FOREST PRACTICES

Silviculture Practices Section

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SILVICULTURE NOTE 29

EFFECTS OF STOCK TYPE ON SEEDLING PERFORMANCE IN THE NORTHERN INTERIOR OF BRITISH COLUMBIA: TWENTY-YEAR RESULTS

Introduction

In the late 1970s, trials were established in the northern interior of British Columbia to investigate alternative regeneration methods and the suitability of different forms of seedling stock on brush-prone sites. This report summarizes the 20 year results of four of the planting trials[1] in the Prince George Forest Region, where the effects of stock type and size on tree survival and growth were investigated.

Site Descriptions

The four study locations—Gleason, West Torpy, Sande, and Severeid—are within 15 km of each other, approximately 100 km east of Prince George in the northern interior of British Columbia. The Sande location had two sites planted in consecutive years (i.e., Sande 78 and Sande 79). Site histories and descriptions are shown in Table 1.

The Gleason site had relatively minor competing vegetation following harvest, but alder (*Alnus tenuifolia*) seeded in and became a serious competitor five years after harvest. Likewise, alder became a serious competitor later at West Torpy, though not to the same extent as at Gleason. West Torpy is located in a pronounced frost pocket.

The Severeid site represented backlog conditions because, immediately following harvest, a prescribed burn failed and vegetative competition quickly established. The planting trial was established three years after clearcutting, by which time dense brush was 80+ cm tall. Later competition from alder was minor. The trial site was accidentally sprayed with herbicide fourteen years after planting.

Methods

Six types of interior spruce seedling stock were compared (Table 2).

The 2+1 stock used in this trial was three-year-old stock that did not undergo grading after the second year of growth and prior to transplanting. At final lifting, the 2+1 and 2+0 stock were graded by height for this study. Of the 2+1 stock, only the largest 20% (2+1 L) and the smallest 20% (2+1 S) were used, and only the middle 60% of the 2+0 stock was used (2+0 M). The 2+1 L stock was very large and twice the fresh weight of the 2+1 S stock. The container-grown seedlings were conspicuously undersized at the time of planting, especially

[1] The trials were established by Bob McMinn, now retired, who was a research scientist at the Pacific Forestry Centre of the Canadian Forest Service in Victoria, B.C.

Table 1. Site descriptions

	Gleason	West Torpy	Sande		Severeid
Harvested	winter 1978/79	winter 1977/78	winter 1977/78		winter 1974/75
Planted	spring 1979	spring 1978	spring 1978	spring 1979	spring 1978
Brushed (glyphosate)					1992
Regen delay (y)	<1	<1	<1	1	3
Biogeoclimatic classification	SBSvk 01, 06	SBSvk 01, 06	SBSvk 01, 05, 06		SBSvk 01, 05, 06, 10
Soil texture	loam	silt loam	sandy loam		loam
Aspect	south	flat	north		north
Elevation (m)	855	790	700		840
Competing vegetation	alder, willow, thimbleberry, twinberry, bracken	willow, cow parsnip, twin-berry, stinging nettle, alder	twinberry, cow parsnip, thimbleberry, fireweed, stinging nettle		stinging nettle, twinberry, cow parsnip
Assessments (years after harvest)	2, 3, 4, 5, 15, 18, 20	1, 2, 3, 5, 17, 19, 20	1, 2, 3, 5, 16, 19, 20	1, 2, 3, 4, 5, 15, 18, 20	3, 5, 9, 10, 15, 20

Table 2. Stock types used in the study

		Height (cm)		Root collar diameter (cm)		Root mass (g)	
Stock type	Description	1978[a]	1979	1978	1979	1978	1979
Bareroot[b]							
2+1 L	Largest 20% of transplant bareroot	33	24	0.84	0.72	6.5	4.6
2+1 S	Smallest 20% of transplant bareroot	20	19	0.59	0.54	3.8	2.6
2+0 M	Middle 60% of bareroot	17	20	0.35	0.32	0.8	0.5
Container[c]							
415A	Plug 8	21	22	0.30	0.25	0.3	0.6
312A	Plug 4	19	20	0.25	0.21	0.3	0.4
211A	Plug 2	13	16	0.18	0.17	0.2	0.2

[a] West Torpy, Severeid, and Sande 78 were planted in 1978; Sande 79 and Gleason were planted in 1979.

[b] Bareroot stock is graded operational stock.

[c] Container stock is unsorted operational 1+0 Styroblock® stock.

regarding root mass. Some culling of the container stock was done at the nursery to remove the poorest quality plugs.

Among bareroot and container stock, the larger stock types had higher root-growth capacities than the smaller types.

Randomized block designs were used on the five separate sites, which were not similar enough to be considered replicates. Plots consisted of 50 seedlings planted in lines at 3 m spacing, each line being replicated five times. Planting was carried out in the spring of 1978 and 1979. Assessments for height and diameter were conducted at different years and ages for the different sites (Table 1).

Results and Discussion

The largest differences among stock types were expressed in terms of mortality. High early mortality of small bareroot stock occurred at four sites (Figure 1). Bareroot stock—which had been lifted, root pruned, and cold stored—was more susceptible to stress at planting than container stock whose roots were more intact and less prone to desiccation. The lowest mortality was observed with 415A and 2+1 L stock types, and the highest was generally observed with the 2+0 M stock type. Mortality of the 2+0 M stock type was so high at Severeid that later monitoring was discontinued.

Seedling performance generally improved with increasing stock size for both bareroot and container stock. Twenty years after planting, differences between the largest and smallest stock were generally significant for mortality, height, root collar diameter, and volume of both bareroot and container stock (Figures 1, 2, and 3; data not shown for volume). Many of the relative rankings by root collar diameter at year 3 persisted through to the year 20 measurements.

The best overall performance was achieved with the 2+1 L stock, which consistently had the highest rankings for height (Figure 2), root collar diameter (Figure 3), and volume. At the last assessment, root collar diameter and volume were significantly greater for the 2+1 L than other stock types at four sites, and height was significantly greater at three sites. Measurements made on a subset of seedlings prior to planting showed the 2+1 L stock was initially larger than the other stock types in terms of height, root collar

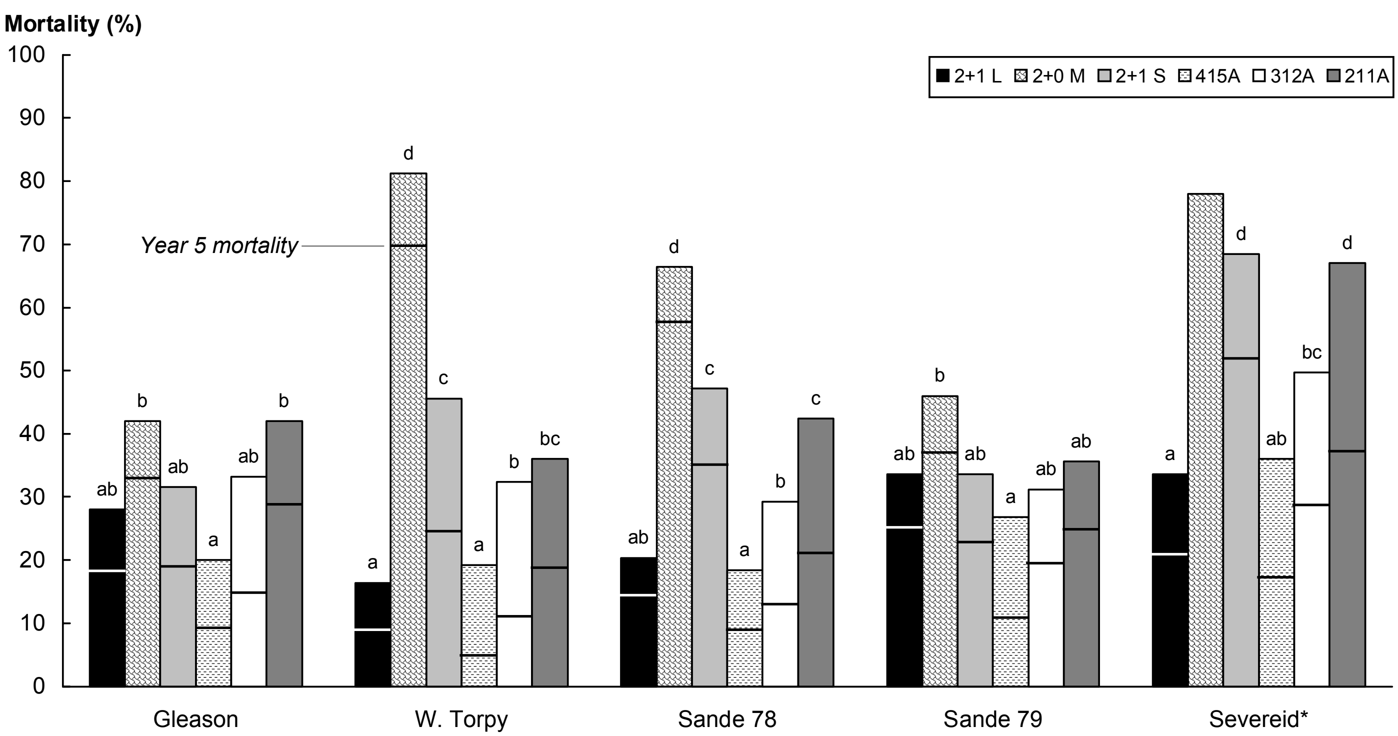

Figure 1. Mortality of interior spruce stock types by year 5 (horizontal line through bar) and year 20. Twenty-year means with the same letter at each site are not significantly different. *2+0 stock type for the Severeid site shows year 5 mortality only.

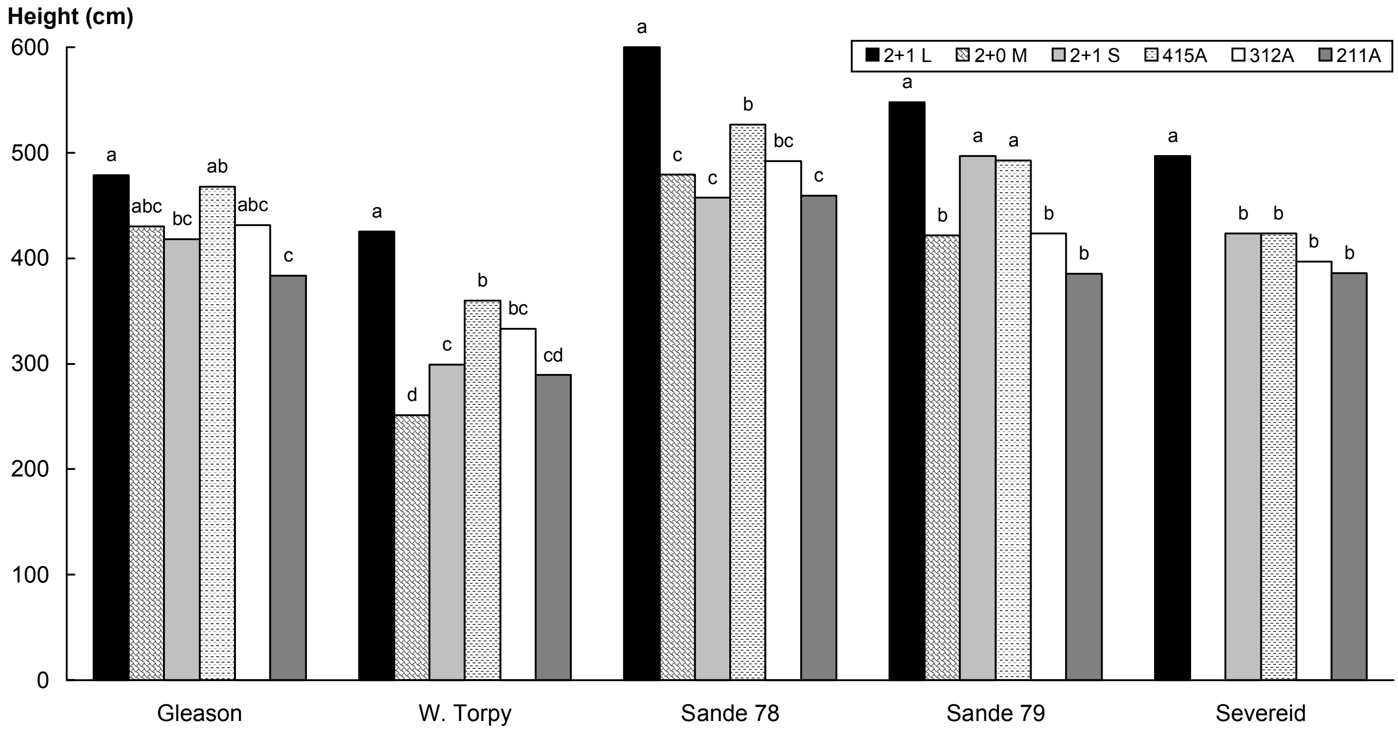

Figure 2. Height of interior spruce stock types by year 20.

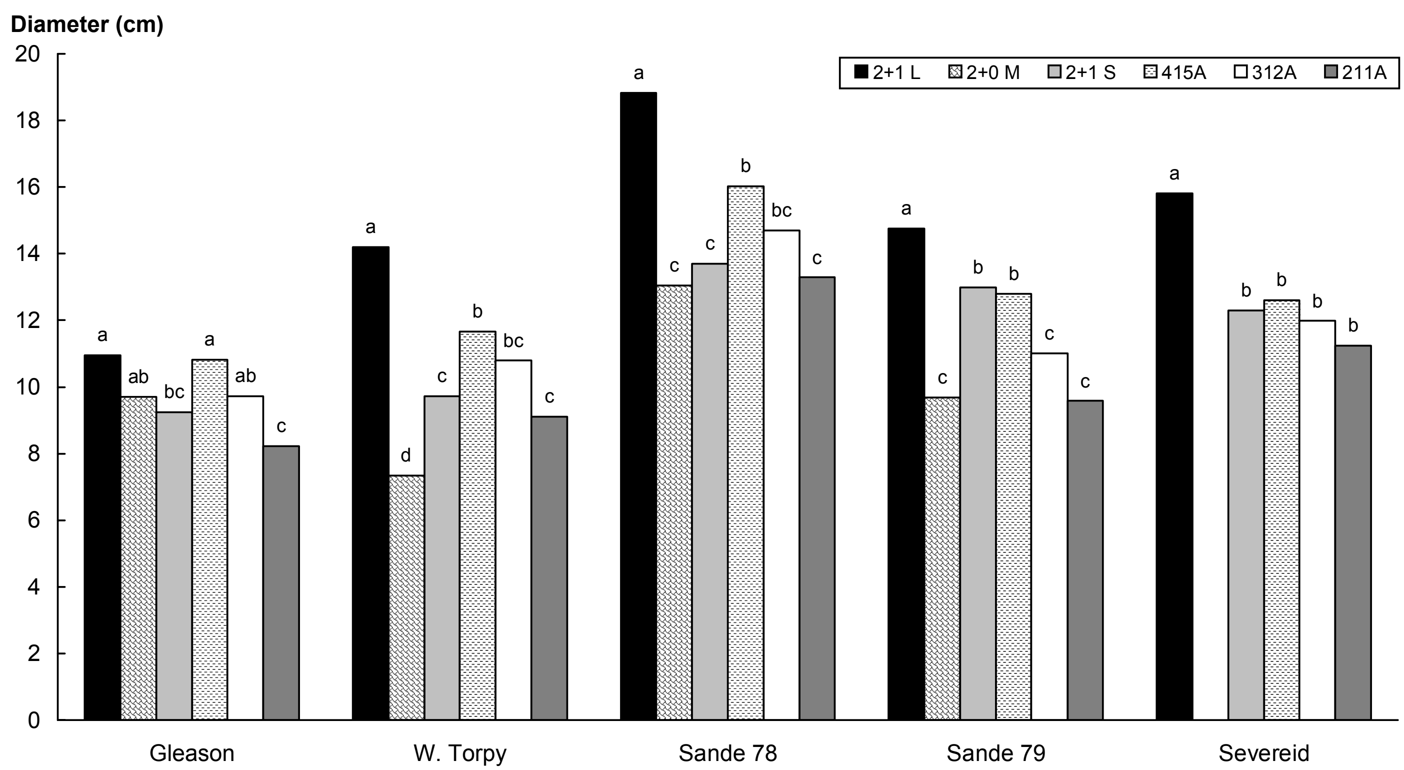

Figure 3. Diameter of interior spruce stock types by year 20.

diameter, volume, and mass (Table 2). It appears that initial size differences were retained through the trial period, but covariance analysis would be necessary to confirm this. Unfortunately, that analysis is not possible because a full set of measurements was not taken at the time of planting.

Both stock type and stock size affected seedling growth. Container stock had smaller initial volume for both planting years, but the 415A stock out-performed the 2+1 S and 2+0 M stock on most sites in terms of survival, height, stem volume, and volume/ha (except at Sande 79). Trends in stock performance were less consistent in the poorer performing stock types, although the 211A and 2+0 M had the lowest ranking heights and volumes.

Although formal vegetation measurements were not made, subjective observations suggest brush was an important factor affecting seedling development over both the short and medium term. The 20 year results for overall height and volume were lowest at Gleason and West Torpy where alder became a serious competitor. Height and volume at the Sande 79 site were consistently less than at the Sande 78 site for all measurement years. The extra year in regeneration delay increased the vegetative competition hazard, which in turn impaired seedling development for the Sande 79 seedlings. The 2+1 L stock was the only one large enough to overcome the brush on the backlog site at Severeid. Heavy alder invasion in portions of the Severeid, Gleason, and West Torpy sites probably impaired the growth of trees, regardless of stock type.

By year 20, it was expected that growth rates would be similar for all stock types because, over time, the effects of stock size would diminish and site influences would predominate. It is difficult to discern if the effects of stock type and size are still evident on height increment after 20 years because of weevil damage and alder competition. Weevil populations may persist until trees are nearly 30 years-old in northern ecosystems. Growth rates of the 2+1 L stock seemed to be increasing compared to the other treatments at West Torpy, and growth rates of the 211A stock were decreasing at Gleason compared to other treatments after 20 years.

When interpreting the results of these data it is worthwhile to consider that nursery techniques have improved considerably since the late 1970s. The 415A and 312A stock types are no longer produced, and the 211A type is not available for spruce. Comparable 415B, 312B, and 211B stock today would have considerably larger caliper and root mass than the stock used in these trials.

Differences in seedlot may have affected comparisons of the 2+0 M stock type with other treatments in 1978, and comparisons between the 1978 and 1979 treatments.

Sorting the bareroot seedlings by size prior to planting may have resulted in stock with genetically based differences in growth rate being grouped into the large or small stock batches. Some of the large stock (2+1 L) may have been very large at the time of lifting from the nursery bed because of its genetic capacity for superior growth rate. The benefits of possible genetic superiority would have been in addition to the general ability of large seedlings to withstand the effects of competing vegetation. Conversely, the small stock (2+1 S) may have been slow growing for genetic reasons, as well as because of the effects of competing vegetation.

The very large initial dimensions and mass of the 2+1 L stock, combined with a possible genetic benefit due to sorting, provided the 2+1 L stock with a considerable advantage compared to the other stock types. The overall performance of the 415A stock type, as expressed by volume, is impressive considering its relatively small size at the time of planting.

Conclusions

The results of this study support the benefits of using large stock. Seedling performance generally improved with increasing stock size for both bareroot and container stocks. The best overall performance was observed with the 2+1 L bareroot transplant stock. The very large initial dimensions and mass of the 2+1 L stock, combined with a possible genetic benefit due to sorting, provided the 2+1 L stock with a considerable advantage. The large container stock performed better than the small bareroot stock. The overall performance of the 415A stock type, as expressed by root collar diameter and volume, is impressive considering its relatively small size at the time of planting. Many of the rankings by root collar diameter and volume observed at year 3 persisted through to later measurements.

Delays in planting increased vegetative competition, which in turn impaired seedling development. Seedling performance declined progressively with the one and three-year regeneration delays. Mortality patterns differed between bareroot and container stock. The majority of bareroot mortality occurred rapidly in the first few years, whereas mortality of container stock was more gradual over many years.

References

Hunt, J.A. and R.G. McMinn. 2000. Effects of stock type on tree growth in the northern interior of B.C.: Twenty-year results. B.C. Min. For., For. Prac. Br., Victoria, B.C. Project file.

For more information

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