Root Pruning of Bareroot White Spruce Planting Stock Does Not Affect Growth or Survival After Six Years

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Pruning roots of bareroot white spruce planting stock to as short as 10 cm before planting had no effect on survival. Effects of pruning on growth were small in the first year after planting and had diminished 5 and 6 years later. Tree Planters' Notes *43(1):4-6; 1992.*

Many bareroot nurseries endeavor to produce planting stock with compact, readily plantable root systems using nursery bed root-culturing treatments such as undercutting, root wrenching, and lateral root cutting (Daniels and Simpson 1990). Even with root culturing, however, long lateral roots often grow within the drill rows. Seedlings with long roots are more difficult to plant and may be more prone to root deformation.

It is therefore common practice after lifting to prune the roots of bareroot seedlings. Root pruning may remove many root tips, thus reducing root fibrosity; in some cases it can result in reduced root growth potential (Simpson unpublished data). As well, seedling root-to-shoot ratios are decreased by pruning. These factors are usually associated with decreased stock quality and field performance.

This experiment was undertaken to determine if root pruning bareroot white spruce planting stock would affect survival and growth after outplanting.

Methods

In mid-June 1985, two types of white spruce planting stock were taken from cold storage (- *2 °C)* and used in this experiment. Plug-transplant stock had been raised in 1983 as 1 + 0 container-grown stock at Ruff's Greenhouses, Prince George, BC, then stored overwinter (- *2 °C)* and transplanted in the spring of 1984 in the bareroot nursery beds of Industrial Forestry Service Ltd.'s Ness Lake nursery near Prince George, BC. These seedlings were lifted from the nursery bed in October 1984, packaged, and stored. Conventional 2 + 0 bareroot white spruce seedlings were produced at the British Columbia Forest Service Surrey Nursery near Vancouver, BC; they were sown in spring 1983 and lifted to storage in December 1984.

The planting stock, although stored frozen (- 2 °C) for most of the winter, was thawed (to + 2 °C) almost 3 weeks before planting. One day before planting, 625 seedlings of each stock type were divided into 5 groups of 125 seedlings and randomly assigned to one of five treatments. Root pruning to 25, 20, 15, or 10 cm below the root collar was done on bundles of seedlings using a sharp meat cleaver. A control group was left unpruned. Thus, the trees with the least amount of roots left were those in the 10 cm group. This method of pruning is common in bareroot nurseries and although some variation in root length results, root drying, which might occur if roots were individually pruned, is reduced.

The seedlings were outplanted on a vegetation-free site, formerly the Northwood Pulp and Timber Co.'s Willow Canyon bareroot nursery, 20 km east of Prince George. The soil throughout the planting site is a deep sandy loam. Moisture stress during the growing season is uncommon at this site because it receives ample precipitation during the growing season. The June-September average for 1950-1980 was 254 mm (10 inches).

The seedlings were outplanted in a randomized block design with five blocks. Within each block, each treatment was outplanted as a row of 25 seedlings. The spacing between rows was 2 m while spacing between seedlings within rows was 1 m.

Terminal shoot growth of each seedling was measured at the end of the first growing (FY GRO) season, and the total height of each plant was measured after the seedlings had 5 (YR 5 HT) and 6 (YR 6 HT) field growing seasons. Terminal shoot growth in the 6th growing season (YR 6 GRO) was determined by subtracting YR 5 HT from YR 6 HT. As the amount of growth can be affected by the size of the trees, the relative shoot growth (RS GRO) in the 6th year from planting was determined as (1/YR 6 HT) x (YR 6 HT - YR 5 HT) x 100% = RS GRO.

Growth data for each stock type were subjected to a one-way analysis of variance (ANOVA on file with author) and where treatment effects were significant differences between means were tested using Duncan's multiple range test (a = 0.05).

Results

Pruning roots of plug-transplant or conventional 2+0 bareroot white spruce seedlings had no effect on survival 6 years after outplanting (table 1). First growing season shoot growth of both stock types was significantly ($P <_ 0.05$) affected by root pruning such that growth was reduced the most in the most severe treatments (table 1). Although the treatment effects were statistically significant, the greatest treatment differences were in fact rather small (1.4 cm for plug-transplant and 0.6 cm for 2 + 0 bareroot).

Total seedling height after 5 and 6 growing seasons from planting as well as actual and relative (percent) terminal shoot growth in the 6th growing season was slightly but not statistically significantly affected by the most severe root pruning of either stock types.

It is clear, for these field conditions at least, that apart from a slight reduction of first-year shoot extension, pruning of white spruce bareroot planting stock (plug-transplant or traditional 2 + 0) has no effect on growth of seedlings for at least 6 years from planting.

Discussion

Root pruning plug-transplant or 2 + 0 bareroot white spruce planting stock even to what seems an extreme degree (10 cm below the root collar) has a very minor effect on field performance. The small, albeit statistically significant, reduction in first field season shoot growth due to root pruning is unlikely to be of practical significance. It is clear that, at least under the field conditions experienced in this experiment, the pruned root systems of plug-transplant or bareroot white spruce were able to provide sufficient moisture during the early growing seasons so that mortality did not occur and growth was only slightly impaired. In a similar study with Douglas-fir (Hermann and Lavender 1976), root pruning of 2 + 0 and 2 + 1 bareroot stock to as short as 12.5 cm did not affect survival on "favorable sites"; however, on "moderate" and "severe" sites, root pruning the smaller 2 + 0 stock reduced survival. It is unclear what the results of the present experiment might have shown had the outplanting environment been more stressful. Planted spruce seedlings are known to regenerate adventitious roots (Coutts et al. 1990), which might replace lost nursery roots and thus minimize the potentially adverse effects of root pruning. Blake (1983) found that pruning to reduce root area by as much as 75% had no effect on measured root area after 6 weeks of growth. Thus in his experiment, root pruning prior to planting substantially stimulated new growth such that no effects on water relations or drought resistance were evident.

Application

White spruce bareroot (2 + 0 or plug-transplant) planting stock can be root pruned to facilitate easier planting without adversely affecting short-term field performance on moist planting sites. Longer term effects of root pruning on root form and tree stability of white spruce as well as interactions) between root pruning and planting site stresses will require further consideration.

Table 1—*Effects of root pruning on growth and survival of white spruce*

Depth of root pruning (cm)	FY GRO (cm)	YR 6 GRO (cm)	YR 5 HT (cm)	YR 6 HT (cm)	RS GRO (%)	YR 6 Survival (%)
Plug transplant						
Control	6.4 a	10.2	73.6	83.8	14.4	99
25	6.5 a	8.5	74.4	82.9	11.8	98
20	6.1 a	9.5	73.3	82.7	13.3	98
15	5.6 b	9.8	72.5	82.3	13.6	98
10	5.1 c	9.2	69.6	78.8	13.5	96
Bareroot						
Control	3.7 a	10.0	68.4	78.4	14.8	96
25	3.4 ab	8.8	65.5	74.3	13.8	98
20	3.2 b	8.2	66.5	74.8	13.4	93
15	3.2 b	8.4	66.0	74.4	13.6	97
10	3.1 b	8.1	65.3	73.4	13.5	92

Means followed by the same letter(s) are not significantly different ($P \leq 0.05$). FY GRO = first year's growth, YR 6 GRO = terminal shoot growth in year 6, YR 5 HT & YR 6 HT = total height growth after 5 and 6 years, RS GRO = relative shoot growth in year 6.

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