OLD FIELD PLANTING OF WHITE SPRUCE IN SOUTHERN ONTARIO

R. E. MULLIN
Ontario Department of Lands and Forests
Ontario, Canada

An experiment with white spruce 2-0 and 2-2 planting stock was established in the spring of 1962 on an old field at Midhurst Nursery, about 50 miles north of Toronto. At the time of the experiment, there was a moderate to heavy grass sod, with many weeds. The planting area was level and stone free, and the soil was fresh to moist. Soil tests had indicated a moderate level of organic matter, good levels of P and K, but very low N. The pH was about 5.0 at the time of planting.

The planting stock was obtained from Midhurst Nursery, and the seed source was from the same site region as the planting location (3). The 2-0 was selected from the largest stock available in the seedbeds, and the 2-2 trees were taken from regular shipping supplies. The 2-0 averaged about 7.5-8.0 cm. in top length and 0.7 to 1.0 g. in ovendry weight; the 2-2 averaged 20-25 cm. in top length and 8.0 to 10.0 g. in ovendry weight.

Randomized within each main plot (age-class), there was a control treatment and three site-treatment procedures. In the control, the trees were planted directly in the sod. In the second, the planting area was plowed and cultivated (with disc and harrow) in early spring, about 2 weeks before planting. In the third treatment the sod was shallowly scraped away with a bulldozer blade, and piled in 10-foot strips surrounding the planting area. The fourth treatment consisted of bulldozing as above, followed by plowing and cultivating the bare area. Each of the subplots was 50 feet square and contained 100 trees after planting.

Each of the subplots above contained four randomized sub-subplots which received different treatments. These treatments were a control (no further treatment was applied), an irrigation treatment (with an oscillating lawn sprinkler used to supply irrigation water from an adjacent creek, to supplement rainfall to an average depth of about 1 inch per week from June to August inclusive, in the year of planting only), a fertilizer treatment (agricultural limestone at the rate of 2,000 pounds per acre and ammonium nitrate at 200 pounds per acre, applied as a top dressing 2 weeks after planting), and a combination treat

ment of the irrigation and fertilization treatments, as outlined. Each sub-subplot contained 25 trees.

The planting was done by a crew of eight men on May 2, 1962. The day was cloudy and cool with some light rain. All planting was done by the wedge method. In subsequent years no care or maintenance was given except to cut small invading trees or brush.

A count of surviving trees was made 1 year after planting, and the terminal leaders of all living trees were measured. This process was repeated in the following 2 years to obtain information on the second and third-year growth. In the fall of 1968, at the end of the seventh growing season, a total height measurement was obtained, for all living trees.

Results

The survival percentages have been summarized in table 1, and the data have been separated by age-classes, to show the effects by site treatments and by fertilizer and irrigation treatments within them. The significant main effects in the analysis of variance are shown at the base of each column. The significant interaction terms are indicated at the bottom of the table. The assessment within treatments is shown in detail only for the seventh-year results, in which more detailed statistical comparisons were performed. Similarly the records of the measurements to date on terminal growth and total height and their analyses of variance in terms of plot average, random selection of equal numbers per plot, and unequal frequency adjustments, have been summarized (table 2).

Discussion

Comparison of age classes.-Excluding the planting in sod, because of poor results, the remaining data (interpolated from tables 1 and 2) show that by the seventh year the 2-0 stock had an average survival of 79.7 percent and an average height of 80.0 cm. whereas the 2-2 stock had an average survival and height of 96.3 percent and 168.6 cm. respectively. The seedling stock was therefore much less satisfactory than the transplants. This is in accord with other results in this species (5, 7).

TABLE 1.—*Survival by ages and treatments*

Item	First year	Second year	Third year	Seventh year	
2-0 Planting stock:	*Percent*	*Percent*	*Percent*	*Percent*	
Site treatments—					
1	90.0	66.0	59.6	51.6	a
2	94.0	88.8	83.8	80.8	b
3	85.4	82.0	79.8	78.8	b
4	90.0	86.4	83.2	79.6	b
Average	89.8	80.8	76.6	72.7	
	**	***	***	***	
Fertilizer treatments—					
i	89.2	80.4	76.6	73.8	a b
ii	86.6	76.8	73.0	67.2	a
iii	92.2	85.4	82.2	79.0	b
iv	91.4	80.6	74.6	70.8	a
Average	89.8	80.8	76.6	72.7	
	NS	*	***	*	
2-2 Planting stock:					
Site treatments—					
1	99.2	96.4	94.0	92.6	a
2	99.6	99.6	99.4	96.4	b
3	98.2	98.0	97.8	96.8	b
4	98.2	97.8	97.6	95.8	b
Average	98.8	98.0	97.2	95.4	
	**	***	***	*	
Fertilizer treatments—					
i	99.6	98.6	98.4	97.4	a
ii	99.4	98.4	97.8	96.4	a
iii	97.6	97.2	95.6	93.4	a
iv	98.6	97.6	97.0	94.4	a
Average	98.8	98.0	97.2	95.4	
	NS	*	***	NS	
Interactions—					
Site treatment x fertilizer	NS	NS	NS	NS	
Age x fertilizer	*	*	**	**	
Age x site treatment	NS	NS	NS	**	

* Significant differences in classes at 5.0-percent level.
** Significant differences in classes at 1.0-percent level.
*** Significant differences in classes at 0.1-percent level.
Figures not followed by the same letter are significantly different at the 5.0-percent level or better.

Site treatments.-The site treatment comparisons were made largely on the basis of the results with 2-2 stock, as 2-0 stock growth and survival were insufficient for practical purposes.

In sod planting, the survival and heights of the 2-2 trees were significantly lower at the 7-year stage, than those of other treatments. Previous work (4) has also demonstrated that spruce is a poor competitor in early years.

No statistical differences were found between the remaining three methods of site preparation for the 2-2 stock. All these methods temporarily reduced competition, and some of the increased growth may have been caused by a greater moisture supply for the planted trees (2). The growth on the uncultivated bulldozed area was as good as that on both

TABLE 2.—*Terminal growth and total weights by ages and treatments*

Item	First year leaders	Second year leaders	Third year leaders	Seventh year heights
2-0 Planting stock:	*Cm.*	*Cm.*	*Cm.*	*Cm.*
Site treatments—				
1	3.11	3.98	3.10	63.9
2	3.34	4.90	3.93	78.5
3	3.05	4.66	4.58	80.6
4	3.20	5.19	4.61	80.8
Average	3.18	4.73	4.06	76.0
	NS	**	***	**
Fertilizer treatments—				
i	2.91	4.52	3.94	78.4
ii	2.98	4.51	3.81	74.9
iii	3.29	4.91	4.27	80.7
iv	3.51	4.95	4.44	78.2
Average	3.17	4.72	4.12	77.9
	**	***	NS	NS
2-2 Planting stock:				
Site treatments—				
1	7.46	6.98	4.91	129.5 a
2	7.43	10.02	10.33	175.3 b
3	6.83	7.88	11.24	163.5 b
4	7.30	8.08	10.00	167.0 b
Average	7.26	8.25	9.12	158.8
	NS	**	***	**
Fertilizer treatments—				
i	7.13	7.11	9.39	160.1 a
ii	7.26	7.48	9.28	156.8 a
iii	7.14	8.87	9.02	159.2 a
iv	7.49	8.58	8.97	160.6 a
Average	7.26	8.25	9.17	159.2
	**	***	NS	NS
Interactions—				
Site treatment x fertilizer	NS	NS	NS	NS
Age x fertilizer	NS	***	NS	NS
Age x site treatment	NS	NS	NS	**

* Significant differences in columns at 5.0-percent level.
** Significant differences in columns at 1.0-percent level.
*** Significant differences in columns at 0.1-percent level.
Figures not followed by the same letter are significantly different at the 5.0-percent level or better.

of the cultivated treatments. Hence, cultivation gave little or no improvement in the physical structure of this soil for growth, in contrast to other findings (6). This may be because the experiment was on a sandy loam as opposed to a clay loam for the other study.

The survival and height growth of the trees in the three methods of site preparation, appears extremely good in relation to the averages for several other experiments, in which the usual wedge method in furrows was used (4, 5). This indicates that further direct comparison of these methods, using the wedge in furrows method, should be made. In the meantime the choice between methods must be largely one of cost and convenience.

Irrigation and fertilization treatment.-The comparison of the irrigation, fertilization, and the com-

bination of these two treatments on the sub-subplots is restricted to the 2-2 planting. None of the treatments had a greater survival than that of the control. The differences in survival were of minor significance at the second and third years but were not significant by the seventh year. Similar results were found for the terminal growth.

We hoped that the irrigation and fertilization treatments would have had an effect on reduction of check after planting. The data (table 2) show that the 2-2 trees generally were in check, even for 3 years after planting, as compared with nursery growth in the year before planting. The early indications (table 2) were that the irrigation had a minor influence for improvement of growth, but only in the year it was applied. The fertilizer had a comparatively greater effect but only in the second year. This may have been caused by a prolonged growing period for fertilized trees (1), or to the formation of a better terminal bud at the end of 1962, which caused better terminal growth in 1963. The results indicate that annual application, or use of slow-release fertilizers at longer intervals, might be necessary for any lasting effects.

Literature Cited

1. Armson, K. A.
   1966. The growth and absorption of nutrients by fertilized and unfertilized white spruce seedlings. Forestry Chron. 42 (2): 127-136.
2. Barring, U.
   1965. On the importance of scalping and some other problems connected with planting of *Pinus silvestris* L. and *Picea Abies* Karst. Studia Forestalia Suecica. No. 24 (summary in English).
3. Hills, G. A.
   1960. Regional site research. Forestry Chron. 36(4): 401-423.
4. Mullin, R. E.
   1966. Influence of depth and method of planting on white spruce. J. Forestry. 64: 466-468.
5. ----------
   1968. Comparisons between seedlings and transplants in fall and spring planting. Ontario Dep. Lands and Forests, Res. Branch, Res. Rep. 85, 40 p.
6. Tucker R. E., Jarvis, J. M., and Waldon, R. M.
   1968. Early survival and growth of white spruce plantations. Manitoba, Canada, Dep. Forestry and Rural Development Forest Br. Dep. Publ. 1239. 26 p.
7. Wang, B. S. P., and Horton, K. W.
   1968. An underplanting experiment with white pine and white spruce seedlings and transplanted stock. Forestry Chron. 44 (4): 36-51.