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A COMPONENT OF VARIATION IN SEEDLING GROWTH OF WHITE SPRUCE AND LODGEPOLE PINE AT THE ALBERTA TREE NURSERY, ARISING FROM PHOTOPERIODIC DIFFERENCES AT SEED SOURCE.

Northern Forest Research Centre
Environment Canada
Edmonton

A Component of Variation in Seedling Growth of White Spruce and Lodge-Pole Pine at the Alberta Tree Nursery, Arising from Photoperiodic Differences at Seed Source.

by

D. Hocking[1]

INTRODUCTION

For reforestation in Alberta, seed use is restricted to within 50 miles distance and 100 feet elevational difference from the original source. This is in recognition of general ecotypic adaptations.

Seedlings for the entire province (lat. 49°N. to 60°N.) are grown at one central nursery (lat. 53°40'N.) under the same day length (17 hrs. mid summer).

Seedling growth and development is widely variable among various seed sources. Some of the variation is attributable to difference in day length at the nursery from that at seed source. The Alberta Forest Service requested a study to determine just how much.

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[1]Research Scientist, Northern Forest Research Centre, Forestry Service, Environment Canada, Edmonton, Alberta.

MATERIALS AND METHODS

Seed samples were drawn from operational seed stocks at the Alberta Tree Nursery, selected for the widest available range of latitude, 5 sources for each of white spruce (Picea glauca (Moench) Voss. var. albertiana (S. Brown) Sarg.) and lodgepole pine (Pinus contorta Dougl. var. latifolia Engelm.). Details of the sources are in Table 1.

Seedlings were grown on nursery soil under greenhouse conditions that differed only in the duration of photoperiod: 14, 18, or 22 hours. Complete details of experimental design, methods, and statistical analysis are being published elsewhere (Hocking, 1973).

RESULTS

The dry weights of seedlings grown at the different photoperiods are shown in Table 2. These dry weights were plotted and values for growth at the midsummer day length at seed source and at the nursery were interpolated. The difference between these two values, for each seed source, represents the photoperiodic component of the ecotypic variation.

Expressed as percentages of the growth at the day length of the seed source, these differences are plotted in Fig. 1.

For both species, there was about a 4% decrease in growth of northern seed lots and a similar increase in growth of southern seed lots, per degree of latitude that the seed source was distant from the nursery.

DISCUSSION

It is clear that significant changes in growth occur as a result of differences in photoperiod between the nursery and seed sources. The question is, what can the nursery manager do about it? The answer: control photoperiodically effective lighting individually for seed sources.

For container seedlings, such control is cheap and practical; and it may also be practical for outdoor seedbeds. It has been shown that breaking the night with a short light period (as little as ½ hr) is as effective for growth response as a much longer continuous light period. This is true for white spruce (Vaartaja 1957) and for lodgepole pine (Giertych and Farrar 1962). Furthermore, the threshold light intensity for photoperiodic response is very low, in the order of 1.5 foot candles (Pauley and Perry 1954).

Practical seedbed lighting has been described and found effective by Allen and MacGregor (1962).

REFERENCES

Allen, R. M. and McGregor. 1962. Seedling growth of three southern pine species under long and short days. Silvae Genet. 11(2): 43-45.

Giertych, M. M. and J. L. Farrar. 1962. A provenance study of jack pine seedlings. Silvae Genet. 11(4):111-114.

Hocking, D. 1963. Ecotypic variation and clinal response to photoperiod in seedlings of Alberta white spruce and lodgepole pine. Can. J. For. Res., submitted for publication.

Vaartaja, O. 1957. Photoperiodic responses in seedlings of northern tree species. Can. J. Botany 35:133-138.

TABLE 1. SEED SOURCES

White Spruce Ref. No. White Spruce	Latitude	Approx. Altitude (ft.)	Approx. Mid-summer Day Length	Divisional Forest	Legal description of source					Alberta Forest Service Seedlot No.
					Subdivision	Section	Township	Range	Meridian	
1	50°35'	8,000	18.20	Footner Lake	-	23	110	23	W.5	DF.3-1-63
2	56°45'	2,000	17.50	Athabasca	10-11-19	32	89	11	W.4	67-33
3	54°15'	2,800	17.15	Whitecourt	-	3	60	12	W.5	DW.5-5-68
4	52°30'	3,800	16.50	Rocky Mountain	8	10	41	11	W.5	DR.6-1-68
5	49°20'	4,800	16.15	Crowsnest	-	24	4	4	W.5	DC.1-1-68
Lodgepole pine										
1	56°30'	3,500	17.45	Peace River	14	32	86	2	W.6	67-5
2	55°15'	3,500	17.25	Grande Prairie	8-9	19	72	26	W.5	68-6
3	53°40'	3,800	17.00	Edson	6	2	54	14	W.5	DR.4-4-68
4	52°20'	4,000	16.45	Rocky Mountain	N.E.	12	38	9	W.5	68-17
5	49°35'	4,000	16.20	Crowsnest	-	-	7	3	W.5	68-36

TABLE 2. GROWTH OF ALBERTA WHITE SPRUCE AND LODGEPOLE PINE PROVENANCES UNDER DIFFERENT PHOTOPERIODS

		Total Dry wt (mg) at			Shoot/root ratio (wt/wt) at			Photoperiodic growth influence at the Alberta Tree Nursery
		14 hrs.	18 hrs.	22 hrs.	14 hrs.	18 hrs.	22 hrs.	
White spruce								(%)
N.	1	107d	262bc	438b	1.21	2.18	3.25	-21
	2	138c	285ab	476b	1.94	2.23	2.81	-12
	3	176b	248c	452b	1.63	2.14	2.16	- 4
	4	225a	313a	545a	2.41	2.59	2.85	+3
S.	5	180b	244c	259c	2.65	2.49	2.45	+2
	Mean	165	270	434				
Lodgepole pine								
N.	1	407b	952a	1509a	3.98	3.28	2.59	-12
	2	338c	662b	989b	2.97	2.94	2.69	- 7
	3	360c	568b	975b	3.10	3.23	2.67	0
	4	658a	994a	1579a	3.42	2.96	2.18	+3
S.	5	696a	1003a	1607a	2.22	2.21	2.99	+10
	Mean	492	836	1332				

Basis: Means of 100 seedlings. Figures in the same column followed by the same letters do not differ significantly (P =.05), by *t* test.

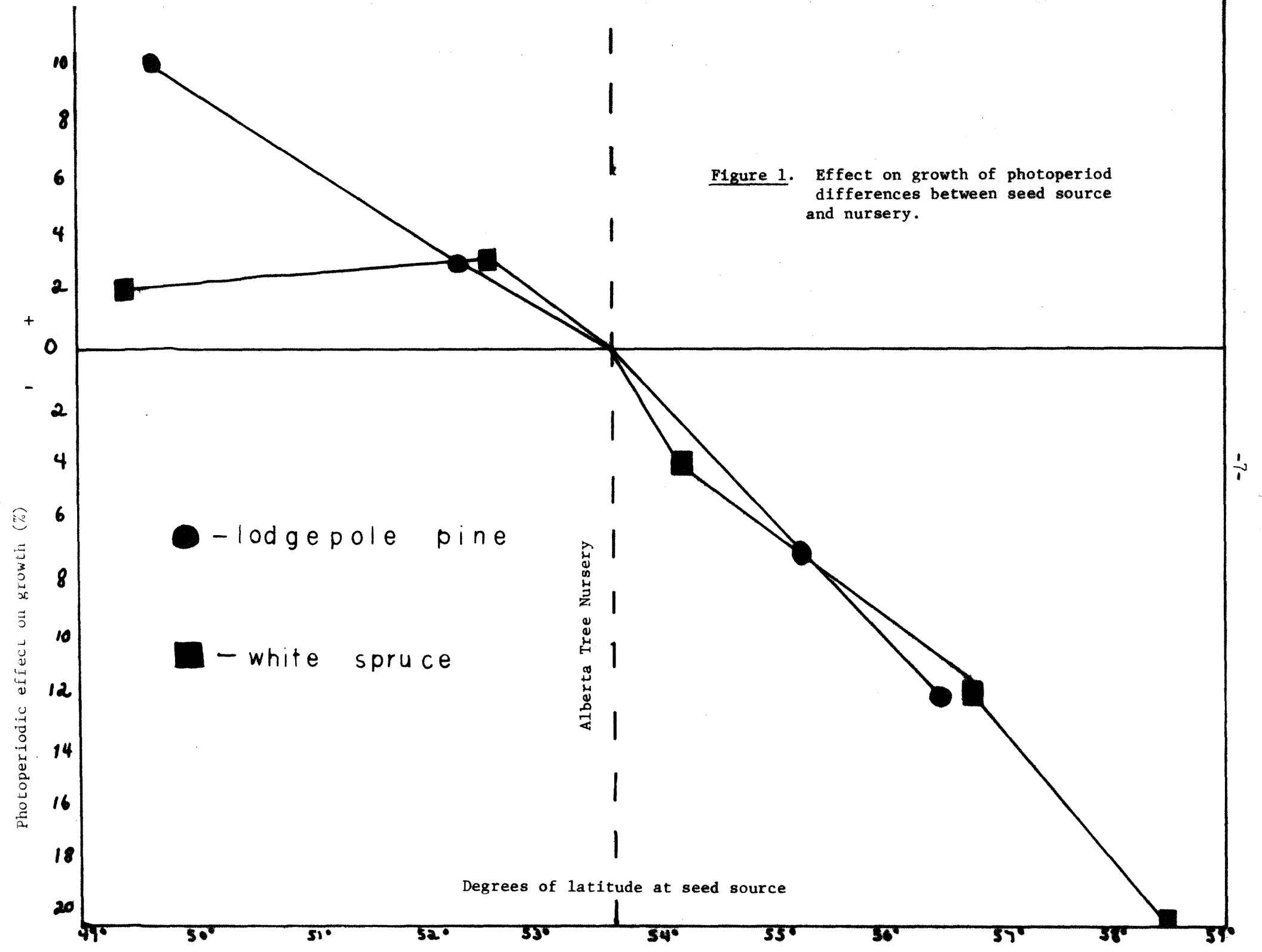

Figure 1. Effect on growth of photoperiod differences between seed source and nursery.