How containers affect tubed seedlings 5 years after planting

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Introduction

Canada is expending a great deal of effort toward containerization of seedlings (2). One of the first methods to gain practical acceptance was the "Ontario" tubeling, a seedling grown in a cylindrical tube 7.6 cm in length, 1.4 cm in diameter, open at both ends, and made of high-impact, non-biodegradable styrene, 0.3 mm thick. Tubes are slit along their entire length, so that they may open and thus release the seedling's roots.

The planting hole is formed with a dibble that has the same dimensions as the tube. The tubed seedling is then dropped in the hole.

To assess the effect of the tube on seedling performance after planting. a planting trial was initiated in 1969 to compare survival and growth of jack pine *(Pinus banksiana* Lamb.) and black spruce *(Picea mariana (Mill.)* 13.S.P.) tubed seedlings planted either with the tube intact or with the tube removed from the root "ball." This report describes the trial and gives survival and height growth of these seedlings 5 years after planting.

Experimental Design

A 2 *x* 2 factorial design was used: the first variable was the planting method (with or without tube) and the second variable was the planting date. Four different planting dates (June 3 and June 17: July 1 and 29) were chosen within the growing season to show whether differences in time of planting were important for survival. There were four replications of 20 trees for each species-planting method-planting date treatment; thus. 1,280 seedlings were planted in all.

Methods

In February 1968, jack pine and black spruce seeds were sown in tubes filled with a mixture of soil, sand, and peat. The seedlings were grown in a heated greenhouse at Quebec for 3 months, with the required watering but with no supplemental fertilizers added. They were then transported in early June 1968 to the Nicauba Research Forest (lat. 49°27'N., long. 74°01' W.. elev. 390 m), where the planting sites were located. During that summer, they were placed in an outdoor shadehouse at the field station and watered from time to time. They were then overwintered at the same location without any protection. As the Nicauba Research Forest and the planting sites are located in the boreal forest, winter temperatures are extremely low (minimum around - 40° F) but the thick layer of snow (1 m) gives good protection against such extreme temperatures.

In June 1969, the seedlings were planted, half with the tube, half without. The mean height of jack pine and black spruce at planting was 5 cm and 3 cm, respectively. The planting site had formerly supported a mixed stand of jack pine and black spruce which had been logged and burned in 1957. This well-drained sandy site was very clean at the time of planting, with little vegetative competition.

Survival and height of the seedlings were measured in September 1969 and August 1973; the results were subjected to analyses of variance to determine effects of treatments.

Results

Percentage survival after one growing season in the field is given in table 1.

Analyses of the data showed no statistically significant differences at the 95 percent level-between tube and without tube treatments-for jack pine and black spruce.

Percentage survival at the end of

*TABLE 1.—Percentage survival after one growing season in the field**

Planting date	Jack pine		Black spruce	
	With tube	Without tube	With tube	Without tube
June 3, 1969	100	100	95	100
June 17, 1969	99	99	92	95
July 1, 1969	100	100	95	99
July 29, 1969	98	100	97	100
Mean	99.25	99.75	94.75	98.50

*Based on 80 seedlings/planting date/species.

*TABLE 2.—Percentage survival after five growing seasons in the field**

Planting date	Jack pine		Black spruce	
	With tube	Without tube	With tube	Without tube
June 3, 1969	80	92	85	82
June 17, 1969	84	90	67	65
July 1, 1969	89	89	66	76
July 29, 1969	77	94	71	64
Mean	$82.50^{(a)}$	$91.25^{(b)}$	$72.25^{(c)}$	$71.75^{(c)}$

*Based on 80 seedlings/planting date/species
When the superscripts are different, there is a significant difference, at the 99% level between tube and without tube treatments.

*TABLE 3.—Height (cm) of seedlings after five growing seasons in the field**

Planting date	Jack pine		Black spruce	
	With tube	Without tube	With tube	Without tube
June 3, 1969	49.5	57.8	17.8	31.1
June 17, 1969	34.9	52.7	26.7	26.0
July 1, 1969	43.8	50.2	19.7	21.0
July 29, 1969	38.7	47.0	21.6	21.6
Mean	41.7 (±22.6)	51.9 (±24.4)	21.5 (±11.0)	24.9 (±11.3)

*Based on 80 seedlings/planting date/species.

the fifth growing season is given in table 2.

The analyses showed no statistically significant differences at the 95 percent level-between tube and without tube treatments-for black spruce but did for jack pine; those trees planted without tubes had a significantly higher survival rate.

Height growth for seedlings after 5 years is given in table 3.

The standard deviations of the means are given in parentheses, indicating that variations from seedling to seedling were substantial. It is, therefore, not surprising that the analyses showed no statistical differences at the 95 percent level-between tube and without tube treatments-for jack pine and black spruce.

Discussion

Survival

Survival of jack pine and black spruce seedlings after one growing season in the field was very good, with and without tube treatments. This could have resulted from favorable climatic conditions through the growing season that year. At this early stage, the only difference between treatments was a small negative effect of tubelings on black spruce.

Monthly values from a local weather station during the 1969 growing season were, for June, July, and August respectively: 74.1° F, 87.5° F, 81.0° F maximum air temperature; 26.5^{0} F, 36.0° F, 36.3° F minimum air temperature; and precipitation of 0.7. 1.1, and 1.8 inches.

After 5 years, the positive effect of tube removal on survival of jack pine was evident and statistically significant at the 99 percent level. However, removal of the tube did not significantly improve the survival of black spruce; this survival after 5 growing seasons remained good, with or without the tube around the seedling's root system.

Fifth-year survival obtained in this experiment was high, probably the result of using older stock that had been overwintered on site. Larger plantations established the following year at the same location, with younger stock that had not been overwintered, gave fifth-year survival of 53 percent for jack pine and 40 percent for black spruce (3).

Height growth

The absence of statistically significant differences in height growth between treatments for jack pine and black spruce is probably due to the large tree-to-tree variation, as shown by standard deviations, amounting to 50 percent of the mean value. However, as jack pine planted without tubes had a mean height growth 10 cm (25 percent) superior to the tube-planted category. the trend indicates a detrimental effect of the tube on height growth. As this effect appeared only after 5 years, and only for jack pine, we concluded that the negative effect of the tube on tree growth may well be more detrimental with time. It is probable that the slower growing black spruce planted in the tube will begin to show signs of reduced growth performance over the next few years. Similar trends, indicating a negative influence of rigid containers on the growth performance of some species, but not on others, has been noted by (I).

Conclusions

After five growing seasons in the field, survival of jack pine and black spruce tubelings was over 70 percent for all treatments. Removing the tube at planting had a statistically significant positive effect on fifth-year survival of jack pine. but not on black spruce. This difference may reflect the greater space needed by jack pine because of its faster juvenile growth.

The height growth of jack pine with the tube removed was 10 cm (25 percent) superior to the growth of tube

plan led seedlings. This difference was not statistically significant, due to large tree-to-tree variation (standard deviation was around 50 percent). On sandy sites such as this, one would expect wildlings of jack pine to be twice the height of black spruce after five growing seasons in the field, which was the result obtained with these container-grown seedlings.

The four planting dates did not result in any significant survival and height growth differences for either species or treatments.

Literature Cited

1. Arnott. J. T.
1973. Evolution of the styroblock reforestation concept in British Columbia. Comm. For. Rev. 52(1): 72-78.

2. Cayford, J. H.
1972. Container planting systems in Canada. For. Chron. 48: 235-239.

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1973. Survie de plantubes resineux en foret boreale. Serv. Can. For.. Centre Rech. For. Laurentides, LAC-X-6, 41 p.

New Publications

(Continued from p .34)

Egging, Louis T.. and David F. Gibson

1974. Helicopter logging: a model for locating landings. Intermt. For. Range Exp. Stn. Ogden, Utah. 36 p. USDA For. Ser. Res. Pap. INT-155

Presented are a model and an accompanying computer program that optimally locate landing areas for a helicopter logging operation. Given a haul road, unit centroids, volumes of timber to be harvested, and helicopter operating parameters. landings are located so as to minimize yarding, hauling, and landing construction costs. The model considers constraints such as areas that are not suitable for landings. and topographical obstacles. Written in FORTRAN IV, the computer program affords several evaluation and output options. Two examples are provided.

Jones. John R.

1974. A spot seeding trial with southwestern white pine and blue spruce. Rocky Mt. For. Range Exp. Stn., Ft. Collins, Colo. 8 p. USDA For. Ser. Res. Note RM-265

Following rodent reduction, 300 seed spots each of southwestern white pine and blue spruce were sown on three mixed conifer clearcuttings. Germination was abundant. Despite favorable slope aspects, absence of heavy herbaceous competition, good cold air drainage, and initial rodent reduction, very few seedlings survived to the middle of the third summer. Major known causes of death were frost heaving. predation, and burial by soil movement. Importance of these factors differed between species. Additional seeding trials should emphasize broadcast seeding.

Nicholls, Thomas If., and Darroll D. Skilling

1974. Control of *Lophodermium* needlecast disease in nurseries and Christmas tree plantations. North Cent. For. Exp. Stn., St. Paul, Minn. 11 p., illus. USDA For. Serv. Res. Pap. NC 110

Presents fungicide and cultural control recommendations for the disease. *Lophodermium pinastri.* which has recently caused serious losses in red pine and Scotch pine nurseries and plantations in the United States and Canada. Written primarily for land managers for use in developing operational control programs.