

TOLERANCE OF WHITE SPRUCE SEEDLINGS  
TO FLOODING ON THREE OCCASIONS  
DURING THE 1966 GROWING SEASON

by

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FOREST RESEARCH LABORATORY  
EDMONTON, ALBERTA  
INTERNAL REPORT A-46

CANADIAN FORESTRY SERVICE  
DEPARTMENT OF FISHERIES AND FORESTRY  
MAY, 1971

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INTRODUCTION

Mortality of white spruce (Picea glauca (Moench) Voss) seedlings on machine-scarified seedbeds occurs on wet sites because of flooding which totally immerses the seedlings. Scarification trials over a soil moisture range in the B-18a Mixedwood Forest Section have emphasized this problem which occurs after snow-melt and after heavy rainstorms during the growing season. The impervious clays of the B<sub>t</sub> and B<sub>g</sub> horizons increase the problem since even on better-drained slopes, the scarified area may be basin-shaped and simply fill with water several times in the growing season. Laboratory tests with 1- and 2-year-old seedlings of white spruce indicated that 14 days' immersion is lethal while a small percentage of seedlings survive shorter and repeated immersions (Lees, 1964). This experiment was conducted to test seedling tolerance to flooding at various times in the growing season, under conditions more closely approximating those in the field.

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## METHODS

Three-year-old natural seedlings of white spruce were lifted from a clearing in a spruce-aspen stand near Smith, Alberta, in early June, 1966. They were transplanted into trays filled with a soil mix of local clay loam and mull humus and watered regularly during a 20-day establishment period. Blocks of 20 trays, each containing 10 seedlings, were then immersed in a tank of local stream water set into the ground under diffuse light from a canopy of juvenile jack pine (Pinus banksiana Lamb.). There were four immersion periods,  $3\frac{1}{2}$ , 7,  $10\frac{1}{2}$ , and 14 days, and treatments were begun on three dates during the season; June 30, July 30, and August 3. At the end of each immersion, five trays (50 seedlings) were lifted from the water and allowed to stand for 8 days, after which survival was assessed by recovery as rewatering continued.

## RESULTS AND DISCUSSION

Table 1 shows percentage survival by date and duration of immersion in the field. Mean survival obtained in earlier laboratory tests are also included for comparison.

Table 1. Seedling percentage survival by date and duration of immersion

Duration of immersion	Date of immersion				Lab. test mean (1964)
	June 30	July 30	August 13	Mean	
Percentage survival					
3½ days	84	92	96	90.7	64
7 days	74	88	90	84.0	34
10½ days	60	72	64	65.3	18
14 days	54	70	52	58.7	0
Mean	68	80	76		

The individual tray dates are further analysed in Table 2.

Table 2. Analysis of variance - numbers of survivors

Source of variation	Degrees of freedom	Sum of squares	Mean square	"F" ratio
Dates	2	15.83	7.915	5.130*
Trays	4	1.26	0.315	.204 N.S.
Main plot error	8	12.34	1.543	
Duration (days)	3	102.93	34.310	21.524**
Dates x duration	6	9.17	1.528	0.929 N.S.
Sub-plot error	36	57.40	1.594	
Total	59	198.93		

\*  $p \leq 0.05$

\*\*  $p \leq 0.01$

N.S. Not significant ( $p \leq 0.05$ )

Survival varied significantly ( $p \leq 0.05$ ) between dates and duration of immersion. Seedlings immersed for 3 to 10 days are better able to tolerate flooding later in the growing season. For longer immersion, tolerance does not seem to depend on date of immersion, but it does not contribute to a significant interaction of dates x duration. For all immersion periods, survival is better than levels achieved in the previous laboratory study where 14 days' immersion killed all seedlings. Conditions under the field study more closely approximate flooding of scarified seedbeds. Water temperatures were lower and water aeration and insolation higher than in the laboratory where tap water was used. However, 10 days under water in the field killed between 28 and 40% of the seedlings. The effect of repeated immersion, which commonly occurs in the forest, was not tested.

#### REFERENCE

- Lees, J. C. 1964. Tolerance of white spruce seedlings to flooding.  
Forest.Chron. 40(2): 221-225.