FOURTEEN YEAR RESULTS OF A WHITE SPRUCE PROVENANCE TEST PLANTED IN MAINE

by Kathy N. Hale, Tree Improvement Forester
Maine State Forest Nursery
Passadumkeag, Maine 04475

Abstract. —Survival, total height, annual height growth, diameter, and cone production of white spruce grown in a central Maine plantation from seed collected from 30 sources were studied. Variation in all traits except survival was significant at the 1% level. Trees from St. Raymond, Quebec, Lake Mattawin, Quebec, and Beloeil, Quebec had the best total height, annual height growth, and dbh, respectively. These sources also had better than average survival. Greatest survival was exhibited by a source from Mitchinamekus Lake, Ontario, which was also better than average in all other growth traits. Trees from a Connecticut source showed poorest survival, total height, annual height growth, and diameter. However, those trees did have the greatest frequency of cone production. Growth of trees from different sources was not significantly related to the latitude or elevation of seed origin. Results of this test do not confirm the findings of other studies that indicate the Cobourg—Beachburg corridor to be the area of choice for seed collection for southern and central planting sites.

INTRODUCTION

White spruce (*Picea glauca* (Moench) Voss) has been one of the most widely planted and intensively studied northeastern conifers. This paper presents the results of one of a series of provenance test plantations initiated by the Canadian Forestry Service in 1955 to determine suitable seed source areas for planting in various regions throughout the range of white spruce.

METHODS

Seed was collected from 1955 to 1957 from sources in the Great Lakes—St. Lawrence forest region (Table 1; Figure 1). Twenty—eight of these sources were hand planted as 2-3 stock in May of 1965 at the Maine State Forest Nursery in Passadumkeag, Maine. Two additional sources of unknown origin and age were also planted. The soil of the plantation is a fine sandy loam approximately two feet in depth. It overlies stratified sandy, fine—sandy, and loamy river terrace material and is moderately well drained. The

land slopes gently to the west. At the time of planting, there was a fairly heavy sod of wild grass with a considerable number of volunteer white pine and white spruce.

A randomized complete block design with 10 replications and 10—tree row plots was used. Spacing was 6' x 6'. Subsequent unsupervised mowing of the grass around the plantation effectively reduced the plantation to 7 complete replications. All trees in these seven replications were evaluated for survival, total height, annual height increment, dbh, and cone production 14 years after planting.

Analysis of variance, Duncan's multiple range test, and correlation analysis were used to evaluate the data.

RESULTS

Total height, annual height increment, dbh, survival,and the presence of cones were recorded in August 1979 (Table 2). There were significant differences among provenances at the 1% level for all characteristics except survival.

Survival ranged from 60 to 88%. The source from Mitchinamekus Lake, Quebec exhibited the best survival while a source of unknown origin, labelled Connecticut, had the worst.

Analysis of variance indicated that total height differed significantly among provenances at the 1% level (Table 3). Average heights ranged from 10.4 feet for the Connecticut source to 14.4 feet for the St. Raymond, Quebec source. That source was different than all others by Duncan's multiple range test.

Differences in annual height increment for 1979 were also significant, ranging from 1.1 feet for the Connecticut source to 1.5 feet for the Swastika, Ontario source, the Lake Mattawin, Quebec source, the St. Raymond, Quebec source and the Miller Lake, Ontario source (Table 4). These top four sources were found to be different from all others by Duncan's test.

Diameter (dbh) differed significantly at the 1% level among sources, ranging from 1.56 inches for the source from Connecticut to 2.86 inches for the source from Beloeil, Quebec (Table 5). The Beloeil source and the Lake Mattawin source (2.84 inches) were determined to be different from all others by Duncan's test.

Cone production was the most variable characteristic, ranging from no cones present on several sources to 69.4% of the trees of the Connecticut source producing cones. Sixty percent of the sources did show some cone production, ranging from 1.8 to 9.3% of the trees. Differences in cone production were significant at the

1% level (Table 6).

There was no significant correlation between latitude of the seed source and any of the characteristics measured, nor was there any significant correlation between elevation of seed source and any characteristic. Latitude and elevation were unavailable for the two sources of unknown origin.

DISCUSSION AND CONCLUSIONS

There was a great deal of variation among sources in this test. From previous white spruce provenance tests, including one in Bradley, Maine, it has been stated that sources from the lower Ottawa River valley generally performed best (Nienstaedt, 1969).

Those sources performing best overall in this plantation were Beloeil, St. Raymond, Lake Mattawin, and Mitchinamekus Lake, all in Quebec, and Swastika, Ontario. All of these sources had better than average survival and growth characteristics. All except St. Raymond are beginning cone production. The Edmundston, New Brunswick source, which is closest to being local for this plantation, showed excellent survival, but slightly less than average performance on growth characteristics.

This same series of provenances has been planted in thirteen locations in Canada. Results of those tests, including seed source recommendations for various regions, were reported by Teich (1973). Sources recommended in these studies for New Brunswick, the area closest to Maine, were Peterborough, Ontario, Beachburg, Ontario, and McNally Lake, Quebec. These sources were of average or less than average performance in our plantation.

Performance of several sources has been quite variable throughout the range of plantations in this series. The Peterborough source has shown markedly different survival rates at several sites, but has grown consistently well where it has survived. The Swastika source has proven to be one of the hardiest on all sites, but growth has ranged from below average (Kapuskasing plantation) in southwestern Ontario to far above average in Passadumkeag, western Ontario, and Quebec (Teich, 1973; Teich, et. al., 1975).

It is important to note that the general prescription of lower Ottawa River valley (specifically Cobourg—Beachburg corridor) does not hold up in central Maine and that continued provenance testing is needed to insure proper selection of seed source for planting in a particular area.

LITERATURE CITED

Nienstaedt, H. 1969. White spruce seed source variation and adaptation to fourteen planting sites in northeastern United States and Canada. Proc. 11th. Meet. Comm. Forest Tree Breed. Can. Macdonald College, Quebec 1968:183-193.

Teich, A.H. 1973. White spruce provenances in Canada. Can. For. Serv. Inf. Report PS—X-40. 27p.

Teich, A.H., E.K. Morgenstern, and D.A. Skeates. 1975. Performance of white spruce provenances in Ontario. Can. For. Serv. Special Joint Report No. 1. 31p.

Table 1. Location of Seed Sources.

Acc. No.	Source	Lat.	Long.	Elev.
2438	Peterborough, Ont.	44°08'	77°32'	256'
2444	Beachburg, Ont.	45°48'	77°11'	410'
2445	Cushing, Que.	45°39'	74°57'	172'
2446	Beloeil, Que.	45°38'	72°57'	102'
2447	Grand Piles, Que.	46°34'	72°43'	306'
2449	St. Raymond, Que.	46°48'	71°23'	245'
2450	Casey, Que.	47°45'	74°37'	1405'
2452	Lake Mattawin, Que.	46°51'	73°39'	1200'
2453	Frannchere Twp., Que.	46°51'	73°39'	1200'
2454	N. Baskatong Lake, Que.	46°43'	75°59'	775'
2455	Lac Dumoine, Que.	47°19'	76°28'	1225'
2462	McNally Lake, Que.	46°21'	76°00'	570'
2463	Notre Dame du Laus, Que.	45°51'	75°39'	640'
2464	Chalk River, Ont.	46°00'	77°26'	550'
2467	Miller Lake, Ont.	44°34'	80°55'	597'
2469	Aylmer Lake, Que.	45°55'	71°21'	980'
2470	St. Sylvestre, Que.	46°28'	71°04'	476'
2471	Monk, Que.	46°58'	69°47'	1295'
2472	Price, Que .		67°54'	875'
2473	Edmundston, N.B.	47°22'	68°17'	488
2475	Upper Green River, N.B.	47°22'	68°17'	488'
2480	Kakabeka Falls, Ont.	48°24'	89°37'	735,
2484	Mitchinamekus Lake, Que.	47°13'	75°10'	1280'
2485	Lac Simard, Que.	47°46'	78°19'	1020'
2486	Swastika, Ont.	48°09'	80°05'	964'
2491	Valcartier F.E.S., Que.	46°56'	71°28'	556'
2603	Marquette Cty., Mich.	46°13'	88°08'	1155
2604	Shipshaw, Que.	48°39'	71°12'	500'
1000	unknown			
2000	Connecticut			

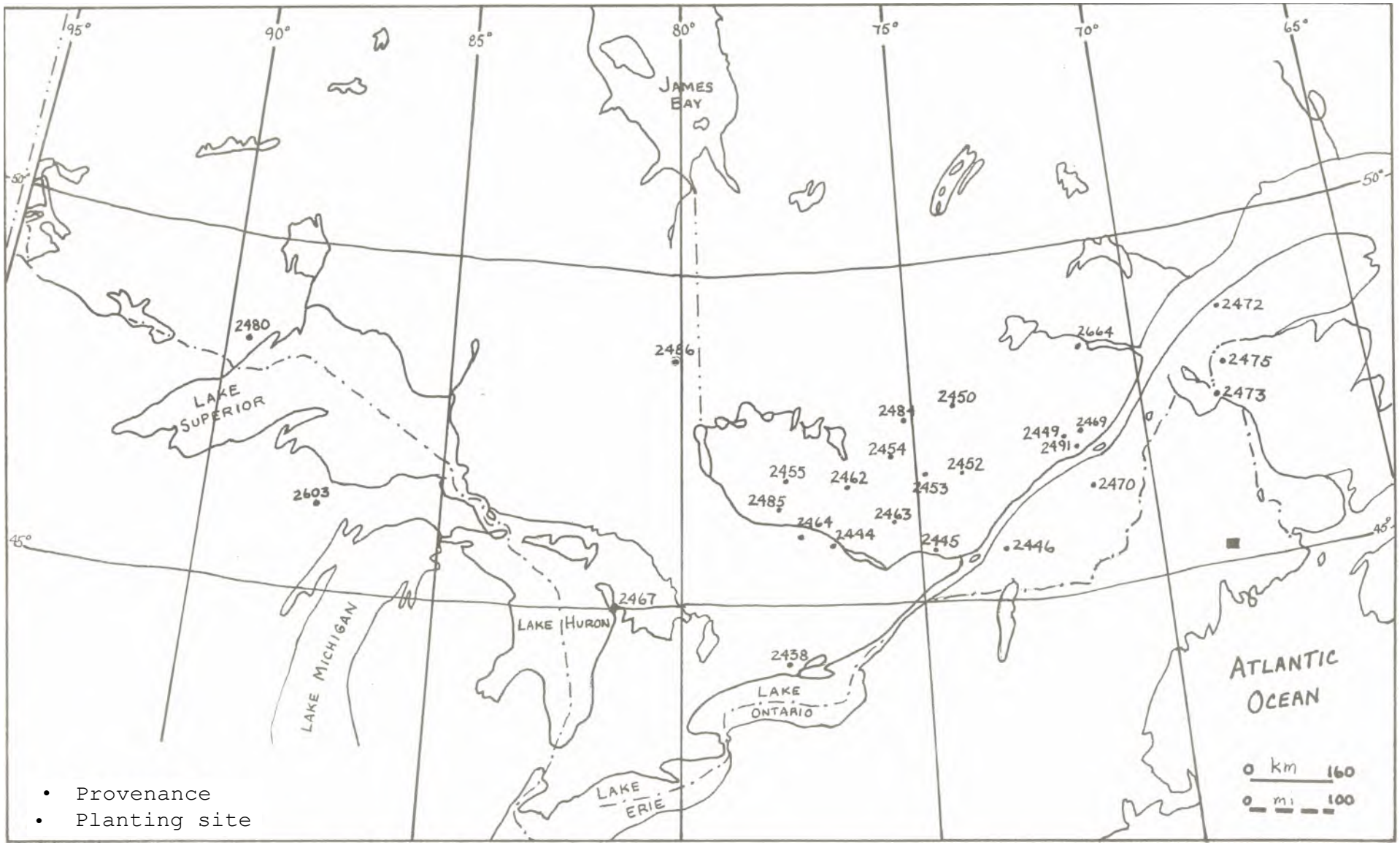

Figure 1. Location of white spruce provenances planted in Passadumkeag, Maine (Adapted from Teich et. al., 1975).

Table 2. Survival, Total Height, Height Growth, DBH, and Cone Production for 30 Provenances of White Spruce.

Acc. No.	Survival (%)	Total Hgt. 1979 (ft.)	Hgt. Growth 1979 (ft.)	DBH (in.)	Cones (%)
2438	65.00	12.76	1.40	2.60	7.9
2444	68.33	13.15	1.37	2.62	5.1
2445	68.57	13.03	1.28	2.70	4.2
2446	85.71	13.75	1.33	2.86	3.3
2447	72.86	12.92	1.37	2.57	0.0
2449	73.33	14.36	1.47	2.79	0.0
2450	70.00	12.75	1.38	2.59	0.0
2452	78.57	14.17	1.49	2.84	1.8
2453	67.14	13.17	1.31	2.69	0.0
2454	68.57	13.49	1.39	2.79	2.1
2455	72.86	13.22	1.30	2.67	2.0
2462	67.14	12.46	1.36	2.38	2.1
2463	63.33	13.00	1.38	2.55	2.7
2464	81.43	12.43	1.35	2.41	0.0
2467	78.33	13.09	1.46	2.61	4.3
2469	84.29	13.10	1.33	2.72	0.0
2470	61.43	11.95	1.18	2.24	0.0
2471	68.57	12.17	1.42	2.45	2.1
2472	68.57	12.71	1.33	2.42	0.0
2473	84.00	12.23	1.30	2.51	0.0
2475	72.86	12.38	1.37	2.50	2.0
2480	75.71	11.70	1.33	2.13	3.8
2484	88.33	13.39	1.42	2.78	1.9
2485	86.67	11.43	1.12	2.31	2.0
2486	75.71	13.39	1.47	2.76	5.7
2491	72.86	12.75	1.38	2.80	0.0
2603	64.29	13.42	1.26	2.64	0.0
2604	61.43	11.81	1.26	2.40	9.3
1000	77.14	11.69	1.16	2.31	7.4
2000	60.00	10.35	1.11	1.56	69.4
planta-tion average	72.65	12.74	1.34	2.54	4.6

Table 3. Analysis of variance for total height.

Source	DF	Type I SS	MS	F value	Signif.
Source	29	948.09	32.69	5.22	**
Rep	6	366.63	61.11	9.76	**
Error	1417	8870.54	6.26		
Total	1452	10185.26			

Table 4. Analysis of variance for annual height increment.

Source	DF	Type I SS	MS	F value	Signif.
Source	29	13.08	0.45	1.89	**
Rep	6	7.30	1.22	5.10	**
Error	1413	337.29	0.24		
Total	1448	357.67			

Table 5. Analysis of variance for diameter (dbh).

Source	DF	Type I SS	MS	F value	*Signif.*
Source	29	85.18	2.94	4.91	**
Rep	6	47.56	7.93	13.25	**
Error	1387	829.83	0.60		
Total	1422	962.57			

Table 6. Analysis of variance for cone production.

Source	DF	Type I SS	MS	F value	Signif.
Source	29	16.71	0.58	20.98	**
Rep	6	0.21	0.04	1.25	ns
Error	1411	38.76	0.03		
Total		55.68			