SEVENTH-YEAR RESULTS OF A TAMARACK PROVENANCE STUDY

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According to Roe (1957), tamarack [*Larix laricina* (Du Roc) K. Koch] has one of the widest ranges of the American conifers, occurring widely in boreal and northern forest regions. It grows under a great variety of conditions on a spectrum of sites, but is usually recognized as a tree of bogs and swamps, especially in the southern portion of its range. In the northern part of the range it normally grows on much drier sites.

The most southern natural stand of tamarack, or eastern larch, is located at an elevation of 2250 feet in Cranesville Swamp, approximately 50 miles to the east and slightly south of Morgantown, West Virginia. A species with such an extensive range (Yukon territory east to Newfoundland and south to West Virginia) might be expected to have considerable intraspecific variation.

In an attempt to isolate and quantify this variation, a seed source study was initiated in 1961 through the NC-51 regional project, CSRS (Pauley, 1964). Seed for this study was supplied to J. W. Wright of Michigan State University aid grown there in the nursery. Sufficient 2-2 seedlings from 16 seed sources were obtained from Wright to establish the West Virginia study (Table 1 and Figure 1). All of these sources were from the southeastern portion of the species range and therefore could be expected to survive when planted as far south as Morgantown. Unfortunately, no seedlings were available from either the West Virginia or Maryland sources.

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The subject plantation is located on the West Virginia University forest 15 miles north of Morgantown, West Virginia, at an elevation of 2300 feet. It is on a medium-quality cove-hardwood site where red maple and red and white oaks originally predominated. The oak site index is 75. It is a relatively moist location with a permanent stream flowing just south of the plantation. An existing opening was enlarged sufficiently to accomodate the plantation and provide a clear buffer zone 30 feet wide. Prior to planting, the site was cleared, planting spots marked with stake flags, and the spots sprayed with Simazine, covering an 18" radius around the flag. One seedling was planted at the center of each spot. Six replications of four tree linear plots were dibble-planted on a 8 x 8 foot spacing and the plantation was surrounded with one row of trees consisting of extra seedlings from several sources.

Initial survival was excellent (93%). After the first year, grass and herbaceous growth provided intensive competition. Mowing and brush control was provided for the first time in 1970. Competing vegetation overtopped the seedlings, and during the first clearing, two to three of them were accidentally cut. Fortunately vegetative shoots developed from the lower part of these seedlings, and although some growth was lost, there was no effect on survival. (It has been noted that very little growth reduction occurs when a seedling sprouts the year after being cut, and there was little effect from the moderate pruning.)

Larch sawfly larvae were first noticed in 1970 after two trees had been virtually defoliated. The loss of a few small trees can be attributed to this and late season defoliation in subsequent years. The area was checked annually for sawfly larvae, but in spite of this some damage has occurred.

Heavy snow and glaze storms occur periodically in this area. To date the test tamarack has been resistant to breakage, although some deformities have resulted from the weight of ice and heavy snow.

RESULTS

Diameter at breast height and height were measured at the end of the growing season in 1973 (Table 2). Although the Clare, Michigan, source is actually the tallest (421 cm.), the Anoka, Minnesota source has grown the greatest amount after transplanting (370 cm.). The seedlings from the Ontario source were smallest when they were field planted, and are still the shortest (265 cm,), having grown the least (207 cm.). In spite of the fact that the Clare, Michigan, source is the tallest, it is fourth in average dbh (2.8 cm.) compared to the Anoka, Minnesota, source, which has the largest average dbh (3.2 cm.). It is interesting to note that dbh correlates perfectly with net growth at the end of the 1967-73 period.

An analysis of variance indicated that differences among sources in height growth for the period 1967-73 were statistically significant at the .01 level as were differences among replications. An LSD analysis suggests that the Ontario source is different from all the others.

Spearman's rank correlation test indicated differences among sources for latitude compared to height and diameter growth significant at the .02 and .05 level, respectively.

There was a significant difference in percent survival which varied from a high of 87.5 for the Shiawassee, Michigan, the Itasca, Michigan, and the Eau Claire, Wisconsin, sources to a low of 58.3 for the Waukesha, Wisconsin, source (Table 2).

There appears to be no correlation between elevation at seed-source and performance at the University Forest; however, there is a negative correlation between total height and latitude of origin and net growth and latitude of origin, each being significant at the .01 level ($r = -.64$ and $-.69$, respectively (Figures 2 and 3).

DISCUSSION AND CONCLUSIONS

There are real differences among sources. The seedlings from the southern sources generally grew most rapidly. Seedlings from the most northerly source grew the least and did not appear to be of the same statistical population as the other sources represented in the study (Table 2).

Height growth of the seedlings which grew most rapidly (Anoka, Michigan) is excellent at 53 cms. (1.75 ft) per year. These seedlings have grown more rapidly to date than red or white pine planted nearby on similar sites. It is possible that other larch species might grow more rapidly on this site (Jeffers and Isebrands. 1972) but this thesis would have to be tested. Of the hardwood species, only yellow-poplar might be expected to grow at a more rapid rate. The study indicates that seedlings from the area of the slowest growing source (Ontario) would not be a good choice for planting in this area. Both Sajdak (1970) and Jeffers (1975) have presented results from plantations established with material from the NC-51 parent project. Sajdak reported briefly that seedlings planted on the Keweenaw peninsula of Upper Michigan survived well (over 90%) but that considerable snow damage had occurred. The seedlings for the Clare, Michigan source had grown the most rapidly as in our study.

Jeffers (1975) described the survival and growth of two plantings in Northern Wisconsin. In all cases where the same provenance appear in West Virginia and Wisconsin, the average height of the West Virginia planting at age 6 is greater than the corresponding provenances at age 7 and 8. However, the ranking is different. Unfortunately only four sources are comparable in one Wisconsin plantation and two in the other.

Larch sawfly damage has occurred to some extent every year, but is kept under control by insecticide application. Mortality of a few trees is directly attributable to sawfly damage which occurred one or two years after planting.

Although the minimum-seed-bearing-age of tamarack is listed as 40 years (Schopmeyer, 1974), two trees bore cones in 1970, three years after transplanting or seven years from seed. In 1972, eleven trees, representing eight sources, bore cones. Individual trees from both the sources that bore cones in 1970 had cones again in 1972. However, in 1972 different trees were represented for each source (Table 3).

Six of the trees bore abnormal cones in 1972. These cones were normal in every way except that the tip meristems had proliferated into foliage bearing branchlets. Doak (1935) noted that such indeterminate growth is "not uncommon" in many coniferous species and that it perhaps occurs most frequently in the genus Larix. However, to have cones with indeterminate axes on 55% of the bearing trees, with 27% of the cones on those trees being abnormal is unusual, and may be in part caused by juvenility. Seed from both the abnormal and normal cones were empty as determined by a standard cutting test.

While more time is required before any practical recommendations can be made, information from this 7-year-old test plantation indicates that tamarack could be considered as a suitable species for planting in West Virginia at medium elevations on medium to good sites. Certainly it is imperative that seed from the proper source be used, and, if interest in tamarack were great enough, a more extensive provenance test would be adviseable.

Although larch sawfly damage must be expected and controlled in the early years, under conditions similar to those represented in the current study, any one of the tallest four provenances (Clare, Mich., Cass, Mich., Richland, Wis., Anoka, Minn.) would be useable.

Abstract: Seven year measurements of a 16 provenance study of tamarack located near Morgantown, WV, indicated that survival of all sources was satisfactory and that any one of the four provenances with the most rapid growth would provide plantations with good growth potential. There was a significant negative correlation with growth rate and latitude. Precocious cone production occurred. On 55% of the bearing trees, 27% of the cones were abnormal.

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Table 1 -- Location of Seed Sources

	Accession Number	State	County	Lat.	Long.	Elev. (Ft.)
1	11	Wisconsin	Washington	41-26	81-11	1100
2	12	Wisconsin	Washburn	46-	91-45	980
3	17	Wisconsin	Waukesha	43-	88-15	820
4	24	Wisconsin	Richland	43-15	90-20	1000
5	27	Wisconsin	Eau Claire	44-45	91-	-
6	47	Wisconsin	Sawyer	46-	91-30	1196
7	13	Minnesota	Carver	45-	93-45	750
8	20	Minnesota	St. Louis	47-53	91-51	1420
9	21	Minnesota	Anoka	45-05	93-	-
10	22	Minnesota	Itasca	47-10	93-20	-
11	50	Michigan	Van Buren	42-10	86-08	775
12	52	Michigan	Cass	41-52	85-57	840
13	55	Michigan	Clare	44-	85-	-
14	56	Michigan	Shiawassee	42-49	84-21	-
15	65	Michigan	Kalamazoo	42-23	85-22	840
16	64	Ontario		49-28	82-16	750

Table 2 -- Survival, total height, net growth and dbh for 16 provenances of tamarack

Accession Number	Source	Survival (%)	Average Height (cm)	Average Net Growth (cm)	Average dbh (cm)
55	Clare, Mich.	83.3	421	363	2.9
21	Anoka, Minn.	70.8	419	370	3.2
24	Richland, Wis.	79.1	417	365	3.0
52	Cass, Mich.	83.3	414	363	2.9
50	Van Buren, Mich.	75.0	407	359	2.7
11	Washington, Wis.	83.3	404	361	2.8
65	Kalamazoo, Mich.	79.1	395	340	2.7
13	Carver, Minn.	66.7	388	330	2.3
22	Itasca, Minn.	87.5	387	332	2.5
56	Shiawassee, Mich.	87.5	384	334	2.5
20	St. Louis, Minn.	83.3	373	291	2.2
27	Eau Claire, Wis.	87.5	351	305	2.3
17	Waukesha, Wis.	58.3	329	275	2.2
47	Sawyer, Wis.	66.7	319	266	1.8
12	Washburn,Wis.	70.8	314	270	2.0
64	Ontario, Canada	87.5	247	207	1.4

Table 3 -- Cone-bearing trees

1970				1972					
Accession Number	Source	Rep,	Tree	Accession Number	Source	Rep.	Tree	Number Normal Cones	Number Abnormal Cones
13	Carver, Minn.	6	3	13	Carver, Minn.	4	3	12	3
52	Cass, Mich.	5	4	52	Cass, Mich.	4	4	3	1
						3	2	6	0
				56	Shiawassee, Mich.	3	3	7	7
				50	VanBuren, Mich.	6	2	5	1
				24	Richland, Wis.	5	2	2	3
						2	3	6	0
				21	Anoka, Mich	6	1	5	2
				55	Clare, Mich.	3	3	11	0
						4	1	34	0
				17	Waukesha, Wis.	5	1	14	0
					Total			105	16

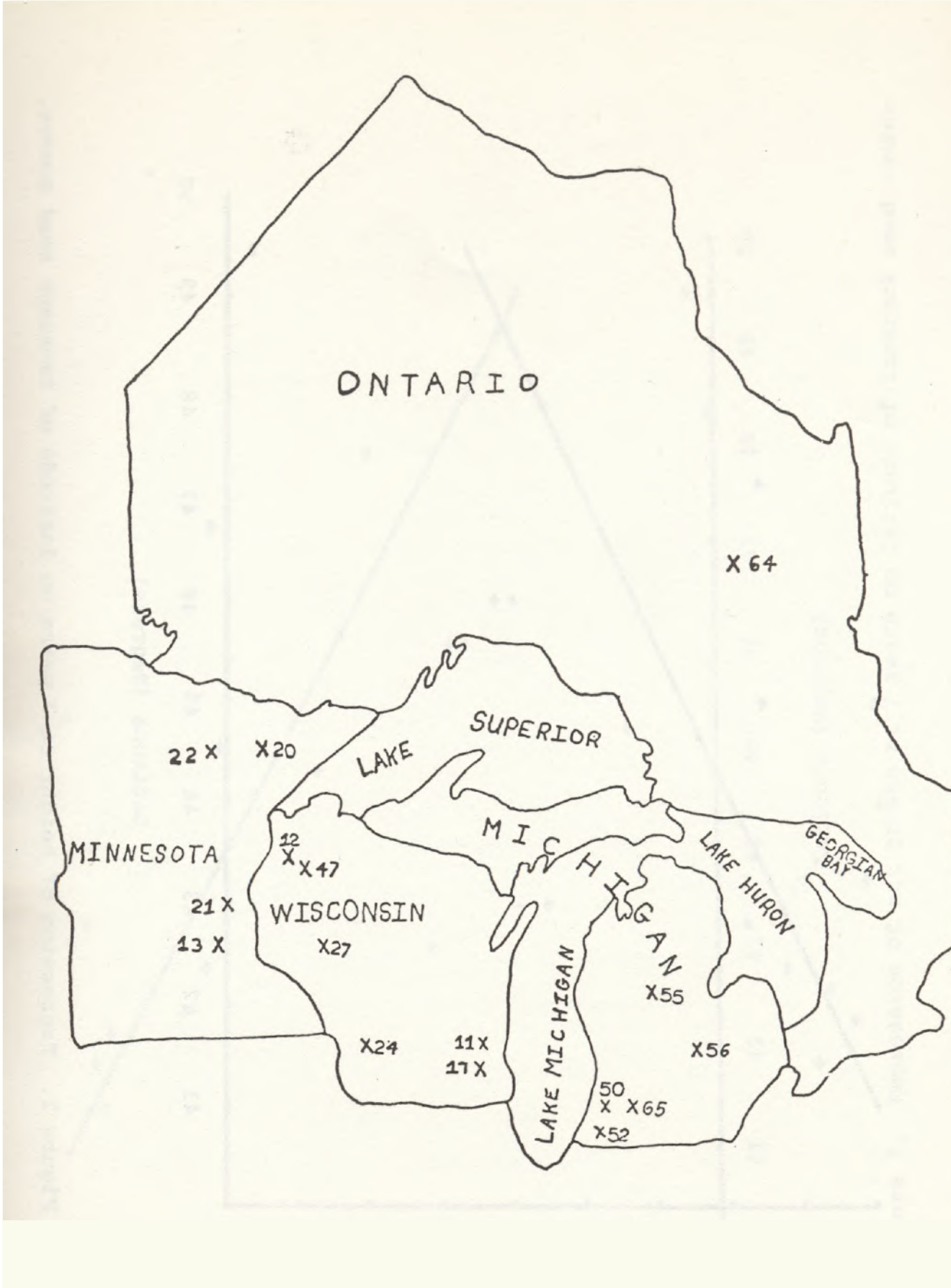

Figure 1. Location of tamarack seed sources (provenances).

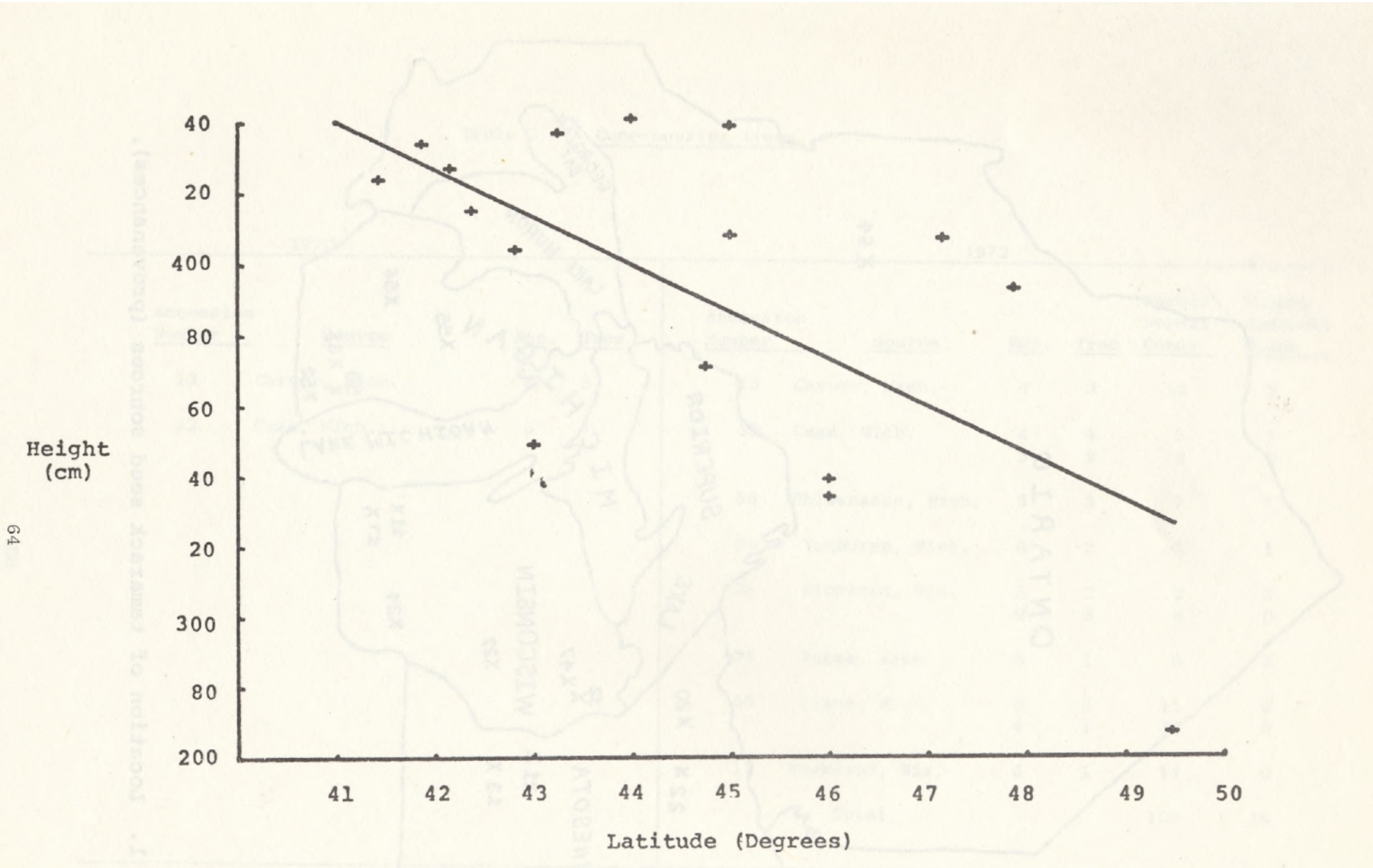

Figure 2. Regression of height at 7 years on latitude of tamarack seed source .

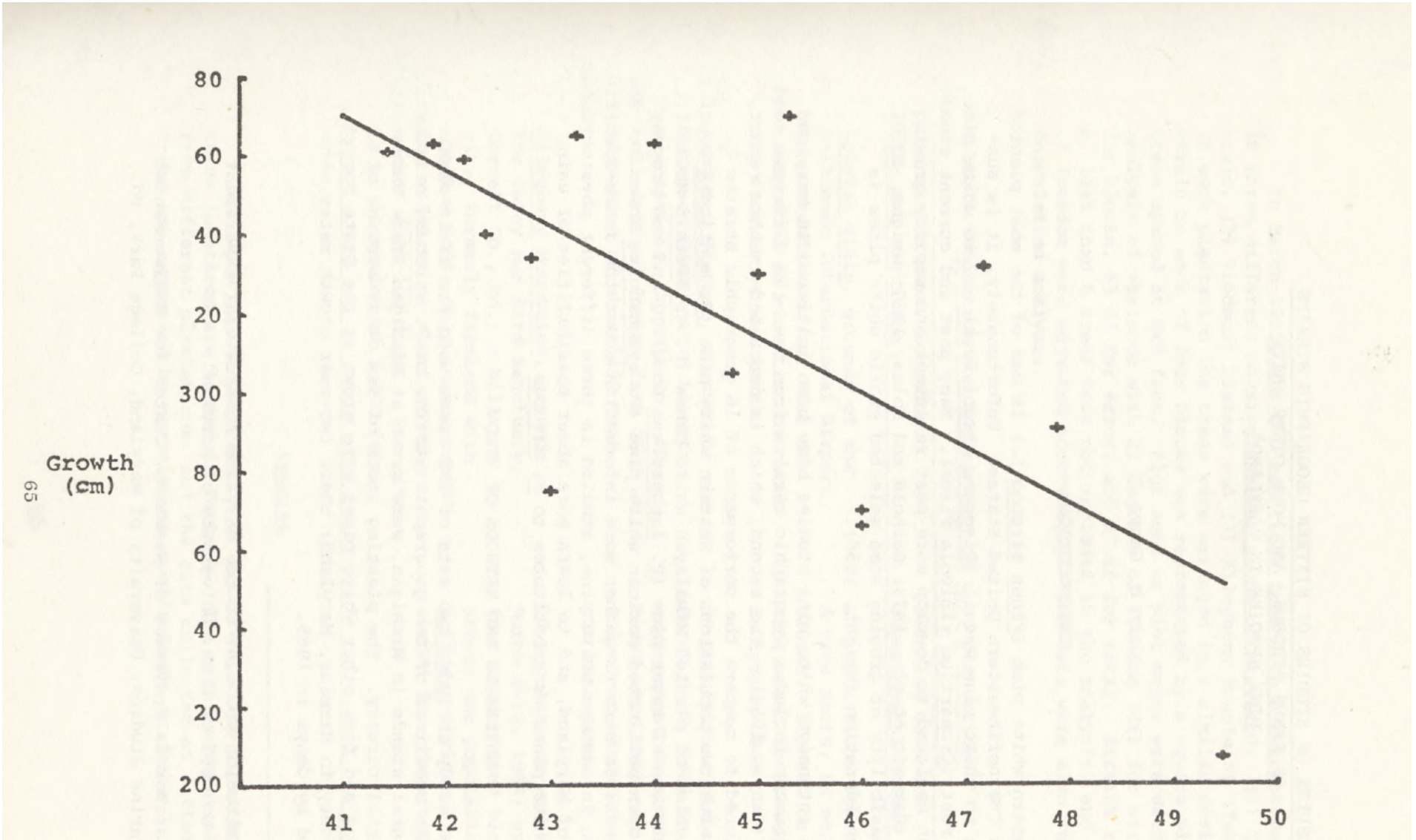

Figure 3. Regression of net growth at 7 years on latitude of tamarack seed source.