EARLY RESULTS OF AN OTTAWA VALLEY WHITE SPRUCE PROGENY TEST PLANTED IN MAINE

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Abstract .--One-hundred-nineteen families from 31 stands located in the Ottawa Valley were tested for superior height growth in nursery beds in Maine. After two growing seasons, survival was 88.2% with a range in stand survival of 76% to 100%. Stand and family height differences varied significantly accounting for 27% and 14% of the total variation respectively in 1979. Nine of the top ten stands were from the Beachburg, Ontario area and averaged 15% better than the study mean and 37% better than the local Maine sources.

Additional keywords: *Piceca* glauca, population variation

Basic to most white spruce (Picea glauca (Moench) Voss) improvement programs has been the high degree of genetic variation exhibited by this conifer. Inter-provenance variation has been demonstrated for many characters including height growth, wood density, branch angle and date of budbreak (Hoist 1960, 1962, Nienstaedt 1969, 1972, Yeatman and Venkatesh 1974, Wilkinson 1977).

Numerous range-wide provenance tests have identified seed sources and delineated areas of rapid growing white spruce. These sources, located in the southeastern portion of the range have been shown to be adapted to a wide variety of test sites and still display consistently superior height growth (Nienstaedt 1969, Wilkinson 1977, Wright et al, 1977). Furthermore, Nienstaedt (1981) has shown evidence of the persistence of juvenile growth superiority in white spruce for 18 years after field planting.

A study was initiated in 1977 to further investigate the genetic diversity and variation pattern of this species and to identify the best adapted, fastest growing seed sources for inclusion in planting programs in Maine. This report summarizes the results from the early nursery phase of the project.

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Table 1.--Location of white spruce provenances.

Stand	Number of Families	Location	State or Province	Latitude °N	Longitude °W
1001	1	T1 R6	ME	45-41	68-33
1002	1	T4 R18 Comstock	ME	45-47	70-01
1003	1	T4 R18 Comstock	ME	46-00	70-04
1004	1	Pittston Plt.	ME	45-54	69-59
1005	1	T1 R6	ME	45-43	68-28
1006	1	Glenwood Plt.	ME	45-47	68-10
8003	3	Boyer Twp.	QUE	46-35	75-10
8004	4	Booth Twp.	QUE	46-47	78-42
8009	4	Erin Twp.	ONT	43-44	80-06
8010	4	Mulmer Twp.	ONT	44-14	80-04
8011	4	Havelock	ONT	44-26	77-50
8012	4	Digby	ONT	44-45	78-56
8016	4	Trout Creek	ONT	45-59	79-27
8019	4	Rutherglen	ONT	46-17	79-51
8020	3	Estaire	ONT	46-14	80-43
8024	8	Petawawa F.E.S.	ONT	46-00	77-26
8025	8	Bancroft	ONT	45-06	78-02
8026	4	Forester Falls	ONT	45-41	76-48
8027	3	Irvine Creek	ONT	46-00	77-17
8028	4	Renfrew	ONT	45-28	76-44
8029	4	Rankin	ONT	45-45	77-10
8030	4	Bracebridge	ONT	45-07	79-18
8032	4	Antrim	ONT	45-19	76-11
8033	4	Mowat Twp.	ONT	45-54	80-26
8153	4	Big Jocko River	ONT	45-36	79-10
8154	4	Davis Mills	ONT	45-45	77-12
8155	4	Douglas	ONT	45-30	77-01
8161	3	Alice	ONT	45-46	77-17
8209	1	Burritts Rapids	ONT	45-02	75-50
8210	4	Silver Lake	ONT	44-49	76-41
8211	4	Apsley	ONT	44-55	78-04
8273	4	McGill Twp.	QUE	46-15	75-35
8274	4	Lesage Twp.	QUE	46-20	75-10
8319	4	Davis Mills	ONT	45-45	77-15
8323	4	Beachburg	ONT	45-41	76-48
8683	1	Petawawa F.E.S.	ONT	46-00	77-20
8685	1	Petawawa F.E.S.	ONT	46-00	77-20

METHODS

Open-pollenated white spruce seed were obtained from the Petawawa Forest Experiment Station in conjunction with their cooperative white spruce genetic research project. The seed represented from one to eight individual trees from 31 stands located in the Ottawa Valley of southeastern Ontario and southwestern Quebec. Seed from an additional six individuals, one each from six stands located in Maine were included for comparison and control (Table 1). The six local trees were originally chosen on the basis of superior phenotypic characteristics. Thus a total of 127 seedlots (open-pollenated, half-sib families) were obtained for this study.

The seed were sown in Japanese paper pots in January, 1978 at the Great Northern Paper Company's greenhouse in Millinocket, Maine and outplanted the following June into nursery beds at the State's forest nursery in Greenbush, Maine. The study design was a randomized complete block design of five tree row plots in each of four replications.

The nursery beds were watered, fertilized, hand-weeded and winter-mulched throughout the study. Total height, rootcollar diameter and survival were recorded at the end of the first and second growing seasons, 1978 and 1979 respectively.

RESULTS

Survival .--Seedling survival for the two years of record was 94.5% and 88.2% respectively. Stand survival ranged from 86% to 100% in 1978 and 76% to 100% in 1979. Differences in survival among stands was not significant and appeared to be random, not following any geographic pattern.

Growth .--Differences in height growth between stands and between families within stands were found to be highly significant (Table 2) in 1978 and remained so in 1979 though decreasing in magnitude. One explanation for the decreasing magnitude is the diminishing effect of the greenhouse environment compared to the more variable environment of the nursery beds.

Table 2.--Analysis of variance for total height.

Source of Variation	1978			1979		
	D.F.	M.S.	F	D.F.	M.S.	F
Replication	3	1133.4	13.71 a/	3	6520.1	11.81
Stand	36	2258.9	27.30	36	5111.5	9.26
Family/Stand	87	461.9	5.57	87	1119.5	2.03
Error	360	82.7		358	552.0	

a/ All tests were significant at the .01 probability level.

Table 3.--Mean height and percent of mean study height for white spruce stands.

Stand	1978 Mean Height (cm)	1978 Percent of Study Mean Height	1979 Mean Height (cm)	1979 Percent of Study Mean Height
8323	13.4	124	18.3	116
8209	13.2	122	19.9	126
8028	12.4	115	19.5	124
8154	12.3	114	17.9	113
8319	12.2	113	17.4	110
8033	12.1	112	16.4	104
8026	12.0	111	17.4	110
8024	11.9	110	17.6	112
8685	11.8	109	17.0	108
8012	11.7	108	15.7	99
8030	11.7	108	17.8	113
8029	11.5	106	17.1	109
8210	11.4	106	16.6	105
8009	11.4	106	15.2	96
8211	11.3	105	14.9	94
8274	11.3	105	15.8	100
1004a	11.1	103	15.0	95
8032	11.0	102	17.5	111
8027	11.0	102	16.9	107
8161	10.9	101	16.4	104
8273	10.7	99	15.7	99
8155	10.5	97	16.9	107
8004	10.4	96	15.2	96
8019	10.2	94	15.2	96
8153	10.1	94	14.0	89
8011	9.7	90	14.0	89
8683	9.4	87	13.5	85
1001a	9.3	86	15.7	99
8020	9.3	86	14.8	94
8003	9.2	85	11.7	74
1003a	9.0	83	13.8	87
1005a	8.9	82	12.0	76
8025	8.8	81	12.9	82
8016	8.8	81	13.4	85
8010	8.6	80	12.9	82
1006a	7.9	73	11.3	72
1002a	7.8	72	11.5	73

a--Maine stands.

Stand variation accounted for 47% of the total variation in 1978 but decreased to 29% in 1979. Likewise, family variation decreased from 27% to 14% of the total variation over the two year period.

Mean stand height ranged from 7.8 cm to 13.4 cm in 1978 and 11.4 cm to 19.9 cm in 1979 (Table 3). The fastest growing stand in 1978, Beachburg (8323), was still the third fastest growing stand in 1979. Furthermore, nine of the top ten stands in 1979 were located in an area around Beachburg, Ontario. These nine stands averaged 15% better than the study average and 37% better than the local Maine sources.

Table 4.--Mean heights, percents of study mean and percent of local source mean for the ten fastest growing stands in 1979.

Stand	Location	Mean Height (cm)	Percent of Study Mean[a/]	Percent of Local Source Mean[b/]
8209	Burritts Rapids, Ont.	19.90	126	151
8028	Renfrew, Ont.	19.52	124	148
8323	Beachburg, Ont.	18.33	116	139
8154	Davis Mills, Ont.	17.89	113	136
8030	Bracebridge, Ont.	17.82	113	135
8024	Petawawa F.E.S., Ont.	17.62	112	133
8032	Antrim, Ont.	17.46	111	132
8319	Davis Mills, Ont.	17.46	111	132
8026	Foresters Falls, Ont.	17.42	110	132
8029	Rankin, Ont.	17.13	109	130

a/ Study mean = 15.77 cm

b/ Local source mean = 13.20 cm

A rank correlation comparing the mean height of stands in 1978 and 1979 was positive and high (r=.82). This indicates that the general order of stand ranks by height remained uniform over the two years.

Total height measurements were compared to their corresponding rootcollar diameters and were found to be correlated (r=.80).

SUMMARY

After two years in nursery beds, white spruce from the Ottawa Valley continue to show height growth superiority over local sources when planted in Maine. The best performers averaging 15% better than the study mean and 37%

better than the local mean were located near the Beachburg area in a zone stretching from 45 to 46° N and 75 50' to 77° 30'W. Wilkinson (1977) in an earlier report of Ottawa Valley white spruce tested in Maine reported that the Beachburg provenance was 12% taller than the local source. Similar results have been reported for the Beachburg area by Nienstaedt (1969), Dhir (1975) and Wright et al (1977) ,

The significant differences in height growth at the stand and the family levels appear to follow the variation pattern for white spruce, reported by Fowler (1976) to be moderate at the population or stand level and high at the individual or family level. These differences indicate that selection of the best families from the best stands is a promising method for the improvement of white spruce planting stock in Maine.

At the completion of the nursery phase of this study, the trees described in this report were transplanted into two plantations in central Maine. Further investigations should provide information concerning genotypye-environment interactions and persistence of juvenile superiority of the Ottawa Valley stands planted in Maine.

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