

EXPERIMENTAL ESTABLISHMENT OF SPRUCE  
ON  
TOLERANT HARDWOOD LANDS

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ABSTRACT

Field trials to convert tolerant hardwood stands to spruce stands in the Maritime Provinces indicate that (1) bulldozing or clearcutting can be adequate preparation for planting, (2) a dense cover of the tolerant hardwood type inhibits the development of transplants, (3) planting is far superior to broadcast seeding, (4) dense hardwood and shrub re-growth, as high as the spruce transplants, does not hinder the growth of the transplants but dense raspberry does.

INTRODUCTION

Much of the tolerant hardwood forest in the Maritime Provinces is decadent. Drinkwater (1957) has described the tolerant hardwoods in Nova Scotia, and in New Brunswick the poor conditions of such stands have been referred to by the New Brunswick Forest Development Commission (1957). The cost of rehabilitating poor hardwood stands and maintaining them in good condition may not be justified on extensive areas. One possible alternative is to replace them with softwoods.

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<sup>1/</sup> Nomenclature as in Native Trees of Canada (Anon. 1961)

The principal difficulties in stand conversion are site preparation and the establishment and maintenance of desired species. To evaluate these difficulties in the Maritimes, field trials were carried out in Colchester County, N. S. in 1950, and in Madawaska County, N. B. in 1956, 1957 and 1958. The trials included mechanical site preparation and planting and seeding of white spruce.

#### Description of the Study Areas

Both sites are in Loucks's (1962) Maritime Uplands Ecoregion. The study area in Nova Scotia is at Nuttby Mountain near Truro. The planting site is on a sandy loam with a westerly aspect near the summit of a gently sloping 1000-foot-high ridge, 15 to 20 miles wide, which separates the northern coastal lowland from the extensive lowland to the south. A logging operation in 1930 left a scattered overstorey of sugar maple and yellow birch. Before treatment the area supported a dense stand, consisting of some 2500 poor quality hardwood stems per acre. The main tree species were mountain maple, beech, and sugar maple with some yellow birch and balsam fir. No shrub stratum was present.

In New Brunswick, the study area is in the Green River Watershed near Edmundston on a gentle southeasterly upper slope, 1450 feet above sea level. The soil is a well-drained silt loam. A scattered hardwood overstorey remained following a softwood pulpwood cut in 1939 and a sawlog operation in 1955 which removed the best hardwood trees. Cull sugar maple up to 24 inches d.b.h. were dominant with yellow birch, red maple, white birch, balsam fir, and white spruce also present. The dense shrub stratum was made up primarily of mountain maple and raspberry with some sugar maple advance growth.

Data from the nearest weather stations are not applicable to either of the experimental areas because of major topographical differences. However, average regional data from Putnam (1940) indicate the climates of the two experimental areas (Table 1).

#### Methods and Materials

At Nuttby Mountain in Nova Scotia, 12 rectangular fifth-acre plots were established in a block 4 ch. x 6 ch. and six randomly selected plots were clear cut in the autumn of 1950. In May 1951 an unsuccessful attempt was made to burn the slash on the cut-over plots and the litter on the uncut plots.

The plots were subdivided into three subplots, one of a tenth-acre and two of one-twentieth acre each. In late May 1951 all tenth-acre subplots were planted with 50 white spruce, 2-2 stock. At the same time white spruce seed was broadcast over one twentieth-acre subplot at a rate of two pounds of viable seed per acre and in the second small subplot 12 seeds were sown into each of 50 cultivated spots. After seeding the seed spots were lightly covered with soil and protected against rodents with a 10-inch-high cone of 1/4-inch hardware cloth. In the autumn of 1955 all hardwood growth within 3 feet of each transplant was cut back on three of the six clear-cut plots.

At Green River a one-acre plantation was established in each of the years 1956, 1957 and 1958. Planting sites were scarified with a bulldozer in July or August. A D-7 Caterpillar machine was used in 1956 but in 1957 and 1958 the smaller, more manoeverable D-4 model was tried. The D-7

virtually stripped the planting site of all litter and vegetation. The D-4 exposed mineral soil on about 50% of the ground; however, this was considered adequate.

In 1956 and 1957, 2-2 white spruce transplants were set out and in 1958, 2-3 stock was used. The spacing between trees was variable because of the broken terrain but approximated 10 feet. Planting was carried out in mid-September each year. In 1956 planting conditions were unfavourable with dry soil and clear, hot weather. In 1957 conditions were better; the soil was wet, the sky overcast and rain fell in each of the next six days. The soil was wet in 1958 also with rain falling during planting but the following few days were clear. In 1962 the past annual height growth and the total height of each survivor was recorded for both the Nova Scotia and New Brunswick plantations.

#### Experimental Results

At Nuttby Mountain mortality of white spruce transplants on the uncut plots was high and only a few suppressed individuals remain. In contrast, of 300 seedlings planted on the cut-over plots 218 vigorously growing trees remained 12 years after planting (Table 2). Annual height increment has increased steadily since planting, the six plot averages reaching 1.1 to 1.4 feet in 1962. Average total height for the surviving trees was 9.0 feet. Fourteen % of the trees were recorded in this class while 43% fell above and the remaining 43% fell below. Four trees were recorded in the upper height class with an average height of 15.8 feet. There was little difference in height growth between the

white spruce in the plots weeded in 1955 and in those not weeded. However, the effectiveness of the weeding treatment may have been masked by heavy moose browsing of maple on part of the uncleaned plots.

The seeding treatments at Nuttby Mountain gave poor results (Table 3). Only 85 trees were growing on the 300 seed spots on which a total of 3600 seeds were sown, and a total of 80 trees were counted in the six one-tenth acre subplots seeded by broadcasting. The average annual height growth of the seedlings also continued to increase but reached only 0.8 foot in 1962 (Table 3). Consequently their average total heights are much less than those of the transplants. Absence of seed trees has precluded natural regeneration here.

The transplants at Green River have fared well. In 1962 survival was 96, 91, and 88% respectively for the 4-, 5-, and 6-year-old plots (Table 4). As at Nuttby Mountain, mean annual height increment was increasing. Average height increment for the year 1962 varied from 0.9 to 1.0 feet in the three plantations. Average heights reached 3.7, 4.7 and 4.8 feet respectively. The variation in height growth within these plantations was great; some trees suppressed by raspberry grew 0.1 to 0.2 foot per year. This suppresses the average-height values. However, in 1963 a growth rate of 3 feet in two years at this young age was common. One tree grew 5.1 feet in the fifth and sixth growing season since planting. The abundant hardwood seedlings averaged about the same height as the softwood transplants but the hardwoods did not seem to be interfering with the growth of the transplants. However, dense raspberry had been a major hindrance to the softwoods and transplants covered annually by mats of dense raspberry canes

and depressed by snow, were of poor form and growing very slowly. Mountain maple was sparse but, where present, it had outgrown both planted white spruce and other hardwoods. The natural softwood regeneration is being suppressed by hardwood growth.

#### Summary and Conclusions

To evaluate problems associated with the conversion of poor quality hardwood stands to good quality softwood stands in the Maritime Provinces, white spruce was sown and planted experimentally in Colchester County, Nova Scotia, in 1951 and planted in Madawaska County, New Brunswick, in 1956, 1957 and 1958.

Site preparation at the Nova Scotia location consisted of clear-cutting a pole-sized hardwood stand, leaving the trees on the ground and partly burning them. At the New Brunswick location shrub and tree growth was removed by bulldozing.

The results to 1962 indicate that:

- (1) both methods of site preparation (bulldozing and clear cutting) offer an effective means of preparing an environment suitable for white spruce transplants on hardwood sites such as those at Green River and Nuttby Mountain.
- (2) attempts to establish white spruce under dense hardwood cover are fruitless. Eleven years after white spruce was sown and planted on six uncut plots, only a few suppressed trees remained.
- (3) poor results were obtained from both broadcast and spot seeding. The number of seedlings resulting from either method was small in comparison to the amount of seed used. Survival and initial growth were inferior to

those of transplants and further mortality is likely as a result of competition from hardwoods.

(4) hardwood and shrub regrowth did not inhibit the vigorous growth of white spruce transplants. In 1962 the height growth of transplants at both the Nova Scotia and New Brunswick locations was keeping pace with the sometimes dense hardwood growth. Few softwoods, however, have outgrown the hardwoods.

(5) dense raspberry can be a serious threat to the survival of spruce transplants where snow and raspberry canes combine to flatten the spruce.

#### Acknowledgements

The trial at Green River, New Brunswick, was initiated by the late G. C. Cunningham and the trial at Nuttby Mountain, Nova Scotia, by M. H. Drinkwater, Department of Forestry.

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Table 1. Average Regional Climatic Data<sup>1/</sup>, Northern New Brunswick and Northern Nova Scotia

	Northern New Brunswick	Northern Nova Scotia
January mean temperature, °F	8	19
July " " , °F	64	64
Length of growing season, days	162	185
Length of frost free period, days	91	118
Mean annual precipitation, inches	35	42
Precipitation April to September, inches	18	19
Precipitation June to August, inches	10	10

<sup>1/</sup> Putnam (1940)

Table 2. Survival and Growth of Planted Spruce, Nuttby Mountain

Treatment	1951		1954		1962	
	Number planted	Average height	Survival	Average height	Survival	Average height
		<u>Feet</u>	<u>Per cent</u>	<u>Feet</u>	<u>Per cent</u>	<u>Feet</u>
<u>Cut-over plots</u>						
Cleaning	150	0.4	85	1.7	77	9.1
No cleaning	150	0.6	77	2.0	69	8.9
Both treatments	300	0.5	81	1.8	73	9.0
<u>Uncut plots</u>	300	-	-	-	2	1.3

Table 3. Survival and Growth of Spruce Seedlings Resulting from 1951 Seeding, Nuttby Mountain

Method	Number of seedlings		<u>Height increment</u>			<u>Average height</u>
	<u>Total</u>	<u>Per acre</u>	<u>1960</u>	<u>1961</u>	<u>1962</u>	<u>1962</u>
Broadcast seeding	80	133	0.5	0.6	0.8	3.6
Spot seeding	85	142	0.5	0.6	0.8	3.5

Table 4. Survival and Growth of Planted Spruce, Green River

Establishment	Number planted	Average height at planting	1960		1962	
			Survival	Average height	Survival	Average height
		<u>Feet</u>	<u>Per cent</u>	<u>Feet</u>	<u>Per cent</u>	<u>Feet</u>
1956	400	0.8	94	3.2	88	4.8
1957	400	1.2	94	2.8	91	4.7
1958	400	1.2	99	1.9	96	3.7