EFFECT OF METHOD AND DENSITY OF SOWING ON DOUGLAS-FIR SEEDLINGS

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Density in nursery beds has an important effect on the quantity, size, and uniformity of planting stock, and on the proportion of seedlings that fail to meet planting specifications. While it is a primary objective to produce the maximum number of plantable seedlings per square foot, the cost of their production and the efficient use of seed must be considered carefully in formulating nursery practices.

To study the effect of broadcast and drill sowing at various densities on the yield and morphology of 2 + 0 Douglas-fir seedlings, Mr. R. van den Driessche established a designed experiment at Duncan and Campbell River nurseries in the spring of 1961. Sowing rates were varied to obtain approximate densities of 10, 30, 50, 70, and 90 seedlings per square foot at the end of the first growing season (actual densities of 11, 30, 50, 62, and 84 seedlings per square foot were counted in sample plots).

Just before the end of two full growing seasons, shoot and root lengths and dry weight of 25 seedlings per treatment were measured in each replication in July 1962. This analysis [1] showed that growth was much affected by density in the seedbed. At Duncan reduction in density from 55 to 29 seedlings per square foot resulted in an increase of 77 percent in seedling dry weight; at Quinsam reduction in density from 69 to 31 seedlings per square foot resulted in an average increase of 50 percent in seedling dry weight. The increase in dry weight with a relatively small increase in shoot length produced more robust seedlings with large stem caliper. There seemed to be no difference between seedlings produced by drill or broadcast sowing.

In February 1963, after two full growing seasons, all seedlings were lifted from experimental beds, and the number of plantable seedlings and culls were tallied by sowing method and density. Culling was based on the interim minimum standards used in British. Columbia Forest Service nurseries (Revel 1962). Ten plantable seedlings from each treatment were selected at random, and their shoot and root lengths, root volumes, and stem diameters were measured. It was considered more valuable to study the size and field performance of seedlings which met the minimum planting standard, so morphological assessment was not made on "bed-run" plants (no culling).

Seedlings which had been broadcast-sown at all but the lowest density at each nursery were planted in a random block design near Lake Cowichan. After one growing season measurements were taken to determine if their size in excess of the minimum standards would affect their survival and initial growth in plantations.

[1]R. van den Driessche. Final Report EP 564. Un published manuscript: British Columbia Forest Service Research Division, Victoria, British -Columbia. 1962.

Results

When equivalent densities per square foot were compared, there was little difference in yield and size of seedlings between methods of sowing at either of the nurseries. Therefore, data has been evaluated as average for both methods and both nurseries (tables 1 and 2).

The yield of plantable 2+0 seedlings per square foot was 7.4 at a sowing rate of 11.5 viable seeds per square foot and 41.9 at a sowing rate of 106.5. Corresponding changes in sowing rate increased the percentage of cull seedlings from 12.4 to 47.7. At a sowing rate of 11.5 viable seeds per square foot, 1.55 viable seeds produced one plantable seedling; whereas, at a sowing rate of 106.5 viable seeds per square foot, 2.54 were required.

Shoot and root lengths did not vary greatly with density. With decreased density of sowing, regardless of sowing method, differences in stem diameter and root volume of plantable seedlings were not significant until sowing rates were 35.1 viable seeds per square foot or less. Although these seedlings had significantly larger stem diameters and root systems, they did not survive better than those grown at higher densities.

After one year in the plantation, differences in survival and initial growth were not significant between seedlings grown at 30, 50, 62, and 84 per square foot.

Discussion

Perhaps the most important finding of this study is the effect of density on the amount of seed required to produce a plantable seedling. At present, seed resources are a major concern to therefore station program. In the future, maximum utilization of seed will become more critical especially where high-cost elite seed is used. This study has demonstrated that decreased density in beds will significantly improve seed utilization.

TABLE 1.--Yield of 2+0 Douglas-fir seedlings per square foot in relation to seedbed density [1]

Seedling density (after one growing season)	Seedlings and culls	Plantable seedlings	Cull	Viable seeds per plantable seedling
	Number	*Number*	*Percent*	*Number*
11.0	8.5	7.4	12.4	1.55
30.3	27.5	20.3	26.2	1.73
50.1	47.0	30.2	35.8	1.95
62.2	60.2	37.5	37.7	2.20
83.5	80.1	41.9	47.7	2.54

[1] Based on 216 sq. ft. of bed.

TABLE 2.--Morphology of 2+0 Douglas-fir seedlings in relation to seedbed density [1]

Seedling density (after one growing season)	Shoot			Root	
	Length	Diameter	Length/ diameter	Length	Volume
	Cm.	*Mm.*		*Cm.*	*Ml.*
11.0	22.0	4.3	5.1	19.1	5.82
30.3	22.0	3.5	6.3	16.5	3.62
50.1	21.4	2.9	7.4	14.1	2.07
62.2	20.2	2.8	7.2	13.6	1.98
83.5	21.5	2.9	7.3	15.1	2.01

[1] Based on 40 plantable 2+0 seedlings.

The cost of lifting is much affected by the proportion of substandard root-pruned 2+0 seedlings in nursery beds. In beds where 40 percent or more of seedlings did not meet planting standards, increased costs of up to $1 per thousand seedlings have been experienced at Duncan Nursery. These additional costs have usually been associated with densities of 65 or more seedlings per square foot.

Broadcast seeding by hand is practiced in nurseries of the British Columbia Forest Service. Although only the most experienced staff members carry out this operation, uneven distribution of seed commonly results in a wide range in seedling density. More uniformity of sowing might be obtained with a mechanical seeder, either modified with baffles to disseminate seed in a broadcast pattern, or to sow in drills. Drill sowing offers three advantages over broadcast sowing--weeding can be mechanized, root systems can be laterally pruned, and repellent sprays and fertilizers can be applied more effectively.

Conclusions

Overstocking in beds (densities greater than 50 seedlings per square foot) necessitates heavy culling, which wastes seed and nursery resources and increases the cost of 2+0planting stock. Understocking (densities less than 30 seedlings per square foot) produces a low yield of large seedlings, which are expensive to lift, package, transport, and plant, and are unnecessary for normal planting conditions. Densities between 30 and 50 seedlings per square foot yield an acceptable number of good 2+0 seedlings with a minimum waste of seed.

Literature Cited

Revel, J.
1962. Planting stock standards forcoast~ Douglas-fir. British Columbia Forest Service. Forest Research Review 1962: 38.