bi-monthly research notes

A selection of notes on current research conducted by the Canadian Forestry Service and published under the authority of the Minister of the Department of Fisheries and the Environment. A French edition is published under the title of Revue bimestrielle de recherches.

SOILS

Influence of Lime Incorporated in Soil Mix on Growth of Douglas-fir.—Production of containerized seedlings for experimental field planting began at the Pacific Forest Research Centre in 1967 and has expanded to the present British Columbia Forest Service (BCFS) operational production of 25 million seedlings a year. Since the inception of this program, dolomite lime has been incorporated in the soil mix to adjust the pH to about 5, the optimal value for Douglas-fir (Van den Driessche, B.C. Forest Serv. Res. Notes 48, 1969), and to provide an available source of calcium and magnesium. The soil mix, a 3 peat:1 vermiculite V/V (Matthews, Can. For. Serv. Inf. Rep. BC-X-58, 1971) mixture, initially contained 5 kg dolomite lime (12 mesh and finer) (Matthews 1971) per cubic meter of mix. This quantity of dolomite lime was later reduced to 3 kg per cubic meter of mix.

In the normal production of seedlings, chlorosis occasionally develops. To overcome this, biweekly applications of ferrous sulfate, to supplement iron supplied by hi-sol fertilizers, have become part of the normal production schedule. Because this apparent iron chlorosis is speculated to be lime-induced and because some other agencies are not using lime to adjust the pH of the soil mix, there has been some discussion as to the need for continuing the lime incorporation.

The study described here was undertaken to evaluate the need for continuing lime incorporation in the soil mix. In the spring of 1973, we compared the growth of Douglas-fir, using three different levels of dolomite lime (0, 3, and 5 kg/m^3) in the standard 3 peat:1 vermiculite soil mix and associated with the two different fertilizer schedules shown in Table 1.

For this experiment, the peat was shredded sphagnum (Sunshine^R) and the vermiculite was horticultural grade. Seedlings were watered between fertilizer applications as required. The water had a pH of 7.0 and a conductivity of 25 micromhos. All treatment combinations were replicated four times. An individual replicate was one-quarter (48 cavities) of the "Styroblock 2" container (Matthews 1971). Containers were seeded April 15, 1975, with stratified Douglas-fir seed (BCFS seedlot #315, 460 m elevation) and kept in the greenhouse at 20°C for 1 week before being moved to the shadehouse for the remainder of the experiment. Final sampling began in early November 1975. To reduce the edge effect in each "quarter block," only the 20 central cavities were extracted and measured. Measurements on these 20 plants from each replicate included stem diameter (at cotyledon), height (from cotyledons to tip plus 2.5 cm), and top, root, and total dry weight (48 h at 70°C).

The two fertilizers had different effects on the soil mix pH (Fig. 1). Fertilizer 1 and no lime resulted in a gradual increase in pH throughout the season, while fertilizer 2 and no lime produced a slight decline in soil pH in the first 12 weeks, with little or no change observed for the remainder of the experimental period. The differences observed in soil mix pH are probably due to differences in the fertilizer composition. Fertilizer 1 supplies 70% of the nitrogen as urea which, on hydrolysis, yields alkaline products (NH_3 and CO_2). In contrast, with fertilizer 2, 30% of the nitrogen is supplied as urea in the first 13 weeks and none in this form for the remaining 16 weeks. In both instances, however, the no-lime soil mix remained within the desired pH range (4-6) for Douglas-fir growth. As expected, the 5 kg lime incorporation produced a soil mix with the highest pH and, combined with fertilizer 1, it reached pH 6.8 before the end of the growing season, while fertilizer 2 and 5 kg lime increased the pH to 5.9 after 12 weeks and then declined throughout the remainder of the experiment.

TABLE 1

Seedling fertilization schedule

FERTILIZER 1	Week 1 - 3	- Water as required
	Week 4	- 28:14:14* at a concentration of 78 mg/l twice weekly (21.7, 4.7, 9)
	Week 5 - 29	- 28:14:14* at a concentration of 156 mg/l twice weekly (43.5, 9.5, 18)
FERTILIZER 2	Week 1 - 3	- Water as required
	Week 4	- 10:52:10** at a concentration of 625 mg/l twice weekly (62, 141, 52)
	Week 5 - 13	- 20:20:20** at a concentration of 500 mg/l twice weekly (100, 44, 82)
	Week 7	- $FeSO_4$ (anhydrous) at a concentration of 13.6 mg/l was applied at 2-week intervals to experiment termination
	Week 14 - 29	- 10:52:10** at a concentration of 625 mg/l twice weekly (62, 141, 52)

*Plant Products Ltd., Port Credit, Ont.
**Green Valley Fertilizer and Chemical Co., Surrey, B.C.

The figures in brackets are Nitrogen (N), Phosphorus (P) and Potassium (K), respectively, in parts per million.

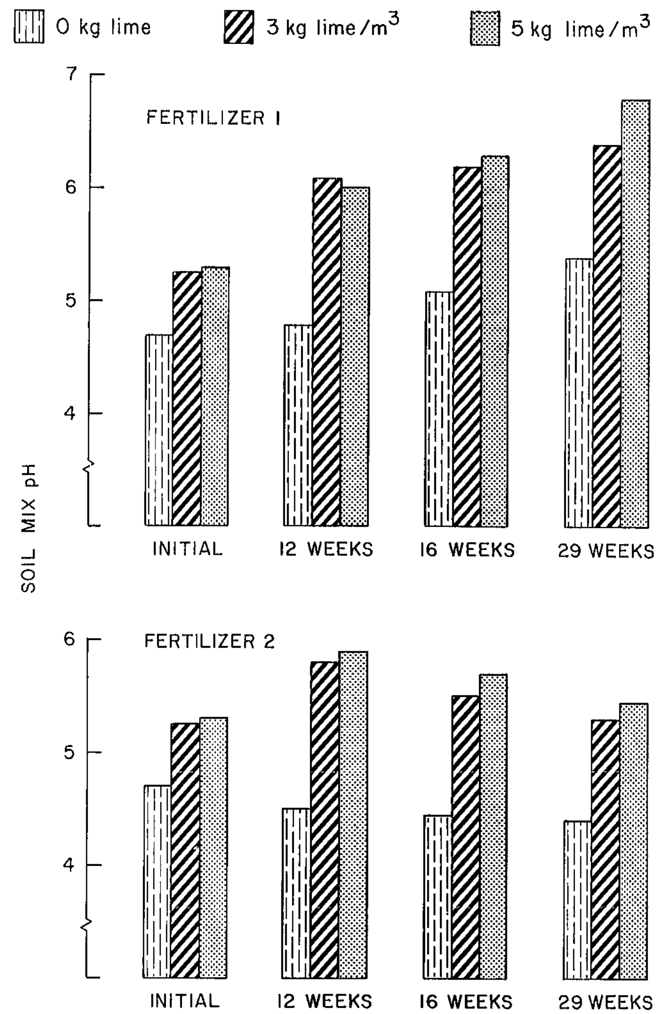

Figure 1. Soil mix pH fluctuations over 29-week production cycle.

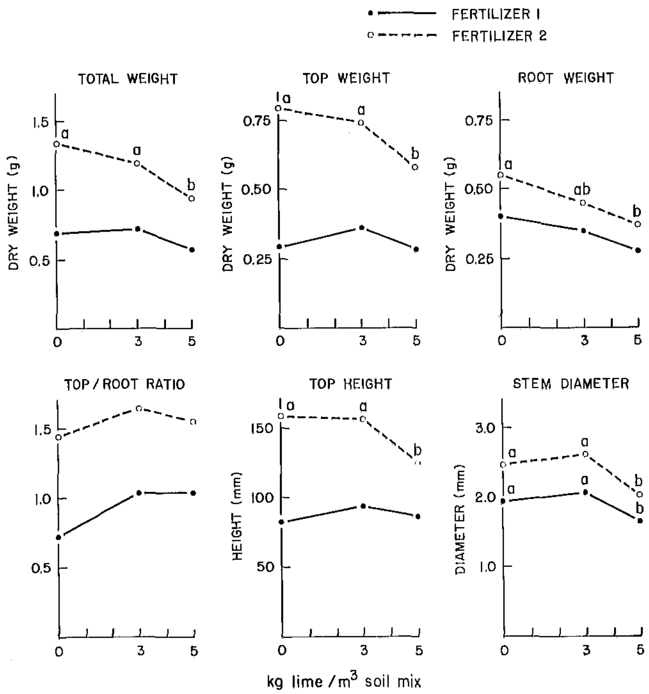

Figure 2. Growth of Douglas-fir seedlings after 29 weeks on three different soil mixes. (Values followed by different letters are significantly different [P=0.05].)

Chlorosis was noted by the end of May (in about 6 weeks) in all treatments receiving lime. The most severe cases were associated with the 5 kg lime application, while the 3 kg lime treatment appeared to have a reduced effect. The final effect of the lime additions on seedling growth for these fertilizers is presented in Fig. 2. With no lime additions to the soil mix, the seedlings produced with fertilizer 2 (present BCFS operational schedule) were nearly twice (1.9 times) as large as those produced with fertilizer 1. With increasing lime additions to the soil mix and fertilizer 2, there was a decrease in total, top, and root dry weights. This growth reduction was statistically significant (P=0.05) only for the 5 kg lime treatment. A similar effect was recorded for height and stem diameter measurements. With the exception of stem diameter, where there was a significant (P=0.05) reduction in size, the differences noted with fertilizer 1 were not significant, although the same general trend as for fertilizer 2 was observed. No significant effects were detected for top-root ratios, although the no-lime treatment produced the smallest ratio.

These observations and those reported by Smilde (Plant Soil 39:131-138, 1973) of a negative response of Douglas-fir shoot dry weight to added lime suggest that the practice of incorporating dolomite lime in the container nursery soil mix should be discontinued. These results further suggest that additional, more detailed experimentation on lime addition and nutrient uptake interactions is required.—J.A. Dangerfield, Pacific Forest Research Centre, Victoria, B.C.

SILVICULTURE

Performance in a Progeny Test of White Spruce Seedlings Produced by Accelerated Growth.—This report describes the height growth of 17 white spruce progenies from a superior seed source (Beachburg, Ont.) in which 1-year-old seedlings produced by accelerated growth were used. Details of the technique and height growth 18 weeks and 25 weeks after sowing were previously reported (Pollard and Teich, Bi-mon. Res. Notes 28:19-20, 1972). In brief, seedlings were grown under 16-h daylength at 22 ± 2° C and fed 3X daily with nutrient solution. Seedlings suitable for field planting can be produced by this method within a year.

TABLE 1

Seed weight and juvenile growth of white spruce progenies from Beachburg, Ont., arranged in descending order according to total height

Progeny seedlot no.	1,000-seed weight (g)	25-week ht (cm)	Height increment (cm) 1975	1976	Survival (%)	Total ht (cm) 1976
70061	2.46	26.6	22	20	95	107.1
70059	3.12	26.8	22	20	100	98.7
70066	3.37	25.3	21	19	70	98.1
70073	3.14	20.9	25	21	97	97.8
70071	2.53	19.0	23	21	86	94.5
70069	2.43	24.3	21	19	83	93.6
70060	2.83	21.3	22	19	83	93.2
70056	2.40	22.7	21	16	93	91.5
70072	2.36	24.5	19	16	81	90.0
70067	2.50	21.1	20	18	82	88.9
70057	2.90	22.7	21	19	83	88.3
70063	2.63	16.9	20	15	100	87.5
70068	2.38	21.4	20	19	90	87.4
70062	2.36	19.9	20	18	88	86.3
70070	2.00	19.2	19	16	90	84.9
70058	2.42	21.6	15	15	83	75.8
70055	2.35	19.5	15	18	87	73.4
Mean	2.60	22.0	20	18	87	90.4
LSD (0.05)		3.8	4.9	4.4		15.5

TABLE 2

Correlation coefficients among seed weight and juvenile growth of white spruce progenies (Y= 0.48 required for significance at P = 0.05)

	Height increment 1975	1976	25-week ht	1,000-seed wt
Total height, 1976	0.87	0.76	0.59	0.49
Height increment, 1975	·	0.85	0.29	0.54
Height increment, 1976			0.42	0.49
25-week height				0.37

A field test was established in the spring of 1972. The experimental design was a randomized complete block with six replications of five-tree plots spaced 1.8 x 1.8 m. Seedlings of a few progenies were insufficient to fill all replications; 2 + 2 Norway spruce were used as filling plants. Total height and height increment during the 1975 and 1976 growing seasons were recorded in 1976.

There were considerable differences in total height among progenies (Table 1). The fact that the tallest was 47% taller than the smallest indicated potential for within-provenance selection. Correlation between 25-week height and final total height was significant (Table 2). The three tallest progenies at week 25 were still the tallest in 1976 (Table 1). However, considerable rank changes occurred among others: progenies 71 and 73 jumped from the 17th and 12th to the 5th and 4th rank respectively. These two progenies also had the greatest height increment during the 1975 and 1976 growing seasons and may eventually outgrow the others.

The correlation between seed weight and height growth was significant except at week 25 (Table 2). The three progenies with heaviest seed ranked 2, 3, and 4 in height in 1976, but the tallest progeny had below-average seed weight (Table 1). The extent of seed weight influence on juvenile growth needs to be further investigated.

Comparison between seedlings produced by accelerated growth and conventional methods cannot be made because the latter were not included in the test. However, there was no evidence of negative effect of accelerated growth on either survival or height growth. This growth-acceleration technique has potential for more efficient production of experimental stock.—C.C. Ying and D.F.W. Pollard, Petawawa Forest Experiment Station, Chalk River, Ont.