SHALLOW SAND COVER GIVES BEST GERMINATION OF BLACK SPRUCE SEEDS

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In trials with black spruce seeds sown on organic soil in plastic tubes at four depths of sand cover, maximum germination resulted with the 1/16 in. cover. Germination was inadequate with depths greater than 1/8 in.

The Ontario method of growing tree seedlings in containers is summarized in an official manual (6). The most suitable container has been a white plastic tube, 1/2 in. interior diameter x 3 in., made from high impact styrene and split along one side. Early trials reported by McLean (5) tested red pine *(Pinus resinosa* Ait.) ; in later trials black spruce *(Picea mariana* (Mill) BSP) and white spruce *(Picea glauca* (Moench) Voss) were tested.

In preparation for a large scale sowing of black spruce, some factors affecting germination were tested. Earlier experience at the Ontario Tree Seed Plant, Angus, showed that 1/16-inch was the preferred depth of sand cover for unsorted black spruce seeds in laboratory sand bench germination tests, resulting in normal germination of over 90 percent in 11 days.

The mechanical device used to apply sand cover on seeds in tubes worked better for depths greater than 1/16 in.; therefore, a trial was necessary to demonstrate the need for the shallowest covering, particularly for small seeds. Since a depth of cover greater than 1 / 16 in. was expected to reduce germination of small seeds, it was necessary to emphasize The care needed for the sanding operation. In large scale production, the loss of 10 percent or 20 percent germination due to improper sand cover would be costly and necessitate replacing blank tubes or sowing additional trays.

The Lake States Forest Experiment Station, in 1938, recommended that white and black spruce seed should be sown in nurseries at a depth of 1/8 in. (8). However, the required depth of sowing in nurseries need not be the optimum depth for greenhouse culture, since moisture retention at the soil surface can be controlled more readily in the greenhouse. Fraser and Farrar (3, 4) considered that for their nursery germination trials with jack pine *(Pin us banksiana* Lamb.) and red pine, those treatments which favored a high moisture content in the seed resulted in good germination. In the present experiment, a high moisture content was maintained by placing the trays of tubes in plastic bags during the early germination period.

Experimental Procedure

Black spruce seeds from northern Ontario were sorted into two size classes by sifting through screens with graduated round openings. Large seeds were selected between 0.0500 in. and 0.0625 in.; small seeds were below 0.0500 in. size. In this seedlot the small size class provided 44 percent of the total, and the large size comprised 56 percent. The basic sample unit was 200 tubes in a wooden

TABLE 1.—*Variance ratios for black spruce germination after 21 days, as influenced by seeding depth*

Source of Variation	Degrees Freedom	Sum Squares	Mean Square	F [1]
Replications	1	361.0	—	0.23NS
Treatments	7	—	—	—
1. Large seed : small seed	1	420.3	—	0.28NS
Large Seed				
2. Shallow : deep seeding [2]	1	15 488.0	15 488.0	10.20*
3. 1/16 in. : 1/8 in. depth	1	64.0	64.0	0.04NS
4. 1/4 in. : 1/2 in. depth	1	7 921.0	7 921.0	5.21NS
Small Seed				
5. Shallow : deep seeding	1	25 538.0	25 538.0	16.81**
6. 1/16 in. : 1/8 in. depth	1	380.3	380.3	0.25NS
7. 1/4 in. : 1/2 in. depth	1	5 402.3	5 402.3	3.56NS
Error	7	1 519.0	217.0	—
Total	15	57 093.8	—	—

[1] NS Not significant.
* Significant at 5% level.
** Significant at 1% level.

[2] Shallow = 1/16 in. and 1/8 in. combined.
Deep = 1/4 in. and 1/2 in. combined.

tray, with two replications for each seed size.

An organic soil of well decomposed hardwood litter at pH 5 was loaded in tubes to a depth of 2 in., and the soil wetted by placing trays in shallow water until the surface became moist. Seeds were taken from storage at 40 degrees F. and soaked in tap water at 40 degrees F. prior to sowing. The optimum treatment times, determined beforehand, were 17 hours soaking for small seeds and 7 days for large seeds, with no change of water during the soaking period. Treated seeds were placed by hand, one to a tube, and covered mechanically with a medium-textured, acid sand at four depths: 1 / 16 in., 1/8 in., 1/4 in., and 12 in.

Each flat was placed in a polyethelene bag to prevent water loss, and kept in a greenhouse at a constant 75 degrees F. with a 16-hour photoperiod provided by extending natural daylength. Trays were removed from the bags when a germinant touched the plastic cover.

Results and Discussion

The cumulative germination percent on 11, 13, 17, and 21 days of after sowing is shown in figure 1. The data clearly indicates a decrease in germination with an increase in seeding depth. The variance ratios from a variance analysis for germination after 21 days are presented in table 1.

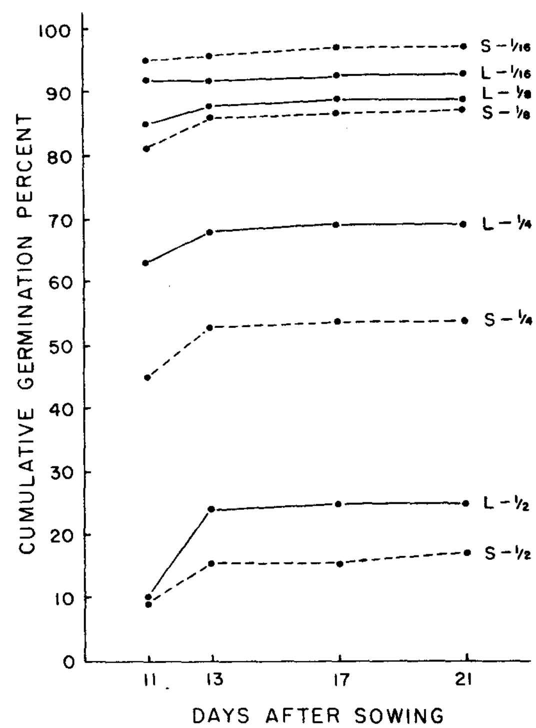

Figure 1.—Percent germination of large (*L*) and small (S) black spruce seeds after seeding at four depths (1/16 in. - 1/2 in.) under greenhouse conditions.

Both seed sizes germinated better when sown with a shallow depth of sand cover. Either 1/16 in. or 1/8 in. was better than 1/4 in. or 1/2 in. There was no significant difference in germination within either seed size between a cover of 1/16 in. and '8 in. However, the 1/16 in. depth of sand appears to give better results than the 1/8 in. depth, regardless of seed size. This difference might be better demonstrated by a larger experiment. Such a difference appears to be more marked with small seed.

The more rapid rate of germination with the shallowest sand cover would be most desirable for tubed seedling culture. The similarity of germination for large and small seeds was contrary to Deen's (1) observation as quoted by Stoeckler and Jones (8), "It has been a general observation that the larger seeds within any seedlot germinate better than others."

Ancillary tests indicated that larger seedling stock resulted from larger seeds, and this favors the use of only larger seeds until a more definite selection can be made of the optimum size for tubed seedling culture.

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