Old-field planting of white spruce

R. E. Mullin

Research Scientist, Ontario Ministry of Natural Resources, Midhurst, Ontario, Canada

In 1963 an experiment was established in an old field to test the planting of white spruce in soil plugs versus bare-root stock; site preparation versus scalping and planting in sod; and 2-0 versus 2-2 stock. The 2-0 stock performed unacceptably. The plugs showed no benefit in survival rate, some in growth but at high cost and considerable damage to the nursery beds. Site preparation was of much benefit, about 12.6 percent greater height at 10 years, at reasonable cost.

Methods

In a series of experiments related to the study of planting check in white spruce *[Picea glauca* (Moench) Voss], an experiment was established in 1963 in which white spruce were removed from the nursery and planted with as little root exposure and disturbance as possible.

The experiment consisted of 5 replications of 10 plots, each containing 100 trees. Each replication was split into two blocks, one for 2-0, the other for 2-2 stock. Within each ageclass block there were 5 randomized plots of the following site preparations and planting methods:

A. hollow-spade, in sod
B. Hollow-spade, in cultivated soil
C. Bare-root, in sod
D. Bare-root, in scalped spots
E. Bare-root, in cultivated soil

The experiment was established on an old-field site at Midhurst -Nursery, about 50 miles north of Toronto. The planting area was level, fresh to moist, a medium to fine sand, with a moderate to heavy cover of grass sod and low weeds. Soil tests indicated a pH about 5.0, moderate organic matter, good levels of P and K but low N.

The stock was selected from nursery beds where the 2-0 averaged about 8.0 cm in top length, 0.26 cm in stem diameter, 0.93 g in oven-dry weight. and 1.94:1 in top-root ratio. In the bare-root lifting a garden fork was used to loosen the soil, the trees were then pulled by hand, packed in wet Sphagnum moss in a cardboard carton and transported to the planting site. The wedge method was used for the planting. In the hollow-spade lifting, a garden trowel was used to remove the tree with a soil plug froth the seedbed with a minimum of disturbance. This Has placed in a round 1-pint ice-cream container for transport to the planting site. At the planting site the process was reversed, a plug was removed from the ground and was replaced by the one containing the tree.

The 2-2 stock was the same as that used for regular shipping. They averaged about 24.0 cm in top length, 0.59 cm in stem diameter, 9.26 g in oven-dry weight and 2.98:1 in toproot ratio. The bare-root lifting was clone in the same way as for the 2-0 stock. For the hollow-spade lifting, special semi-circular spades were made, to remove soil plugs which fitted .5 gallon, round ice-cream containers.

In the cultivated plots, plowing was done on April 25. 1963, followed by repeated discing the same day. In the scalp planting, a sod of about]-foot square was removed. The 2-2 stock was lifted and planted on May I and 2, the 2-0 on May 3 and 7. The plantation has received no subsequent care except for removal of invading trees and shrubs at infrequent intervals.

Results

At the end of the first and second years after planting, the survival and leader lengths (current terminal shoots or replacements) were measured. At the end of the fifth year, survival, total height, and current leaders were measured; and at the end of the tenth year, survival and total height were obtained. This information is summarized in table 1.

The analysis of variance, in terms of angular transformation was used for the survival percentages, and in terms of unequal frequency procedures, and plot averages for the height and leader length information.

Discussion

Comparison of Age-classes

It is evident from table 1 (even more strikingly in the field) that the 2-0 stock performed poorly in comparison with the 2-2 stock. Combining the achievement at 10 years in survival and height, the 2-0 has produced only 92,000 cm of aggregate height per acre (54.8 percent X 1210 trees at 6′ X 6' spacing X 136.1 cm) whereas the 2-2 has produced 224,000 cm of aggregate height.

The second year terminals of both 2-0 and 2-2 are in 'check', but by the fifth year the 2-2 is growing well, while the 2-0 is still very poor. Planting 2-0 trees, which had not received check in the nursery from transplanting, did not show benefit in terms of subsequent growth; the

second check to the transplants was not as restrictive to growth as the severe check in outplanting of smaller trees. The 2-0 trees showed an average yearly growth of only 1.6 cm in the years 2 to 5. whereas the 2-2 showed an average of 1.5 cm in the same period.

Thus it can be considered that the 2-0 has achieved only about 32 per. cent of the aggregate height of the 2-2 planting stock and continues to grow at a slower rate. None of the planting methods tested show any reasonable promise for the use of 2-0 as acceptable planting stock. This is in accord with other studies (2, 3).

Comparison o f hollow-spade and Rare-root Planting

Because of the unsatisfactory performance of the 2-0 stock. the comparison of hollow-spade and bare-root planting will be considered for the 2-2 stock only. The process of scalping offered no significant advantage over planting in the sod t table 11. As there were no significant interactions. the main term effects of hollow-spade (A,B) can be compared with bare-root (C.D.E) . The results are summarized in table 2. The survival rates were not significantly different.

The hollow-spade procedure resulted in better terminal growth than bare-root planting ill the first year but by the second year both methods were overshadowed by check. and no significantly different averages could be shown. However. by the fifth year the hollow-spade procedure showed superior total height, although not statistically significant in the fifth year current growth. At 10 years the hollow-spade method still resulted in better height growth than the bareroot planting. the difference being statistically significant. The difference in height at 10 \-cars is small, about 1).5 percent. and as it was about 12.-1 percent at 5 years it may be diminishing in effect.

The hollow-spade method therefore seems of little promise in general planting in relation to its high cost. and obvious damage to nursery beds. However. potting of trees for replacement planting on research plots has been found a satisfactory procedure (6).

Comparison of Cultivation and Planting ill Sod

The plain term effects of the cultivation procedure (B,E) against sod planting (A.C.D) are also shown in table 2. because there were no significant interactions. Apparently the pro-

Table 1.—Summary of survival, terminal lengths (current leaders) and total heights at 1, 2, 5 and 10 years by age-classes (2–0 and 2–2) and site preparation—planting methods

Age-class	Method	1st yr.		2nd yr.		5th year			10th yr.	
		Surv.	Terms.	Surv.	Terms.	Surv.	Ht.	Terms.	Surv.	Ht.
		percent	cm	percent	cm	percent	cm	cm	percent	cm
2–0	A	71.0	1.96	56.0	3.33	49.2a	37.3a	8.6a	55.4a	117.5a
	B	76.8	1.75	63.6	3.50	54.6a	38.2a	8.2a	55.6a	141.7ab
	C	82.8	2.41	66.8	3.48	59.0a	38.8a	9.0a	58.8a	139.2ab
	D	80.0	2.26	66.0	3.88	44.6a	38.6a	8.5a	45.4a	137.1ab
	E	84.2	2.08	72.8	4.07	59.6a	39.9a	8.8a	58.8a	145.9b
		NS	***	NS		NS	NS	NS	NS	*
	Avg. ..	79.0	2.10	65.0	3.67	53.4	38.6	8.6	54.8	136.4
		**	***	***	*	***	***	***	***	
2–2	A	97.6a	6.99b	95.0a	3.80ab	87.0a	86.8bc	18.1ab	87.0a	273.6abc
	B	98.2a	6.79b	96.4a	4.85abc	89.4a	96.0c	21.3c	88.2a	300.4c
	C	96.4a	5.48a	92.6a	3.77a	85.6a	72.3a	14.9a	84.0a	249.8a
	D	96.6a	5.23a	94.2a	4.01abc	84.0a	79.5ab	15.4ab	82.8a	257.4ab
	E	97.8a	5.58a	94.2a	5.62c	88.2a	91.6bc	20.0bc	87.6a	285.9bc
		NS	***	NS		NS	**	*	NS	*
	Avg. ..	97.3	6.02	94.5	4.41	86.8	85.4	18.0	85.9	273.8
		**	***	***	*	***	***	***	***	***

NS = Not significant.
* = Significant at 5.0 percent level.
** = Significant at 1.0 percent level.
*** = Significant at 0.1 percent level.
No significant interactions.
Figures followed by same letter are not significantly different at 5.0 percent level.

A = Hollow-spade, in sod.
B = Hollow-spade, in cultivated soil.
C = Bare-root, in sod.
D = Bare-root, in scalped spots.
E = Bare-root, in cultivated soil.

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better than small ones. We recommend planting sweetgum seedlings with root-collar diameters greater than .25 inch.

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(Continued from page 4) cedure had no significant effect on survival at any age. However, from the second to the tenth year both terminal growth and total heights were statistically different, usually at the 0.1 percent level or better, with considerable and obvious benefit from cultivation. Ten years after planting, the trees on the cultivated site were about 12.6 percent taller than those of noncultivated sites. This is in accord with other studies of spruce planting (1, 4, 5).

Therefore, in view of the minor cost, there would seem to be considerable benefit from pre-planting cultivation on old-field sites for the planting of white spruce.

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Table 2.—Summary of survival, terminal lengths and total heights at 1, 2, 5, and 10 years, for 2–2 stock only, by main-effect comparisons of hollow spade vs bare-root; and pre-planting cultivation vs. no cultivation

	1st yr.		2nd yr.		5th yr.			10th yr.	
	Surv. percent	Terms. cm	Surv. percent	Terms. cm	Surv. percent	Ht. cm	Terms. cm	Surv. percent	Ht. cm
Hollow-spade ..	97.9	6.89	95.7	4.33	88.2	91.4	19.7	87.6	287.1
Bare-root	96.9	5.44	93.7	4.47	85.9	81.3	16.8	84.8	264.7
	NS	***	NS	NS	NS	*	NS	NS	*
Cult.	98.0	6.18	95.3	5.23	88.8	93.8	20.6	87.9	293.1
Non-cult.	96.9	5.91	93.9	3.86	85.5	79.6	16.1	84.6	260.4
	NS	NS	NS	*	NS	**	**	NS	**

NS = Not significant.
* = Significant at 5.0 percent level.
** = Significant at 1.0 percent level.
*** = Significant at 0.1 percent level.
No significant interactions.