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Variation in Foliar Macronutrients of One Year Old Sitka Spruce Seedlings of Ten Provenances[2]

Abstract

The genetic variation of foliar macronutrients of 10 Sitka spruce (*Picea sitchensis* (Bong.) Carr.) provenances was studied, but no geographical pattern of variation detected in Ca, Mg, P and N needle contents. Only K showed significant provenance to provenance variation.

Introduction

Differences in mineral nutrient concentrations among provenances of conifer species have been found recently (Mergen and Worrall, 1965; Steinbeck, 1966; Van Den Driessche, 1969, 1973). Although the significance of these differences is not unequivocally interpretable at present (Reuther and Smith in Childers, ed., 1954; Gouney, 1956; Lavender and Carmichael, 1966; Leaf, 1968; Voigt, 1968; Lavender, 1970; Waring and Youngberg, 1972); they possibly have some bearing on differences in growth behaviour among provenances.

In 1971, 545 single tree progenies of 38 provenances of the 1970 I.U.F.R.O. Sitka spruce (*Picea sitchensis* (Bong.) Carr.) collection were sown in a new British Columbia Forest Service nursery at Surrey as part of an extensive study of the genetic variability of Sitka spruce natural populations (Falkenhagen and Sziklaï, in press). Foliar analyses of ten selected provenances of Sitka spruce (Table 1) were performed in order to detect any genetically based variation in mineral content which could be related to their geographic origin.

Methods and Material

The material used comes from the 10 seedlings which were growing in polystyrene foam containers in 1971. The origins of the provenances are shown in Table 1.

Modern cultural techniques for growing seedlings were employed (Arnott, 1971). The ten selected provenances were sampled in February, 1972, still quiescent. The provenances were chosen according to their places of origin along a latitudinal gradient. After freeze drying, the needles were separated from the stem and milled, then they were digested in perchloric acid mixture. Potassium was determined by emission and calcium and magnesium by atomic absorption. Phosphorus was determined by the molybdenum blue method of Dickman and Bray. Nitrogen was determined by the well-known semimicro Kjeldahl method. The methods used are all outlined by Chapman and Pratt (1961).

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TABLE 1. Geographical coordinates and foliage analysis of the Sitka Spruce provenances studied. (+)

No. of the Prov.	Name	°Lat	°Long.	Elev. feet	% DRY NEEDLES N A	N B	N D	P A	P B	P D	K A	K B	K D	100 ppm DRY NEEDLES Ca A	Ca B	Ca D	Mg A	Mg B	Mg D
3	Big Qualicum River	49.38	124.62	0	1.24	1.16	1.26	.53	.44	.49	78	79	87	16	15	18	29	29	31
4	Salmon Bay	50.38	126.96	0	1.27	1.12	1.46	.45	.39	.51	71	70	74	14	17	17	31	29	27
15	Aberdeen Creek	54.20	129.82	0	1.26	1.34	1.38	.35	.46	.57	71	78	74	10	14	18	31	29	29
23	Mosspoint, Annette Island	55.03	131.55	0	1.08	1.24	1.22	.49	.42	.32	62	62	70	17	13	18	33	31	27
25	Old Hollis	55.47	132.67	0	1.24	1.34	1.35	.50	.35	.45	72	80	66	17	16	16	31	36	25
27	Ohmer Creek	56.58	132.73	25	1.44	1.21	1.40	.58	.53	.50	52	75	70	15	17	18	33	31	29
28	Duck Creek	58.37	134.58	100	1.40	1.36	1.35	.50	.39	.43	76	69	62	14	18	15	38	33	29
32	Tahsis 1	50.08	127.50	100	1.18	1.16	1.32	.50	.42	.55	71	78	81	14	16	15	31	28	27
37	Moresby Island Cumshewa Inlet	53.05	132.08	200	1.33	1.25	1.24	.43	.46	.49	72	76	66	15	17	18	29	29	31
40	Masset Inlet	53.92	132.08	0	1.14	1.32	1.22	.42	.47	.58	74	76	76	15	17	15	31	28	29

(+) In the nursery, three blocks out of four were sampled: the blocks A, B and D

Results and Conclusions

The results of the analyses are shown in Table 1. The analyses of variance show that there are no significant differences among the provenances for all the elements analyzed except for potassium. The anova model was the randomized complete block design with 3 blocks.

The Duncan's test for potassium is as follows ($= 0.05$):

Provenance number	3	32	40	15	25	4	37	27	28	23

Table 2 shows the mean K content in 100 ppm and the mean epicotyl length in mm.

TABLE 2. Mean K content and the mean epicotyl length.

Provenance number	K content (100 ppm)	Mean epicotyl Length (mm)
3	81	87
32	77	79
40	75	89
15	74	81
25	73	73
4	72	85
37	71	88
27	69	66
28	69	68
23	65	67

There is a tendency for low latitude sources to show higher K concentrations as a significant correlation coefficient of −0.70 between K needle content and latitude shows it. There is also a significant correlation between K content and epicotyl length ($r = + 0.68$). Therefore, one could hypothesize that the provenances with higher dry matter production also have the higher rate of K accumulation. However nutrient absorption, translocation, and loss in forest-trees are not well understood (Voigt, 1968) and a definite interpretation is not possible at the present time. The recent analyses of Sitka spruce seedlings by Benzian and Smith (1973) are not directly comparable as they are based on the analyses of whole plants.

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