	Height	Diameter	Height	Diameter
Lattitude				
Correlation	-0.04	0.00	-0.15	-0.15
Minimum Value	41°52'		39°42'	
Maximum Value	53°45'		58°58'	
Longitude				
Correlation	-0.17	-0.18	-0.34	-0.34
Minimum Value	70°15'		65°09'	
Maximum Value	93°45'		111°40'	
Elevation				
Correlation	-0.02	0.03	-0.08	-0.09
Minimum Value	420		480	
Maximum Value	1400		2690	

a/ The South Range plantations are located at 47°05' North Latitude, 88°39' West Longitude, with an elevation 1120 feet above sea level.

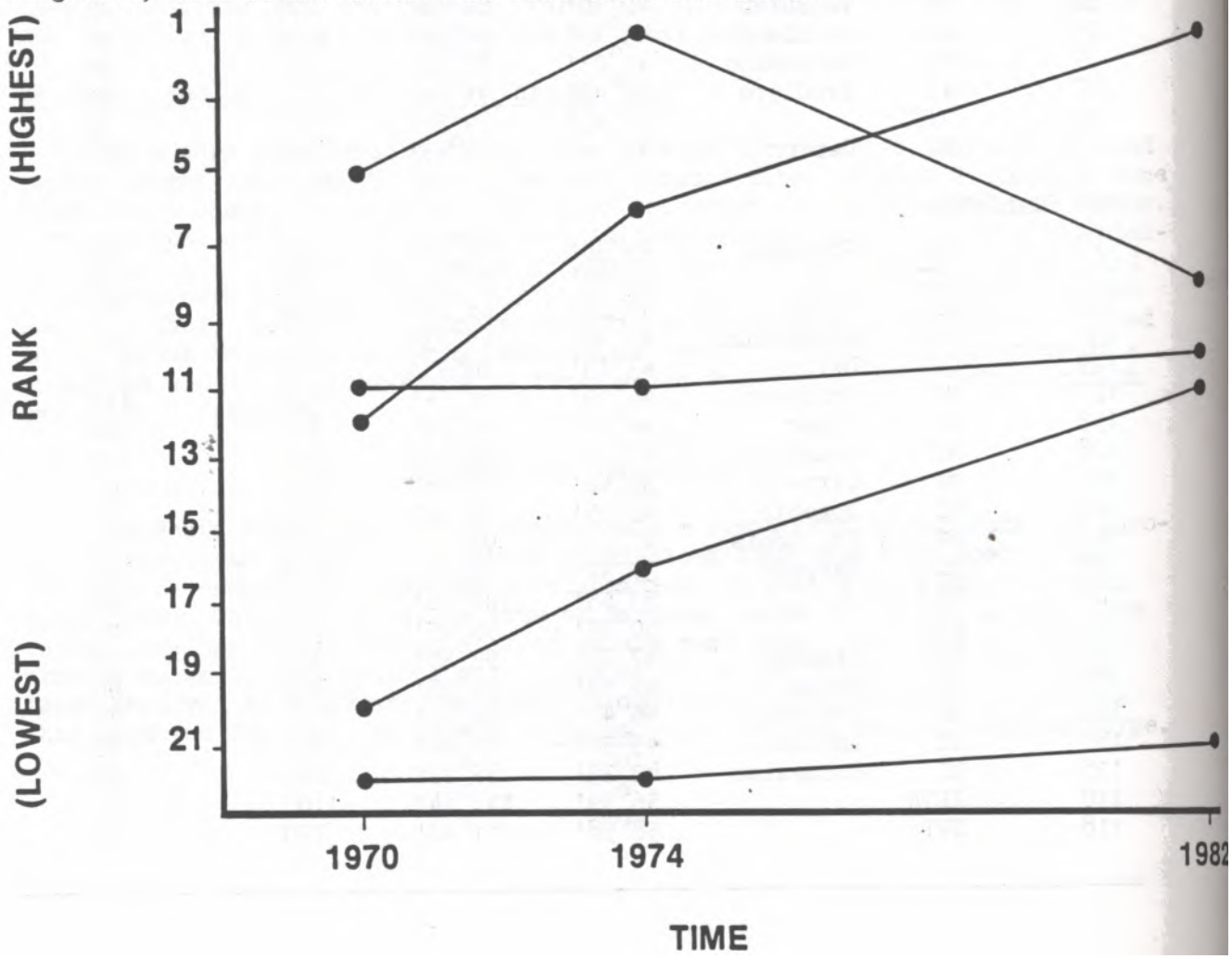

Figure 2.--Relative rankings of height growth among selected seed sources in the South Range tamarack plantation.

The two tamarack plantations allowed the comparison on a single site of the performance of several (49) seed sources collected across Canada and the northern United States. There were no strong relationships indicated between seed source height or diameter growth And original latitude, longitude, or elevation of the seed material. A considerable variation was noted in the relative performance of the tamarack over time. Stock which performed well at age six or ten was not necessarily the best performing at age 18 and may not show the most growth at rotation age.

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