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SEEDING WHITE SPRUCE, BLACK SPRUCE AND JACK PINE ON BURNED SEEDBEDS IN MANITOBA

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INTRODUCTION

Studies (Phelps 1948 and Rowe 1955) in the Mixedwood Forest Section (Rowe 1959) have shown that the removal of all organic matter by fire to expose mineral soil under stands of white spruce (*Picea glauca* (Moench) Voss) and trembling aspen (*Populus tremuloides* Michx.) on upland sites provides favourable seedbeds for the establishment of white spruce. White spruce regeneration has not been studied however on other fire-prepared seedbeds nor has it been compared with regeneration of other commercially important species such as black spruce (*Picea mariana* (Mill.) BSP.) or jack pine (*Pinus banksiana* Lamb.). Therefore, a study was undertaken in 1963 to compare germination and survival of these species on different seedbeds created by fire. Such information will be useful for management programs in which prescribed burning is contemplated as a means of site preparation for regeneration purposes.

STUDY AREAS

The study was carried out in two areas--at the Riding Mountain which is about 180 miles northwest of Winnipeg in the Mixedwood Section of the Boreal Forest Region and at Pine Falls, about 80 miles northeast of Winnipeg in the Lower English River Section (Rowe 1959).

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Both study areas are characterized by a continental climate. Mean January and July temperatures at the Riding Mountain are approximately -3°F and 64°F respectively (Pine Falls -1°F and 66°F). Annual precipitation is about 18 inches of which 7 inches falls during May, June and July (Pine Falls 21 inches and 7 inches respectively). The average moisture deficit for both areas averages about 4 inches (Anon. 1960a). Both study areas are located on gently sloping terrain with a north aspect. Soils belong to the Grey Wooded Great Group of the Podzolic Order (Anon. 1960b) and parent materials consist of well-drained clay-loam tills. Both study areas were classified as fresh sites according to Hills' system of classifying site (Hills 1952).

The study at the Riding Mountain was conducted on a treeless cut-over area. The original stand had been a mixture of mature white spruce and trembling aspen each with a stocking of about 50 sq. ft. of basal area per acre. During the winter of 1962-63 all merchantable trees were logged; those not utilized by the loggers were felled by the Department of Forestry in the spring of 1963. The study near Pine Falls was conducted in a stand of 65-year-old trembling aspen with a stocking of about 110 sq. ft. of basal area per acre.

METHODS

At the Riding Mountain, seedbeds were created by burning slash piles made from the branches of the felled trees. Slash was piled in May 1963 and burned the following August. The fires burned fiercely creating an intense heat so that even large branches were consumed. Seedbeds created included: exposed F horizon[2], exposed H horizon[3], and exposed MS horizon[4].

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[2]F horizon - partially decomposed duff; structure is generally well enough preserved to permit identification of source.

[3]H horizon - well decomposed amorphous organic matter.

[4]MS horizon - mineral soil.

In October 1963 the seedbeds on each burn were mapped and the burns were divided into nine blocks, each with some F, H and MS seedbeds. Within each of the seedbed types in each block, one plot containing three sub-plots (each 1 foot square) was established at random. Sub-plots were chosen randomly for sowing to a given species. Treated white spruce, black spruce and jack pine seed was broadcast at the rate of 25, 20 and 18 seeds per sub-plot[5].

Germination tallies were made at weekly intervals from late May to late June 1964. Each new germinant was staked with a plastic toothpick for further identification. Survival tallies were made in late August 1964 and again in May and September 1965.

The experiment was extended to Pine Falls in the autumn of 1963 when it was learned that a surface fire had occurred in an intermediate-aged trembling aspen stand on the limits of the Manitoba Paper Company. The fire had moved slowly through the stand burning some places but not others. The forest floor resembled a patchwork consisting of undisturbed litter, exposed MS horizon, and exposed F horizon, each distributed more or less evenly and in equal proportions over the entire area. On the unburned portions, the trembling aspen remained alive and shaded the ground.

A representative portion of the burn (about 1 acre) was chosen for the study. Burned seedbeds on this area were mapped, then it was divided into 12 blocks. As at the Riding Mountain, plots were established at random within each block then divided into sub-plots. Sub-plots were sown randomly to treated white spruce, black spruce and jack pine. Seed was obtained from the same lots and the rate of sowing was the same

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[5]Seed was treated with Arasan, Endrin and aluminum flakes; tests after treatment just prior to seeding resulted in germination values of 68, 85, and 96 per cent for white spruce, black spruce and jack pine respectively.

as that used at the Riding Mountain. Germination was not recorded but stocking tallies were made in September 1964 and in October 1965.

Data were subjected to analyses of variance and means were compared by "t" tests as outlined by Cochran and Cox (1950) for randomized split-plot experiments.

RESULTS

At the Riding Mountain, average germination was highest for jack pine followed in order by white spruce and black spruce (Table 1). Seedbed type had no significant effect on the germination of any of the species. After two growing seasons, jack pine stocking was significantly higher than that of either white or black spruce (Table 2). Jack pine stocking was highest on MS seedbeds, intermediate on H seedbeds and lowest on F seedbeds. Black spruce stocking was not significantly affected by seedbed type whereas that of white spruce was higher on MS seedbeds than on H or F.

TABLE 1. AVERAGE NUMBER OF SEED PER SUB-PLOT THAT GERMINATED, RIDING MOUNTAIN.

Seedbed	Species		
	Jack pine	White spruce	Black spruce
F	9.6a	6.2b	3.2b
H	11.0c	8.3d	5.1e
MS	11.5f	8.2f	3.5g
ALL	10.7h	7.6i	4.0j

NOTE:
Reading across rows, figures followed by the same letters are not significantly different; reading down columns, figures enclosed by the same bracket are not significantly different.

TABLE 2. AVERAGE NUMBER OF SEEDLINGS PER SUB-PLOT, FALL OF 1965, RIDING MOUNTAIN.

Seedbed	Species		
	Jack pine	White spruce	Black spruce
F	1.5a	0.2b	0.1b
H	3.4c	0.4d	0.4d
MS	6.1e	1.5f	0.5f
ALL	3.7g	0.7h	0.3h

See footnote Table 1.

At Pine Falls, jack pine stocking was significantly higher than that of white or black spruce (Table 3). No significant difference in stocking was established between MS and F seedbeds for any of the species.

TABLE 3. AVERAGE NUMBER OF SEEDLINGS PER SUB-PLOT, FALL OF 1965, PINE FALLS.

Seedbed	Species		
	Jack pine	White spruce	Black spruce
F	2.0a	0.4b	0.1b
MS	2.3c	1.3d	0.5d
ALL	2.1e	0.8f	0.3f

See footnote Table 1.

DISCUSSION

Available information indicates that weather conditions in 1964 and 1965 were about normal so the relative performance of the three species is indicative of what could be expected in an average year. The seedbeds under consideration had little influence on germination but they did have an effect on stocking, after two years. Although significant differences were not always obtained, results for all species indicate that stocking was highest on MS seedbeds, next highest on H seedbeds, and lowest on F seedbeds. These results agree with Rowe's earlier observations (1955) that light surface fires generally produce unsatisfactory conditions for white spruce regeneration. Furthermore, they show that fires should be severe enough to expose mineral soil.

It is recognized that seedlings require a number of years to become established and the results of this study are not yet final. Nevertheless, the findings to date show that jack pine is much easier to establish by seeding than either white or black spruce. Generally jack pine seedlings are larger than those of black or white spruce and develop much larger root systems. Consequently they are able to survive better than spruce in habitats, such as those created by burning, which are subject to surface drying.

Stocking to both white spruce and black spruce after two growing seasons was about the same at Pine Falls and at the Riding Mountain. Furthermore observations indicated that seedlings were equally vigorous at both locations. On the other hand, jack pine stocking was higher and seedlings appeared to be more vigorous at the Riding Mountain. The better performance of jack pine at the Riding Mountain has been attributed to the fact that it is less shade tolerant than either of the spruces and no tree canopy was present there to shade the seedlings.

In addition to providing data on relative species performance the results have given preliminary information on seeding rates likely to be required in a normal year to produce a given stocking of 2-year-old seedlings on MS, H and F seedbeds on well drained sites. Further studies are contemplated to confirm these results and to obtain data for longer growing periods, different sites, and on the effects of variations in weather conditions.

SUMMARY

Germination and stocking of white spruce, black spruce and jack pine were studied on three seedbed types created by fire on upland sites in Manitoba. Germination and stocking were higher for jack pine than for either white spruce or black spruce. Seedbed type had no effect on germination but did influence stocking after two growing seasons. In general, stocking was highest on mineral soil, intermediate on humus and lowest on partially decomposed duff. This study indicated that for successful regeneration of the above three species, fire has to be severe enough to expose mineral soil.

SOMMAIRE

Dans les collines du Manitoba, l'auteur a expérimenté sur le taux de germination et sur la jeune pousse d'épinettes blanches, d'épinettes noires et de pins gris. Il s'est servi de trois types de terrains qui, tous, avaient déjà passé au feu. Des trois essences, le Pin gris a produit le mieux. Le type de terrain, s'il n'eut pas d'influence sur la germination, agit sur les pousses de deux ans: en général, celles-ci réussirent mieux dans un sol purement minéral, moins dans le mull, et encore moins dans un moder. Il y a donc lieu de croire que pour favoriser la régénération des trois essences susdites, le sol doit avoir suffisamment brûlé pour que la couche minérale soit exposée.

REFERENCES

Anon. 1960a. Economic atlas of Manitoba. Man. Dept. Industry and Commerce.

_____ 1960b. Report of the meeting of the National Soil Survey Committee of Canada. Ontario Agricultural College, Guelph, Feb. 22 to 27, 1960.

Cochran, Wm. G. and G.M. Cox. 1950. Experimental designs. John Wiley and Sons Inc., New York. Chapman and Hall Ltd., London.

Hills, G.A. 1952. The classification and evaluation of site for forestry. Ontario Department of Lands and Forests, Div. Res., Res. Rep. 24.

Phelps, V.H. 1948. White spruce reproduction in Manitoba and Saskatchewan. Canada Dept. Mines and Resources, Lands, Parks and Forests Branch. Dom. For. Serv., Silv. Res. Note 86.

Rowe, J.S. 1955. Factors influencing white spruce reproduction in Manitoba and Saskatchewan. Canada Dept. of Northern Affairs and National Resources, For. Br., For. Res. Div., Tech. Note No. 3.

_____ 1959. Forest Regions of Canada. Canada Dept. of Northern Affairs and National Resources, For. Br., Bull. No. 123.

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