TRANSPLANTS DO BETTER THAN SEEDLINGS, BUT ...

JOHN H. COOLEY [1]

Transplanted conifer stock generally survives and grows better than seedling stock in the Lake States (3). Nevertheless, most species are outplanted as seedlings because the superiority of transplants is not marked enough to justify their extra cost. The major exception is white spruce which, until recently, was commonly outplanted as 2-1 or 2-2 stock.

A test comparing these two classes of stock with 3-0 seedlings shows that transplanting and holding white spruce 1 year in the transplant bed materially increases its chance for survival in the field, but holding the stock for a second year after transplanting increases its chance for survival little, if at all. Seedlings that reach a height of 8.6 inches or more after 3 years in the seedbed survive nearly as well as either 2-1 or 2-2 transplants of equivalent size and grow about as fast as transplants.

Here is What we Did

The test was begun in the spring of 1964 using stock grown at the Chittenden Nursery in Michigan from seed collected locally. Seedlings were grown at an average density of 55 plants per square foot, and transplants were lined out at about 9 plants per square foot. All stock was lifted on the same date, damaged and abnormally small plants were discarded, and those acceptable were placed in cold storage until planted.

Plantings were made in two locations, different as to soil and cover as well as site preparation and planting methods. At one location the soil was classified as Kalkaska with a well developed Bhorizon. The cover was predominantly low shrub species and grass with practically no high brush or trees to compete with the planted trees. There was no site preparation, but the trees were planted with a machine that opened a furrow ahead of the shoe.

At the other location the soil was classified as Montcalm with a day layer at about 3 feet. The site was disked and trees were planted by hand. There was no direct competition at the time the trees were planted, but within 2 years aspen suckers and sumac were overtopping the white spruce on part of this area.

At each location the stock classes were assigned at random to an equal number of rows in each of three blocks. Three hundred and fifty plants of each class were planted at one location and 150 at

1 Silviculturist, stationed at the Northern Hardwoods' Laboratory, maintained at East Lansing, Mich., by the North Central Forest Experiment Station in cooperation with Michigan State University.

the other on May I and May 4, respectively. The weather was favorable during and immediately after planting, the sky generally overcast and enough rainfall to maintain moisture throughout the soil profile.

In early June 1964, the total height of each tree was measured. The 3-0 seedlings averaged 6.4 inches, but 58 percent were less than 6 inches tall so that they would have failed to meet the minimum height specified for conifers in the American Standard for Nursery Stock (1). The 2-1 transplants averaged 5.6 inches and 54 percent were less than 6 inches tall, while the 2-2 transplants average 10.1 inches tall and only 8 percent were below the minimum of 6 inches.

On five trees in each row, a total of 80 plants in each stock class, stems were calipered 1 inch above ground at the same time heights were measured. The height distribution of this subsample was nearly the same as for the entire sample; i.e., 57, 54; and 10 percent of the 3-0, 2-1, and 2-2 stock, respectively, was under 6 inches tall. Yet only six plants, all 3-0 seedlings, had a caliper of less than 3/32-inch, the minimum caliper specified in the standard. All plants that were at least 6 inches tall met the minimum stem caliper specified for their respective height classes.

In mid-August 1964, total height and stem caliper were measured on all surviving trees, and height measurements were repeated a third time in late October 1965.

Here is What we Found

Within each stock class, survival during the first two growing seasons varied with initial height, but the trend was most apparent for 3-0 seedlings (fig. 1) . Transplants 10.5 inches tall or less survived better than seedlings of the same size, but those that were more than 10.5 inches tall survived little better, or not as well as, seedlings of equal size. Since only a small proportion of the seedlings were this size, their overall survival was less (table 1) . The 2-2 transplants had better average survival than 2-1, but this difference was not statistically significant.

Mortality in all stock classes tended to be greater among plants with small stems, but the critical size was smaller for seedlings than for transplants. There was no mortality among 3-0 seedlings with caliper of 7/32 inches or more, but 13 percent of the 2-1 transplants of equivalent size died as did 16 percent of the 2-2 transplants.

TABLE 1.—*Survival and height growth of three classes of white spruce planting stock during the first two growing seasons after planting*

Stock class	Survival	Height growth
	Percent	*Inches*
3–0	56	2.6
2–1	79	2.9
2–2	84	3.1

On the average, transplants grew more than seedlings, and 2-2 transplants more than 2-1, but these differences were small and not statistically significant. Initial height had no discernible influence on height growth during the first two growing seasons, but differences may develop later. Brace (2), working in Canada, found that during the first nine growing seasons the increase in growth rate of 2-2 transplants was related to their initial height even though growth was about the same for all sizes during the first 2 or 3 years.

Is Transplanting White Spruce Necessary?

The most obvious conclusion to be drawn from this test is that transplanted white spruce stock will survive better than seedling stock and, where there is little competition, 2-2 transplants are only a little better than 2-1. However, 80 percent of the 3-0 seedlings, at least 8.6 inches tall survived, suggesting that wider spacing, fertilizing, root pruning, and culling small seedlings developed seedling stock that would survive as well as transplants.

In this study, growth rate was so slow in seedbeds with 55 plants per square foot that only a small proportion of the seedlings were large enough after 3 years to assure good survival. Perhaps more would have been acceptable if there had been only nine plants per square foot, as in transplant beds. But such a low density might take up too much nursery space. Somewhere between these two extremes there

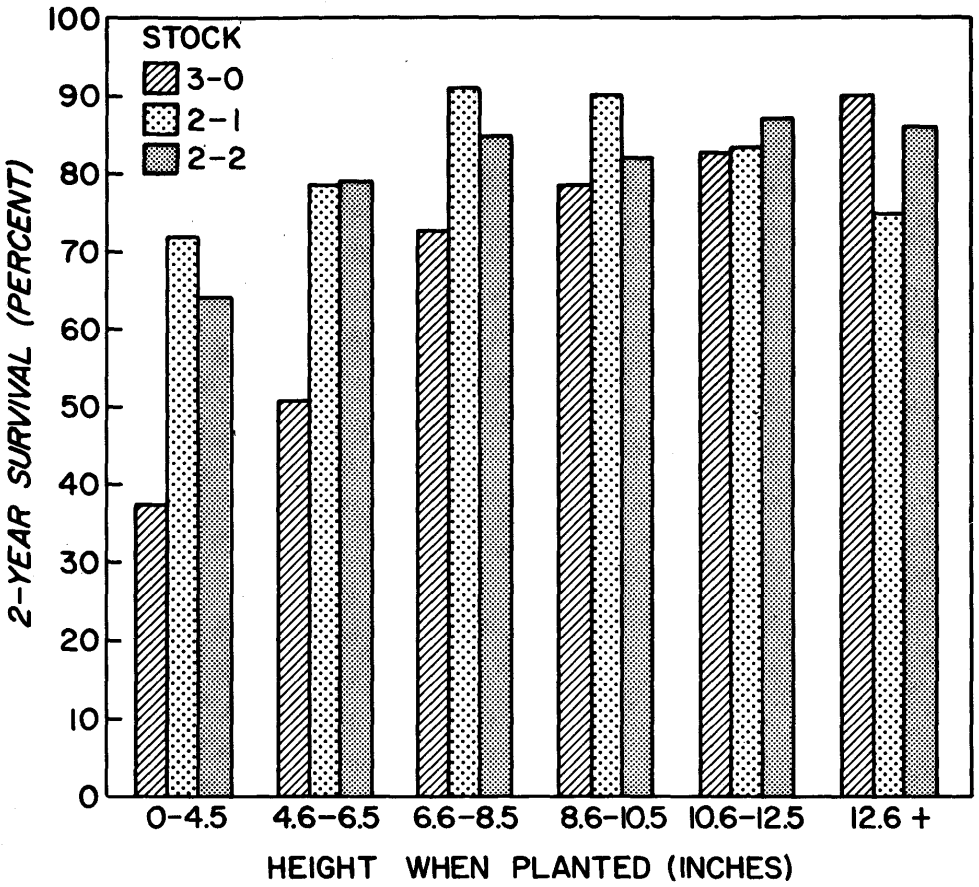

Figure 1.—Survival of white spruce during the first 2 growing years.

must be an optimum that could be established by additional testing.

Heavier fertilization should also be considered as a means of increasing growth rate in the seedbed.

Aside from transplanting, root pruning is the only proven method of developing compact root systems. This study does not reveal the relative merit of the two methods, but root pruning is standard practice now, and it seems reasonable to expect that root pruning would be essential if seedbed density were reduced and transplanting eliminated. In fact, it would probably be necessary to prune vertically as well as horizontally.

More severe culling would probably be the most controversial modification of current practice because it seems wasteful to discard 3-year-old trees. Apparently survival would be high if all seedlings less than 8.6 inches tall were culled, and satisfactory if seedlings down to 6.6 inches tall were retained as long as those with stem caliper of less than 7/32 inches were discarded. These specifications substantially exceed those given by both Stoeckeler and Jones (4) and The American Association of Nurserymen, Inc. (1) but should not increase costs if appropriate steps were taken to increase growth rate. According to Stoeckeler and Jones (4), 20 per-

cent would normally be discarded if 2-0 seedlings were left in transplant beds for 1 year, and they estimate cull in 2-1 transplants at 15 percent. So a loss of at least 30 percent could be expected if 2-1 transplants were used. If stock were outplanted as 3-0 seedlings, something more than 30 percent could be discarded without increasing cost per planted seedling because there would be no cost for transplanting.

One alternative to severe culling might be to transplant 3-0 seedlings that do not meet minimum specifications and outplant those that do. Another possibility would be to outplant smaller seedlings on the more favorable sites and to use larger seedlings where conditions are adverse. Additional study would be necessary to test these possibilities.

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