

PERFORMANCE OF SOME NATIVE
AND EXOTIC PINES IN CENTRAL ALBERTA

by

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ABSTRACT

Scots pine of Russian origin performed best among native and exotic pines planted in Central Alberta during the 1920's. Diameter growth of this provenance was more than 40 per cent greater than that of native lodgepole pine. The results indicate that the former can produce approximately 150 per cent more wood per acre than native lodgepole pine. Exotic pines were damaged by porcupines and sapsuckers, while no damage was apparent to native pines.

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INTRODUCTION

In the 1920's, Mr. G. Bugnet planted various exotic and native trees and shrubs around his homestead near Rich Valley, Alberta. This coniferous plantation being one of the oldest in Alberta, it provided an opportunity for comparing the growth of native and exotic tree species. Studied were Scots pine (Pinus sylvestris L.), ponderosa pine (Pinus ponderosa Laws.), jack pine (Pinus banksiana Lamb.) and lodgepole pine (Pinus contorta Dougl. var. latifolia Engelm.).

All information concerning dates of establishment and sources of seed was supplied by Mr. G. Bugnet.

Review of Literature

In Europe, the natural distribution of Scots pine extends from Turkey to northern Finland; in Siberia it is one of the most important native species producing timber.

Scots pine was one of the first species introduced into the United States and was planted mainly in the northeast.

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As a result of the first large-scale Scots pine provenance tests conducted in Sweden, Germany, Hungary, and Netherlands, Wiedemann (1930) concluded that Scots pine trees with straight stems, originating from northern Sweden, grew very slowly, while Latvian provenances, with straight stems and pointed crowns, grew relatively fast. The Scottish provenances grew slowly and many had forked and crooked stems. Trees originating from Poland and European Russia had the best growth.

In New Hampshire, Weight and Baldwin (1957) found that the relatively fast-growing Latvian-Estonian ecotypes had the best bole form. The Belgian ecotype, although fast growing, had a heavy basal sweep and was susceptible to porcupine damage. Ecotypes originating from Scandinavian countries were slow growing with few bole defects.

Wright and Bull (1963) recognized 14 geographic ecotypes from their 3-year study of Scots pine from 122 origins at Michigan State University's nursery.

Cone, seed, and needles collected from 39 stands in Europe and Asia were studied by Ruby (1967), who found great differences in seed size among the Scots pines from various sources. Generally, those from the north had the smallest seeds, while those from the south (Turkey and Spain) had the largest seeds.

Bella (1967) studied the development of jack pine and Scots pine plantations established in Manitoba in 1916. His results show that Scots pine had a significantly greater diameter, basal area, and volume growth than native jack pine. Although Scots pine grew

faster than jack pine, the former also produced much heavier branches.

Description of Study Area

The plantation is located in the B.17 Aspen Grove Section of the Boreal Region (Rowe, 1959), one mile west and one mile north of Rich Valley in Township 56, Range 3 West of 5th Meridian.

The plantation is at an elevation of 2,300 ft. The climatic conditions, geology, and soils were described by Lindsay et al. (1968). The mean annual temperature is approximately 37°F. January is the coldest month with a mean temperature of 7°F and July is the warmest month with a mean temperature of 60°F. The mean annual precipitation is 18 in. Sixty per cent of the total precipitation falls during the growing season with a peak in late June. The soils are well-drained Solodic Dark Grey developed on fine-textured, stone-free material overlaid by 5 in. of humus. The general topography of the area varies from level to undulating.

All native and exotic conifers were planted in cultivated soil during 1920-1924. Seeds of Scots pine (Ladoga provenance) and ponderosa pine were obtained from the Botanical Garden in Petrograd (now Leningrad), U.S.S.R. The original Scots pine seeds were collected in the Ladoga district while the original source of ponderosa pine is unknown. Scots pine of Swedish and Scottish provenances were received from Indian Head Nursery, but the specific geographic origin in their respective countries is not known. Native lodgepole pine and jack pine seedlings were obtained locally¹.

¹Personal communication with Mr. C. Bugnet

METHODS

In the summer of 1967, the following measurements were taken from each tree: diameter at breast height (inches), bark thickness at breast height (inches), distance from ground to the base of live crown (feet), crown diameter (feet), and diameter of thickest branch (inches). Concurrently, the vigor of each tree was noted. A sufficient number of trees were selected from each species and provenance for data on height and age. Stem diameter (inches) was measured at 8, 16, 24, and 40 ft. above ground for calculation of volume and average form class.

To simplify, we shall call Scots pine from the Ladoga District in U.S.S.R. Provenance A, that of Swedish origin Provenance B, and that from Scotland, Provenance C.

RESULTS AND DISCUSSION

Diameter Growth

Figure 1 shows the mean annual diameter growth for all species and provenances. The best-performing provenance A Scots pine surpassed the second-best species lodgepole pine by 42 per cent.

The mean age and mean diameter growth by 10-year intervals for each species are shown in Figure 2. Provenance A Scots pine had a greater mean diameter growth at 20 years than any other pine at 30 years. Ponderosa pine maintained good diameter growth until 30 years of age.

Height Growth

The mean annual height growth of provenance A Scots pine is almost identical to lodgepole pine and jack pine, whereas provenance B Scots pine and ponderosa pine have comparable height growth to the native pines. Provenance C Scots pine has inferior height growth (Fig. 3).

Crown Diameter

Largest crown diameter is associated with provenance C Scots pine and the smallest with provenance B Scots pine (Fig. 4). The crown diameter of provenance A Scots pine is similar to native jack pine and lodgepole pine. Up to 97 per cent of the variation in crown width is accounted for by the associated diameter at breast height.

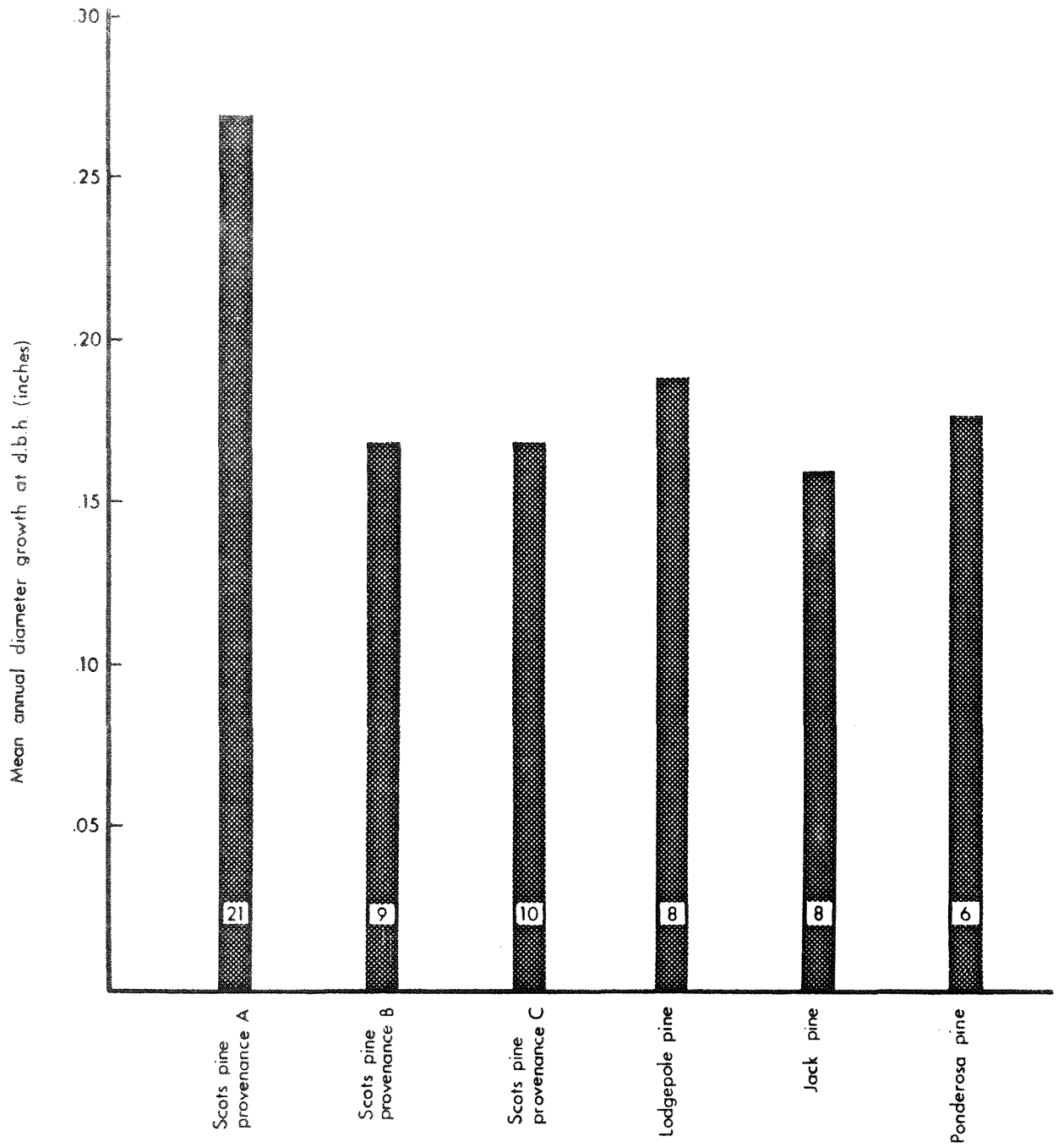
Bark Thickness

The exotic pines had thicker bark than native lodgepole pine and jack pine (Fig. 5). Up to 91 per cent of the variation in bark thickness is associated with diameter at breast height.

Bole Form

The best bole form was observed for provenance B (Fig. 6), and the poorest for provenance C Scots pine, which had forked and crooked stems (Fig. 7). These results are in agreement with Wiedemann (1930), Wright and Baldwin (1957), and Wright and Bull (1953).

Fig. 1. Mean annual diameter growth of pines.



8 No. of samples

Fig. 2. Mean diameter growth of pines by 10-year intervals.

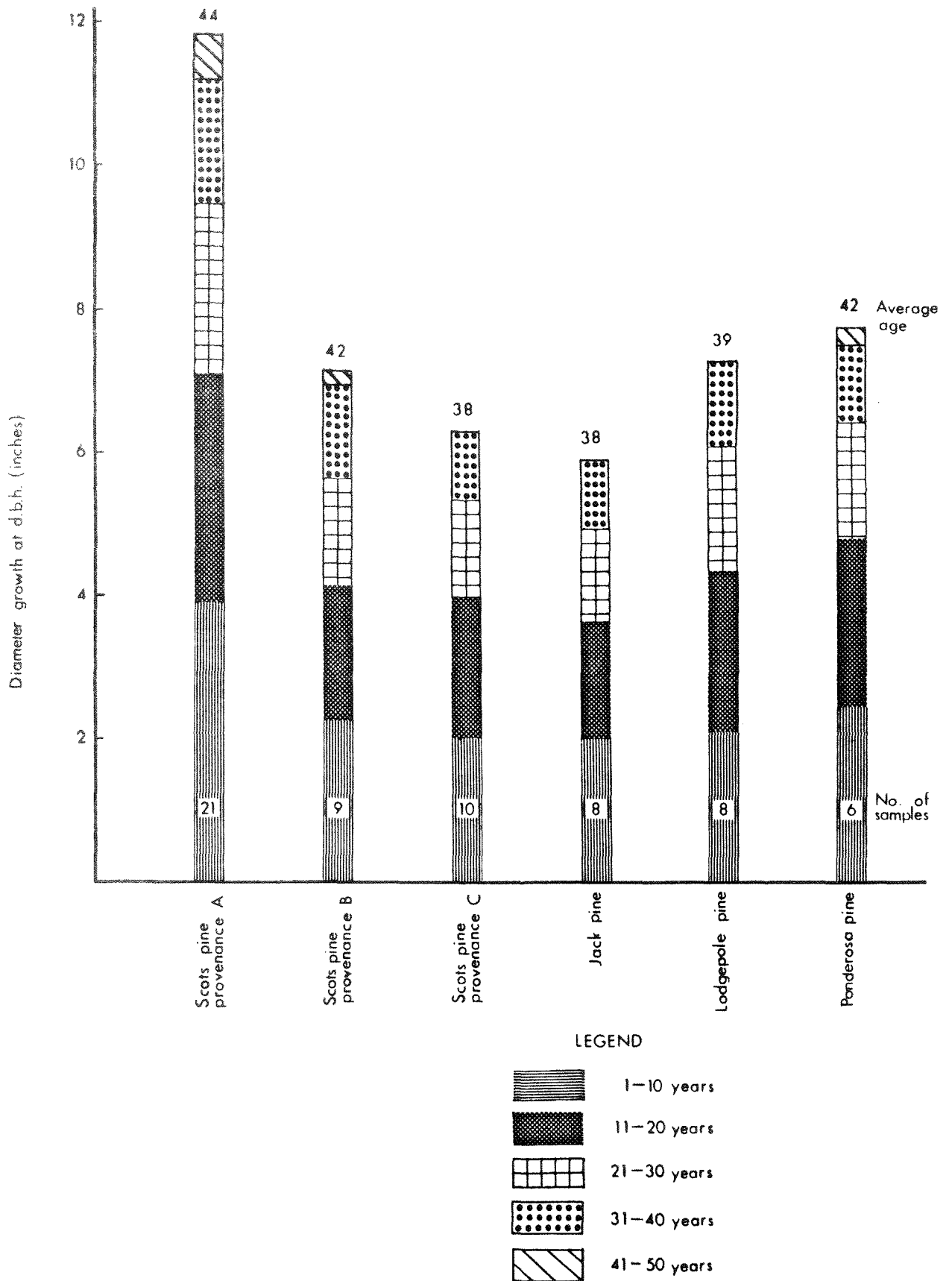


Fig. 3. Mean annual height growth of pines.

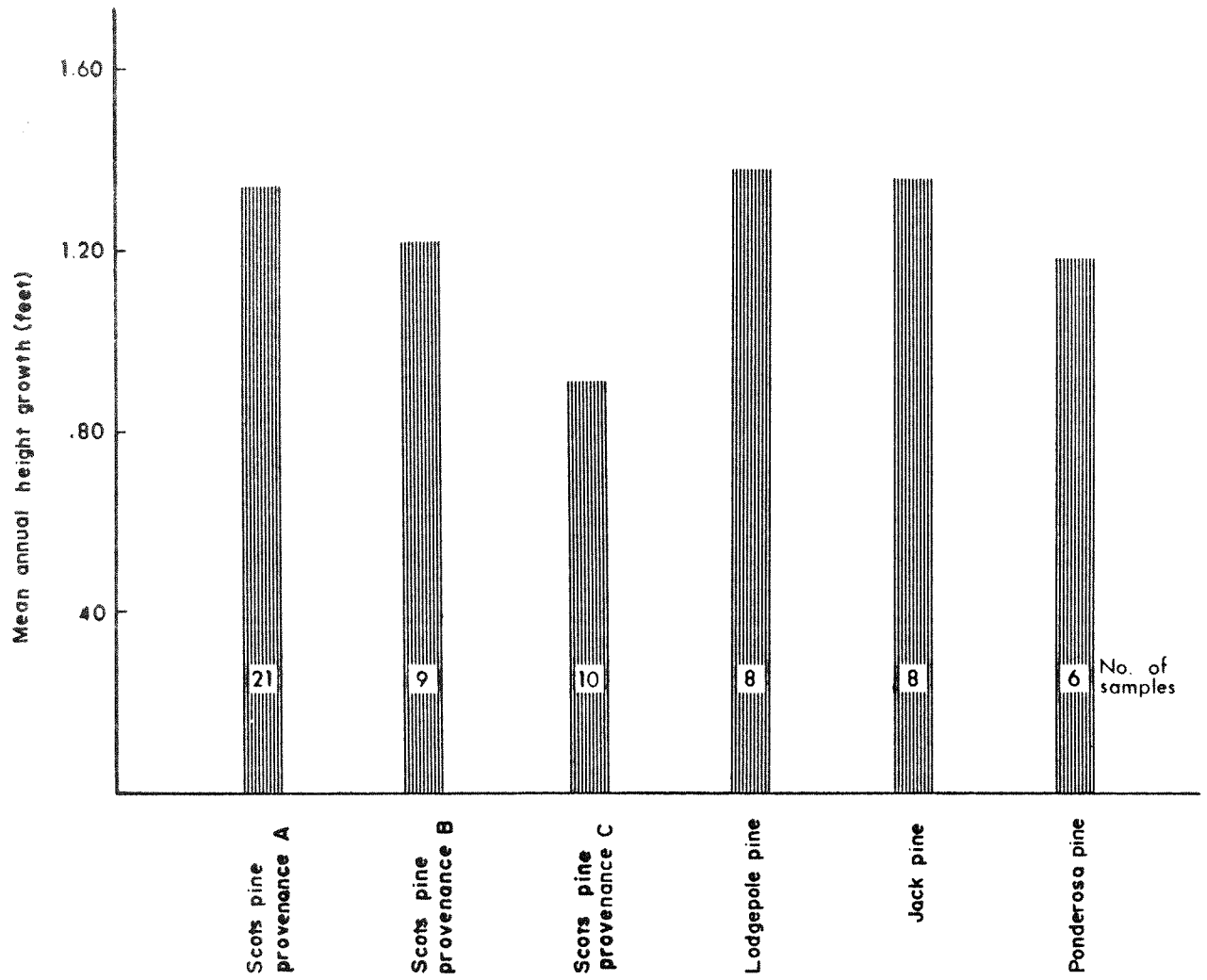
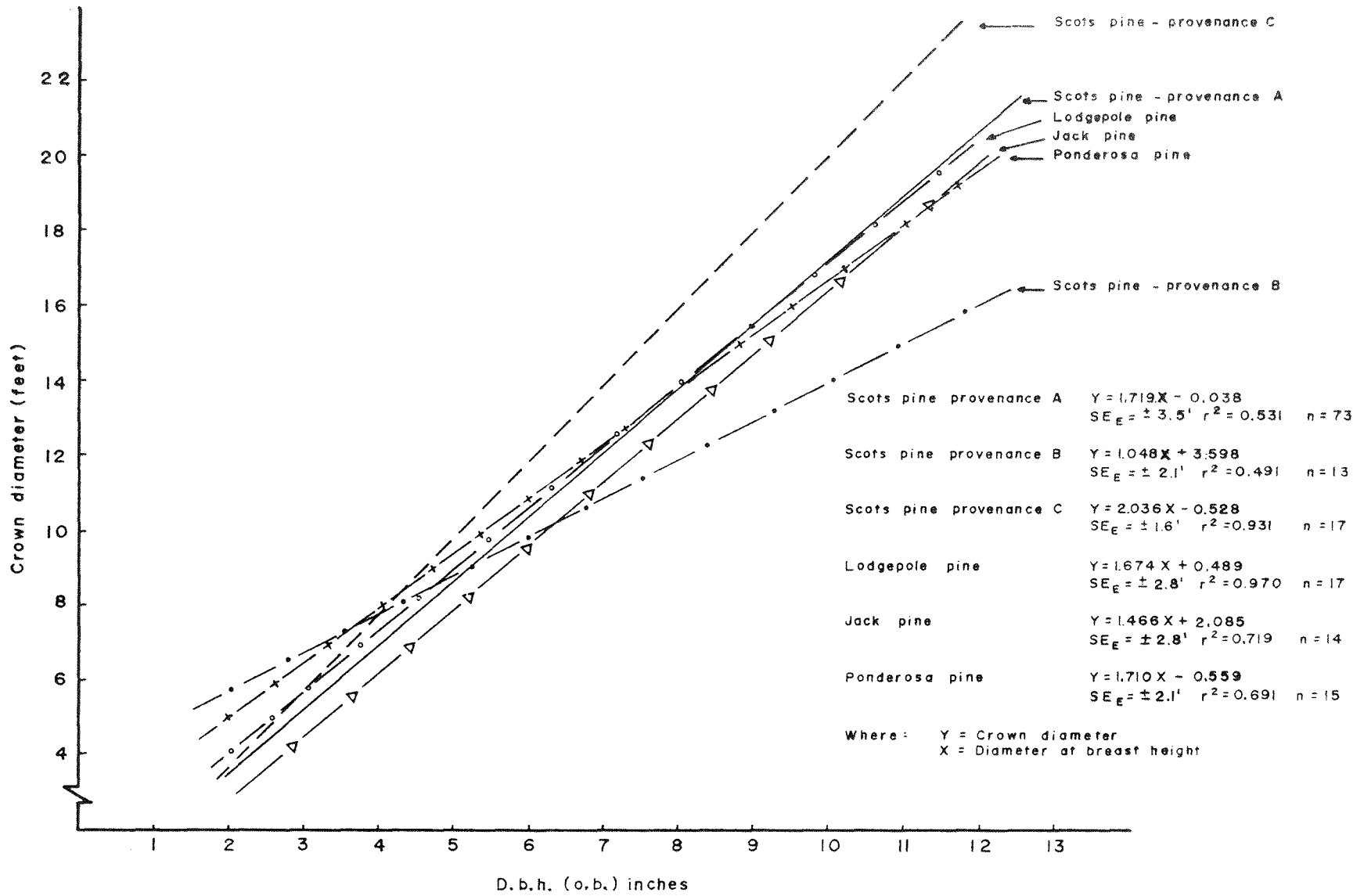


Fig. 4. Crown diameter and d.b.h. relationship of pines.



Mean Maximum Branch Thickness

The native pines, jack pine and lodgepole pine, have finer branching than exotic pines (Table 1). Among the exotics, provenance A Scots pine had the largest branches and provenance B Scots pine the smallest. The mean branch-thickness of provenance B Scots pine is similar to that of lodgepole pine. Similar results were reported by Bella (1967) in Manitoba.

Natural Pruning

The proportion of bole without living branches provides some indication of natural pruning. Table 1 shows that the best performing species is lodgepole pine and the poorest is provenance A Scots pine. The poor branching habit of provenance A Scots pine is attributed to genetics and single row planting. Closer spacing would improve this undesirable characteristic for sawlog production.

Form Class

The native pines had higher average form class than exotic pines (Table 2). In decreasing order of form class, the species are: lodgepole pine, jack pine, ponderosa pine, provenances A, B, and C Scots pines. Except provenance C Scots pine the other pines have relatively high form class, despite the fact that they are growing in the semi-open. Scots pine provenances A and B had a fairly high form class of 0.732 and 0.701. The average form class of southern pines is about 0.78 which may vary from 0.65 for small branchy old pines to 0.83 for older trees growing in dense stands (Chapman and Mayer, 1949).

Fig.5. Bark thickness and diameter relationship of pines.

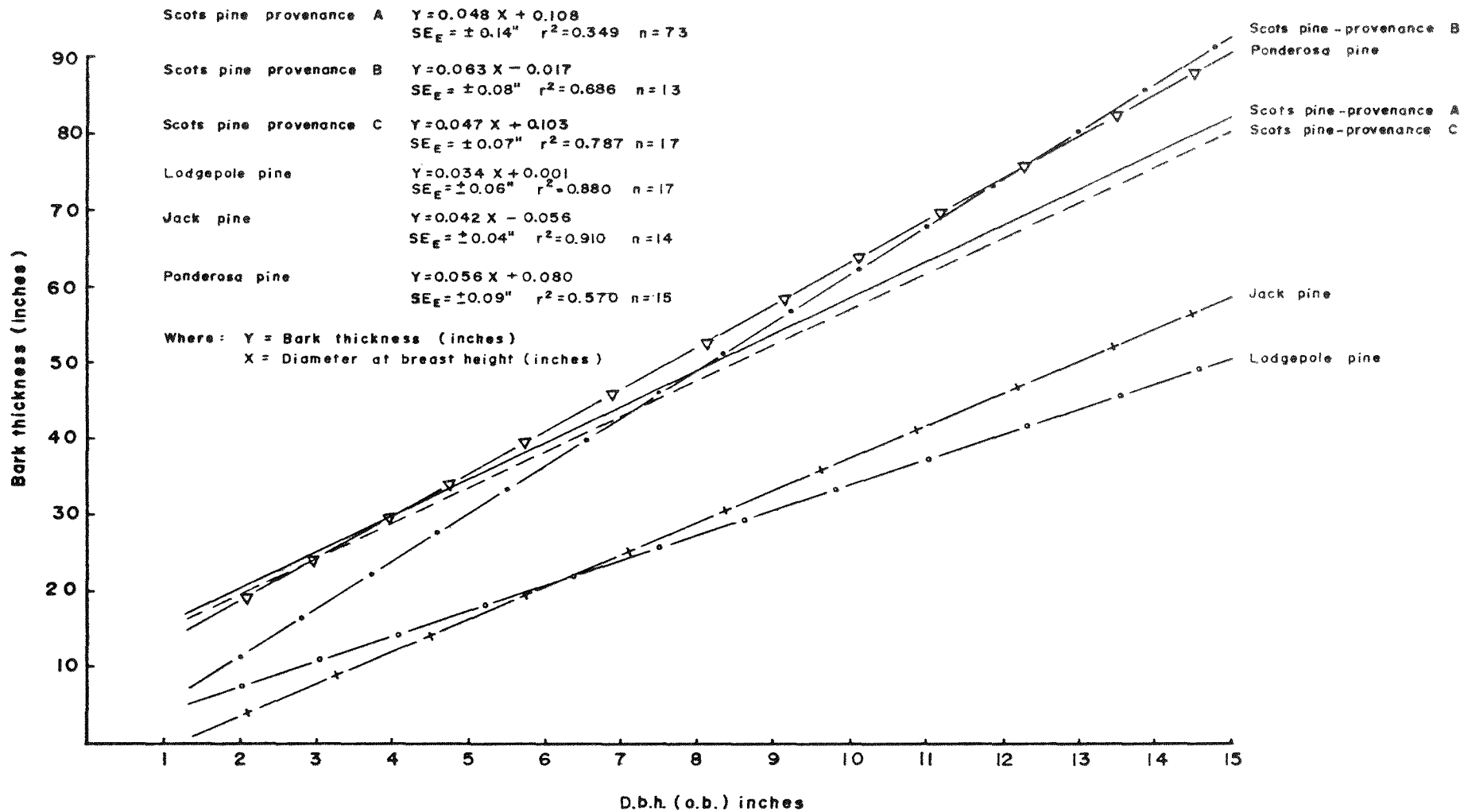




Fig. 6. Bole form of provenance A and provenance B Scots pines.
(Left row is provenance A and the right row is provenance B).



Fig. 7. Typical bole form of provenance C Scots pine.

Table 1. Mean maximum branch thickness and length of bole free of living branches.

Species	Mean maximum branch thickness (inches)	Average distance to base of live crown (feet)	Average total height (feet)	Length of bole without living branches (per cent)	Number of trees sampled
Scots pine provenance A	2.6	15.7	59	26	73
Scots pine provenance B	1.3	17.8	56	31	13
Scots pine provenance C	1.5	13.2	33	39	17
Ponderosa pine	1.7	18.7	48	38	15
Jack pine	0.8	16.7	50	33	14
Lodgepole pine	1.2	21.1	51	41	17

Table 2. Average form class* of different pine species.

Species	Average form class	No. of trees sampled
Scots pine provenance A	0.732	17
Scots pine provenance B	0.701	10
Scots pine provenance C	0.625	13
Ponderosa pine	0.738	10
Jack pine	0.778	10
Lodgepole pine	0.829	10

* Ratio between diameter inside bark at 16 feet above ground and diameter at breast height outside of bark.

Table 3. Various agents damaging pines.

Type of damage	Scots pine provenances A. B. C. combined		Ponderosa pine		Jack pine		Lodgepole pine	
	No. of trees	Percent	No. of trees	Per cent	No. of trees	Per cent	No. of trees	Per cent
Sapsucker	43	42	2	13	-	-	-	-
Porcupine	13	12	2	13	-	-	-	-
Sapsucker and Porcupine	27	26	-	-	-	-	-	-
Gall (cause unknown)	1	1	-	-	-	-	-	-
Completely healthy	20	19	11	74	14	100	17	100
TOTAL	103	100	15	100	14	100	17	100

Vigor

Table 3 shows that damage to native pines was not apparent. The heaviest damage was caused by sapsuckers and porcupines which preferred exotic pines, especially Scots pines. Minor gall damage was found on the branches of one provenance A Scots pine tree.

Volume and Wood Quality

The volume production of provenance A Scots pine appears to be far superior to other pines in Alberta. Table 4 shows that the best Scots pine stands in Hungary (Madas, 1956) and the best lodgepole pine stands in Alberta (Smithers, 1961) had much smaller average diameter and less total height at the age of 40 years than provenance A Scots pine in Alberta. Assuming a stocking of 545 trees per acre at a spacing of 10 x 8 ft. as was observed in the Bugnet plantation, provenance A Scots pine can produce 163 per cent more volume per acre than the best lodgepole pine stands in Alberta.

Kasper and Szabo (1969) found that regardless of fast growth, the physical and mechanical properties of provenance A Scots pine were comparable to native white spruce and lodgepole pine grown in Canada.

Although the volume increase and wood quality of Scots pine of Russian origin are indeed impressive, forest managers must consider the possibility of porcupine and other animal damage if this species is to be planted extensively in Alberta.

Table 4. Total yield per acre of 40-year-old lodgepole pine and Scots pine stands.

Source	Species	Age (years)	Average		Number of trees per acre	Total volume in cubic feet per acre
			diameter (inches)	height (feet)		
^a Empirical Yield Table Foothills Alberta Site Index Class 80	Lodgepole pine	40	4.2	49	1195	2,075
^b Hungarian Yield Table for Site Class I. Hungary	Scots pine	40	8.0	49	1191	3,786
Bugnet plantation Alberta	provenance A Scots pine	40	11.2	54	545 ^c	5,450 ^d

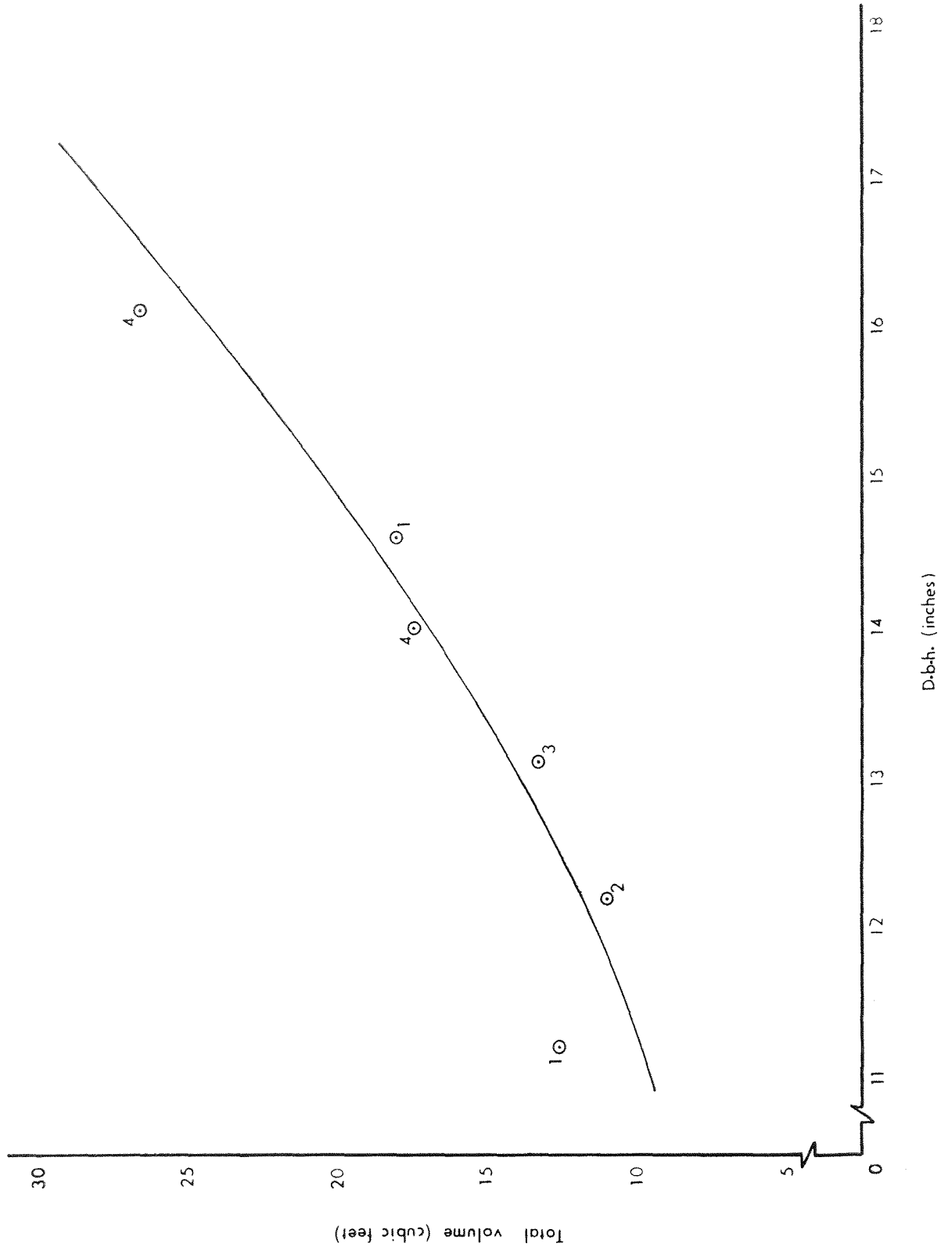
a Source: Smithers, L.A. 1961. Lodgepole pine in Alberta. Can. Dep. Forest. Bull. 127.

b Source: Madas, A. 1956. Erdészeti kézikönyv. (Forestry Handbook) Mezőg. Kiadó.

c No. of trees per acre at 10 x 8 feet spacing.

d Average volume of 10.0 cubic feet was obtained from Fig. 8 and contains only the volume of bole.

Fig. 8. Local volume table for provenance A Scots pine.



ACKNOWLEDGMENTS

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REFERENCES

- Bella, J. E. 1967. Development of jack pine and Scots pine in the Spruce Woods Forest Reserve, Manitoba. Can. Dep. Forest. Rur. Develop., Forest. Br., Publ. No. 1171.
- Chapman, H. H. and W. H. Meyer. 1949. Forest Mensuration. Mac Graw-Hill Book Co. Inc.
- Kasper, J. B. and T. Szabo. 1969. Strength and related properties of a Scots pine tree of Russian origin grown in Alberta. Can. Dep. Fish. Forest. Inform. Rep. A-X-27.
- Lindsay, J. D. et al. 1968. Reconnaissance soil survey of the Buck Lake (NE 83B) and Wabamun Lake (E $\frac{1}{2}$ 83G) areas. Alberta Soil Surv. Rep., No. 24.
- Madas, A. 1956. Erdeszeti kezikönyv. (Forestry Handbook) Mezög. Kiado.
- Rowe, J. S. 1959. Forest Regions of Canada. Can. Dep. Northern Affairs and Nat. Resources, Forest. Br. Bull. 123.
- Ruby, J. L. 1967. The correspondence between genetic, morphological, and climatic variation patterns in Scotch pine. *Silvae Genetica* 16.
- Smithers, L. A. 1961. Lodgepole pine in Alberta. Can. Dep. Forest. Bull. 127.
- Wiedeman, F. 1930. Die Versuche über den Einfluss der Herkunft des Kiefernnsamens aus der preussischen forstlichen Versuchsanstalt. *Ztng. f. Forst u. Jagdwesen* 62.
(Translated by J. W. Wright).

Wright, J. W. and H. T. Baldwin. 1957. The 1938 international
union Scotch pine provenance test in New Hampshire.
Silvae Genetica 6.

Wright, J. W. and W. T. Bull. 1963. Geographic variations in
Scotch pine. *Silvae Genetica* 12.