

TEN-YEAR DEVELOPMENT OF PLANTED CONIFERS IN WESTERN NEWFOUNDLAND

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Résumé en français

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ABSTRACT

A study was undertaken in 1958 in western Newfoundland on a nonreproducing burned cutover to determine which of a group of native and exotic species were most suitable for reforestation purposes. Species planted included black and white spruce, Norway spruce, Douglas-fir, Japanese larch, and five strains of Sitka spruce. The planting site was on a well-drained, deep, stone-free clay-loam. Results from remeasurements in 1959, 1962, and 1968 indicate success with local black and white spruce wildlings and limited success with Norway spruce, Japanese larch, and Sitka spruce from Lillishnoo. Douglas-fir, white spruce from Alaska, and the Sitka spruce from Fisk Bay, Petersburg, Old Sitka, and the Queen Charlotte Islands were unsuccessful. A potentially serious disease problem, that of *Armillaria* root rot, was encountered in the plantation. Initial mortality was attributed to drought and poor-quality stock; *Armillaria* root rot appeared to be the cause of most of the later mortality. It is recommended that the study be repeated in other parts of Forest Section B28b with the species that have shown promise.

RÉSUMÉ

En 1958 dans l'ouest de Terre-Neuve, on fit une expérience de reboisement dans un terrain déboisé ("bûché"), puis incendié, et où il n'y avait aucune régénération de plantes arborescentes. L'on essaya un groupe d'essences forestières indigènes et exotiques, incluant l'Épinette noire, l'Épinette blanche, l'Épinette de Norvège, le Sapin Douglas, le Mélèze du Japon, et cinq provenances d'Épinette de Sitka. Le sol était composé de limon argileux, profond, bien drainé, libre de roches. A la suite de remesurages effectués en 1959, 1962 et 1968, les meilleurs sujets s'avérèrent les sauvageons d'Épinette noire et d'Épinette blanche locales. L'Épinette de Norvège, le Mélèze du Japon et l'Épinette de Sitka provenant de Lillishnoo poussent moins bien, tandis que le Sapin Douglas, l'Épinette blanche obtenue de l'Alaska, et les Épinettes de Sitka provenant de Fisk Bay; Petersburg, Old Sitka et des îles de la Reine Charlotte périrent. La mortalité récente semble surtout due à une maladie pouvant devenir très sérieuse, c'est-à-dire le Pourridié-Agaric. L'auteur recommande la répétition des mêmes expériences ailleurs dans la section forestière B28b, en utilisant cette fois-ci seulement les espèces prometteuses.

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INTRODUCTION

In western Newfoundland cutover sites generally reproduce well to black spruce (*Picea mariana* (Mill.) BSP.), white spruce (*Picea glauca* (Moench) Voss), and balsam fir (*Abies balsamea* (L.) Mill.) or to a mixture of these species with intolerant hardwoods, white birch (*Betula papyrifera* Marsh.) and trembling aspen (*Populus tremuloides* Michx.). However, if these young stands are burned before the trees begin to produce seed, forest succession is retarded and brushland or open forest land may begin to develop.

In 1958 the Canadian Forestry Service² established a plantation in western Newfoundland to test and compare the suitability of several species and strains of exotic conifers and two species of local spruce for planting on nonreproducing burns.³ Survival, growth, and form of the various species for the 10-year period after planting are summarized in this report.

DESCRIPTION OF THE AREA

The area in which this experiment is located had been cut for pulpwood during the period 1939-47; residual white birch trees were subsequently logged for use as railway ties. Regeneration was rapid and resulted in a fully stocked to overstocked stand of balsam fir. In 1949 a fire swept the area leaving no apparent seed source, and resulted in the

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²Then the Forest Research Branch, Department of Northern Affairs and National Resources.

³Wilton, W.C., 1958. A comparison of certain exotic and local species planted under ordinary plantation conditions. Estab. Rep. Silvicult. Project NF-49, Can. Dep. Northern Aff. Nat. Resources, Forest Res. Div., St. John's, Newfoundland.

development of an open forest of scattered white birch, white spruce, and black spruce on what was a potentially productive site.

The plantation is located in the Corner Brook Forest Section, B28b (Rowe, 1959) (Figure 1). The frost-free period is approximately 100 days and precipitation averages about 40 inches a year, 23% of it occurring during the growing season. The average temperature is 58 F for July and 19 F for January; temperature extremes in the 80's and minus 20's have occurred. At the time of planting (May 29 - June 6) the temperature was in the high 60's for the first 2 days and soils were quite dry; during the final 4 days rain occurred periodically and the weather was cool. In July 1964, temperature fell below freezing for one night, killing or damaging the leaders of some trees.⁴ In 1968, the effects of this frost were still evident.

The Cormack area is part of an old river plain with a gently undulating topography. The plantation is located on a lower south-facing slope of a low ridge. The soil is a well-drained, deep, practically stone-free, red-brown clay-loam showing little evidence of podzolization. Tentative classification by the Canada Land Inventory has placed the experimental area in Forest Capability Class 5 mf, bS, bF.⁵ This represents a volume of 1,800 - 3,000 ft³/acre at 60 years with moisture and fertility as limiting factors and a forest cover composed mainly of black spruce and balsam fir (Anon., 1967). Natural regeneration is spotty and the ground cover is composed of mosses, herbaceous plants, and scattered clumps of grasses. Mosses consist largely of *Polytrichum commune* Hedw. and *Cladonia* spp. The herbaceous cover is made up of *Maianthemum canadense* Desf., *Cornus canadensis* L., *Linnaea borealis* L., *Fragaria vesca* L., *Anaphalis margaritacea* (L.) C.B. Clarke, *Lycopodium clavatum* L., *L. obscurum* L., and *L. complanatum* L. Also present are *Trifolium* spp., *Ranunculus* spp., and *Vaccinium* spp.

Plantation Design

The species, origin, age-class, and number planted are shown in Table 1.

The exotic species were grown in a nursery near St. John's; local species were wildlings obtained near the plantation area. At the time of planting, exotics averaged 2-4 inches in height⁶ and local wildlings close to 12 inches.⁷ A total of 2,460 trees were planted by the pit method (Smith, 1962). Spacing between seedlings averaged 5 feet.

⁴Frost damage also occurred on local spruce and fir in the vicinity.

⁵Personal communication, K. Beanlands.

⁶Nickerson, D.E. 1969. Reforestation and afforestation research in Newfoundland. Can. Dep. Fish. Forest., Can. Forest. Serv. Inform. Rep. N-X-34. St. John's, Newfoundland.

⁷Personal communication, W.C. Wilton.

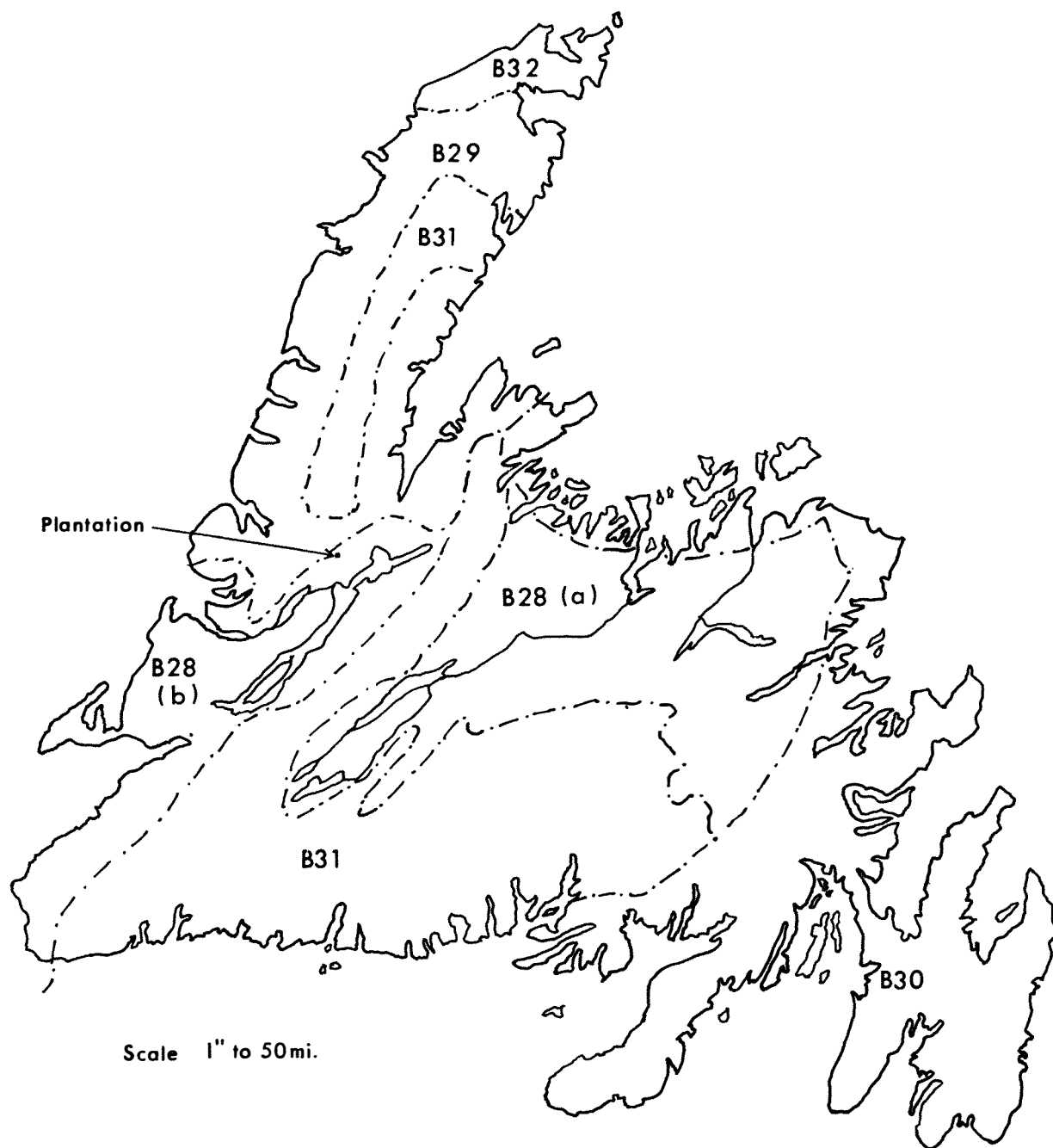


Figure 1. Map of Newfoundland showing forest sections and location of plantation.

TABLE 1. LIST OF SPECIES, ORIGIN, AGE-CLASS, AND NUMBER PLANTED

Species planted						Origin	Age- class	Number planted
Scientific name				Common name				
<i>Picea sitchensis</i> (Bong.) Carr.				Sitka spruce		Lillisnoo, Alaska	2-0	40
"	"	"	"	"	"	Queen Charlotte Is., B.C.	3-1	80
"	"	"	"	"	"	Petersburg, Alaska	3-0	160
"	"	"	"	"	"	Old Sitka, Alaska	3-0	720
"	"	"	"	"	"	Fisk Bay, Alaska	2-0	160
<i>Larix leptolepis</i> Sieb. and Zucc.				Japanese larch		Holland	2-0	360
<i>Pseudotsuga menziesii</i> (Mirb.) Franco				Douglas-fir		Vancouver Is., B.C.	2-0	160
<i>Picea abies</i> (L.) Karst.				Norway spruce		Norway	2-0	160
<i>Picea glauca</i> (Moench) Voss				White spruce		Sewert, Alaska	2-0	60
<i>Picea glauca</i> and <i>mariana</i> (Mill.) BSP.*				White and black spruce		Local wildlings	-	560

*A mixture of these local wildlings was planted.

METHODS

Mortality counts were made in May 1959, May 1962, and August 1968. During the third examination, the height (to the nearest foot) and stem form of survivors were recorded. In addition, the breast-height diameter of all trees more than 4.5 feet in height was measured to the nearest tenth of an inch.

DISCUSSION OF RESULTS

Results of the three remeasurements are summarized in Table 2 and are now discussed by species:

Sitka Spruce (all provenances)

These provenances have not thrived under the conditions prevailing on the planting site. Early height growth was slower than that of the local species and, except for the Lillisnoo strain, survival has been poorer also. During the last few years growth has improved somewhat (Figure 2), but in general most of the trees are not thrifty. All provenances except the Queen

TABLE 2. RESULTS OF 1959, 1962, AND 1968 REMEASUREMENTS

Species	Percent survival			Percent well formed	Height**	Diameter†	Percent diseased††
	1959	1962	1968				
Sitka spruce, Lillisnoo	82.5	77.5	70.0	85.8	3.2	0.2	34.3
Sitka spruce, Q. Charl. Is.	92.5	86.3	61.3	40.8	4.6	0.3	67.1
Sitka spruce, Petersburg	81.9	76.9	48.1	59.7	3.5	0.4	37.6
Sitka spruce, Old Sitka	88.1	84.4*	65.1	58.9	4.0	0.3	42.5
Sitka spruce, Fisk Bay	81.3	70.0	56.3	73.3	2.9	0.3	19.9
Japanese larch	22.2	17.8	17.2	50.0	5.2	0.4	4.5
Douglas-fir	86.3	69.4	46.9	17.3	2.9	0.2	30.5
Norway spruce	85.6	75.0	69.4	86.5	4.2	0.3	12.8
White spruce, Alaska	81.7	68.3	53.2	78.1	5.7	0.4	13.5
Black spruce	-	-	-	64.6	7.0	0.8	-
White spruce	-	-	-	68.1	8.8	0.8	-
Black and white spruce (combined)	90.2	80.4	71.1	-	-	-	19.9

*Based on 480 trees.

**Average height of all trees to nearest ± 0.1 foot.

†Average diameter at breast height to nearest ± 0.1 inch of trees over 4.5 feet in height.

††Percent of trees infected by *Armillaria mellea* (source: Singh and Carew, 1969, as in footnote 8).

Charlotte Islands appear to have good stem form. Investigations by the Forest Insect and Disease Survey in the region have shown that the plantation is infected to some degree by *Armillaria* root rot (*Armillaria mellea* (Vahl ex Fr.) Kummer).⁸ Most of the Sitka spruce provenances are affected to varying degrees.

It would appear that these provenances are not suited for planting on this Newfoundland site because of relatively poor survival (except

⁸Singh, P. and Carew, G.C., 1969. Disease conditions in coniferous plantations in Newfoundland, *Armillaria* root rot. Can. Dep. Fish. Forest., Forest. Br. Intern. Rep. N-13. St. John's, Newfoundland.

in the case of the Lillinsnoot strain), slow growth, and susceptibility to Armillaria root rot. It should be noted that these provenances are from areas lying between 53° and 60° N lat, whereas the plantation is 49° N lat; so more southerly provenances may have performed better.

Japanese Larch

Initial survival of this species was low, but since 1959 survival has been good. Low initial survival was the result of poor-quality stock: the records indicate that the seedlings were partially dried out upon arrival at the planting site. Height development is good and the species does not appear to be affected by Armillaria root rot. Its limited value for pulpwood will restrict its use in the reforestation of burned cutovers in Newfoundland.

Douglas-fir

Poor survival, form, and height growth indicate that this provenance is unsuitable for use as reforestation material in western Newfoundland under conditions similar to those found in this experimental area.

Norway Spruce

Survival of Norway spruce has been comparable to that of the local species; survivors have excellent form and are only slightly affected by Armillaria root rot. Initial height growth has been slow but is apparently increasing as the trees get older (Figure 3). The species appears suitable for reforestation material, providing the initial slow growth can be accepted. Plantations of Norway spruce are somewhat susceptible to leader damage by the white pine weevil (*Pissodes strobi* (Peck)) (Holst, 1955), and this could restrict the use of this species for large-scale planting operations.

White Spruce (Alaska)

In survival and height growth, this provenance has been poorer than the local species and Norway spruce, but the survivors have grown faster than Norway spruce. They have good form and infection by Armillaria root rot is low. Because of poor survival, however, it is doubtful if this provenance is suitable for reforestation in western Newfoundland.

Black Spruce and White Spruce (local)

Several of the local spruces have suffered trespass damage or have had their stems blazed or their tops cut for use as Christmas trees. Notwithstanding, these species have performed well in terms of survival and height growth, thus indicating that they are suitable for planting in Newfoundland. However, the use of wildlings is not recommended over the use of vigorous nursery stock (Smith, 1962) despite this good performance.

With respect to form, the local spruces are poorer than the white spruce (Alaska) and Norway spruce and only slightly better than the Sitka spruce. Examples of fast-growing, well-formed black and white spruce are shown in Figures 4 and 5 respectively.



Figure 2. Well-formed Sitka spruce, 7 feet tall, 18-inch leader.



Figure 3. Well-formed Norway spruce, 7 feet tall, 17-inch leader.



Figure 4. Well-formed black spruce, 10 feet tall, 10-inch leader. Arrow shows top of tree.

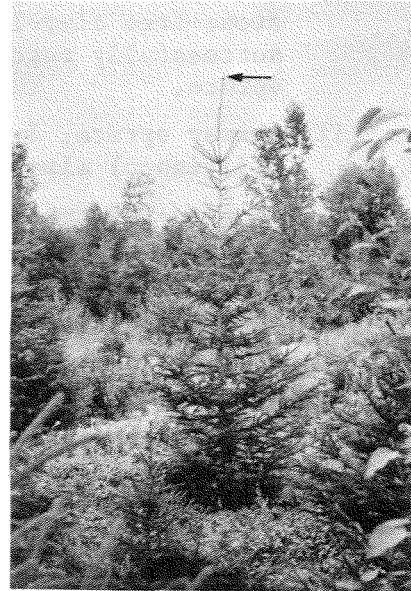


Figure 5. Well-formed white spruce, 9 feet tall, 20-inch leader. Arrow shows top of tree.

All Species

Much of the initial mortality of all species and especially of the exotics was attributed to drought because the stock had small root systems that were probably not in contact with a continuous moisture supply. Later mortality was largely attributed to Armillaria root rot.

The poor form (double or crooked stems) of many trees dated from 1964, the year of the summer frost. It is assumed that the defects arose from damage to the succulent growth of that year.

CONCLUSIONS AND RECOMMENDATIONS

This study has revealed a number of strong trends upon which several conclusions may be based. Survival and growth figures, however, are probably not a fair indication of the suitability of some of the species for planting in Newfoundland. The height of the planted exotics ranged from 2 to 4 inches, whereas the local wildlings averaged 12 inches, thus having a decided advantage in survival. Nevertheless results of the study have revealed a number of strong trends upon which conclusions can be based.

These conclusions are as follows:

- (i) Understocked burned cutovers on well-drained, deep, stone-free clay-loams in western Newfoundland may be successfully restocked with local black and white spruce.
- (ii) Norway spruce, Japanese larch, and Sitka spruce (Lillishnoo) also show promise.
- (iii) Douglas-fir and Sitka spruce (Petersburg, Queen Charlotte Islands, Old Sitka, and Fisk Bay) are not suitable for reforestation.
- (iv) If at all possible, cutover sites heavily infected with Armillaria root rot should be avoided, since all species are susceptible to the disease.
- (v) Frosts occur occasionally during the growing season and result in poor stem form. This may not be too serious if the objective is to grow pulpwood.

From the results of this study it is recommended that:

- (i) Only local black and white spruce be used for reforestation of understocked burned cutovers in western Newfoundland until other species or provenances are proven superior;

- (ii) Plantations be established where Armillaria root rot is not prevalent;
- (iii) The experiment be repeated on similar sites in Forest Section B28b to test further the suitability of Sitka spruce and Japanese larch.

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