Root Pruning in the Nursery

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At the present time, planting stock is usually produced as seedlings instead of transplants. To stimulate development of dense and compact root systems and a high root/shoot ratio, many nurseries prune the roots of seedlings in nursery beds.

Initial experiments with root pruning resulted in increase/d mortality (6) or decreased growth (5). However, recent experiments (8, 3) have shown that root growth can be stimulated by root pruning without significantly sacrificing height growth.

The methods of root pruning commonly used are *bottom pruning,* usually accomplished with a horizontal bar (5) or a reciprocating bar (7), and *side pruning,* which involves rotating coulter discs (2) or knife blades (1) .

This note summarizes two root pruning studies done at the British Columbia Forest Service nursery at Duncan on fine silt loam soils and reported in retail elsewhere (3, 4). Recommendations are based on these and other, unreported, studies.

The Study

Douglas-fir, Sitka spruce, and western hemlock seedlings, drill sown in rows 7 inches (18 cm) apart, were pruned at different times during their second growing season. Root pruning improved the quality of the seedlings, reduced the proportion of culls, -and increased the density and compactness of the root systems without significantly depressing the height growth. However, the degree of root regeneration and growth was greatly influenced by the timing of root pruning. The earlier in the season root pruning was done, the better was the regeneration of pruned roots (fig. 1) . Even seedlings missed by pruning blades produced somewhat denser root systems than the controls. Stimulation of root growth in spring appeared to be the result of both actual root severance and improved aeration in the usually wet soils.

Because of the lack of lateral root development, only bottom pruning was effective at the beginning of the second growing season. Side pruning at this time of the year severed very few roots, and it became more effective as the growing season progressed and lateral roots grew longer. Severance of the long lateral roots as late as the middle of July resulted in increased branching and stimulation of growth in secondary roots of all three species, and hence increased density and compactness of the root systems (figs. 2 and 3) . Side pruning done later than the beginning of August resulted only in the formation of callus tissues around the wound; regeneration of new roots or increased growth of secondary roots was not evident at the lifting time in October. However, the following spring, new roots originated abundantly from the callus.

The results of our study suggest:

a. Bottom pruning of all three species should be done as early in the year as soil con ditions permit.

b. In side pruning, the best compromise dates for ob taining sufficient numbers of pruned seedlings and good root regeneration ap pear to be around the 20th of June for Douglas fir, the beginning of July for spruce, and before the mid dle of July for hemlock.

c. If top growth has been ade quate, Douglas fir should be bottom pruned again at the beginning of August. This encourages the formation of terminal buds and harden ing of the stock.

Since a compromise was necessary between effectiveness of pruning and optimum root regeneration, several further improvements of lateral pruning were suggested:

(1) Produce larger stock by improving growing conditions and earlier (possibly fall) sowing which

Figure 1.—Root of Sitka spruce and hemlock pruned at a different time of the year. Note decreasing root density. (Mgn. 0.3 x.) (Arrows indicate points of pruning.)

Figure 2.—a. Satisfactory root system of Sitka spruce pruned June 16. Though formation of roots around the point of severance was not abundant, branching of existing roots produced an excellent root system. Arrows indicate points of pruning.
b. Unsatisfactory root system of Sitka spruce, representing about 20 percent of unpruned seedlings.

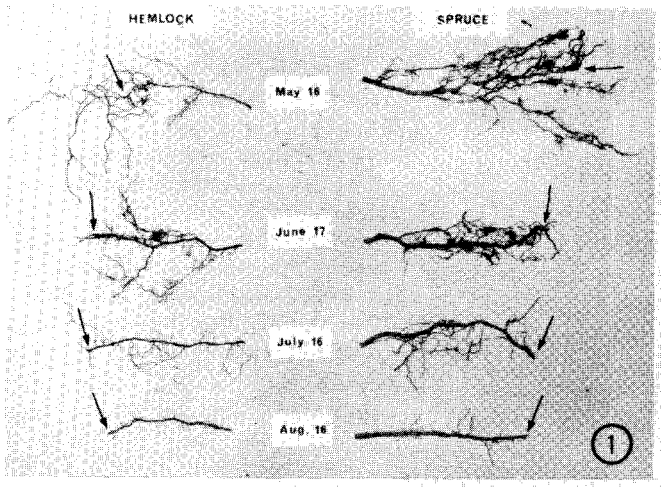
Figure 3.—a. Satisfactory root system of hemlock pruned June 16.
b. Unsatisfactory root system of hemlock, representing approximately 25 percent of seedlings.

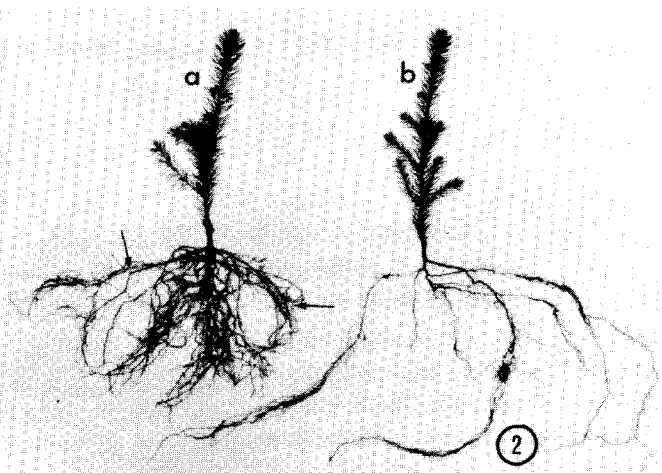
Figure 4.—A frame with pivoting vertical blades for lateral pruning.

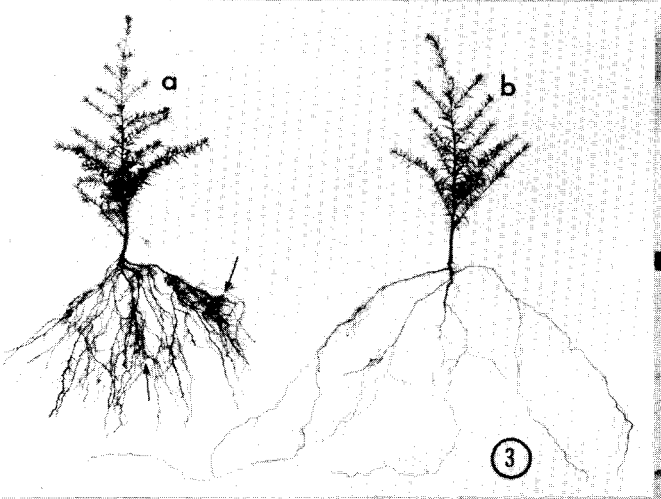
Figure 5.—A frame with horizontal blade for bottom pruning.

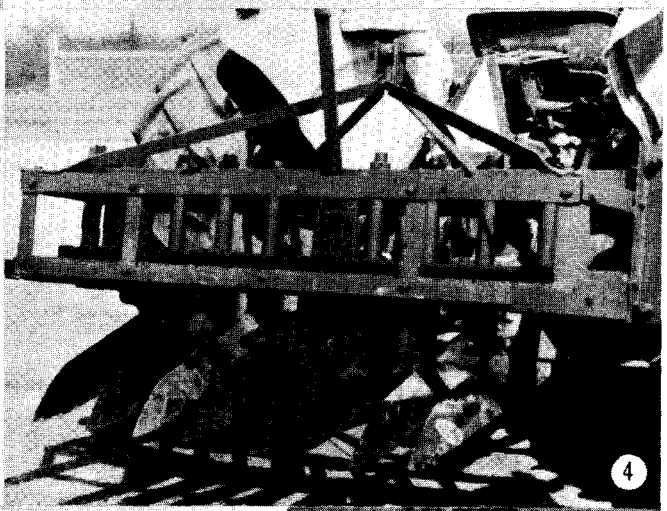
Figure 6.—Bottom pruning equipment in operation. The frame, holding a blade in a predetermined position can be raised or lowered from the tractor.

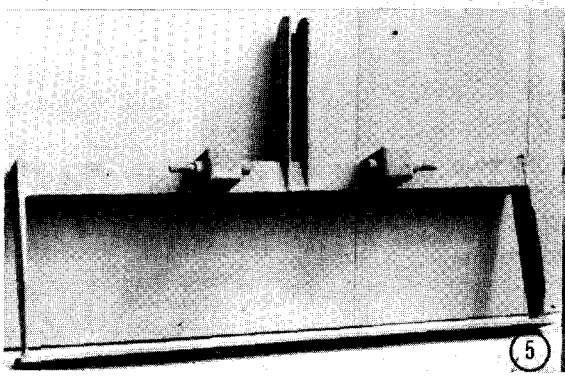
Figure 7.—Lateral pruning equipment in operation. Operator keeps blades in position by pivoting them manually with lever.

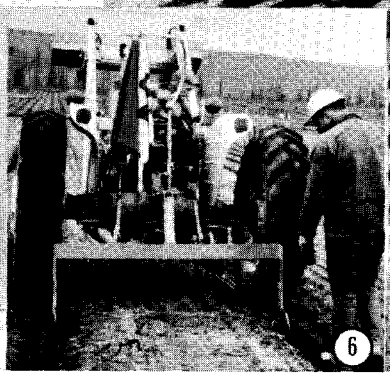












in turn would allow earlier pruning; (2) reduce pruning distance from 3 1/2 inches (9 cm) to about 2.5 inches (6 cm) , and side prune about 2 weeks earlier; (3) reduce the distance between rows, and prune equidistant between rows earlier. This was done in the Duncan nursery in 1970.

Equipment and Procedures

Root pruning equipment (figs. 4 to 7) was developed locally. Bottom pruning is accomplished with a horizontal bar (figs. 5 and 6) , mounted permanently in a frame, which is attached by a three-point hitch directly to the tractor. Depth and angle with the soil surface are controlled hydraulically by the driver.

Lateral pruning is accomplished by a set of vertical blades (fig. 4) pivoting in a frame, which is attached and controlled from the tractor in the same way as the horizontal bar. The position of the blades between rows is controlled manually by a second person sitting or standing on the frame (fig. 7).

Proper soil moisture at pruning time is important. For summer pruning in dry soils, watering a day or two before pruning may be necessary to prevent wilting of disturbed plants. Also, depending on soil texture, the blades may cut roots better and with less disturbance in moist soil. Overwatering should be avoided. In wet, plastic soil, the pressure of the blade may loosen the root ends and push them downward without cutting.

Depending on soil texture and moisture, the reduction of the pruning distance to 21/2 inches (6 cm) in rows 7 inches (18 cm) part, as suggested above, may require two passes of the equipment over each bed, because the blades close together may push soil ahead of them.

The blades should be long and sharp, and their cutting edge set at an acute angle to the soil surface in the direction of travel (fig. 4). Cutting should be accomplished by a sliding motion rather than by pressure.

Most lateral roots of hemlock were found in the top 2 inches (5 cm) of the soil, with very few penetrating deeper than 4 inches (10 cm). In Sitka spruce, in addition to surface laterals, roots penetrating obliquely into the soil were present. Pruning 2 1/2 inches (6 cm) from the row, most laterals of hemlock and spruce would be severed if pruning blades were set for a depth of about 3-4 inches (8-10 cm). Douglas fir was deeper rooted. A pruning depth of 5 inches (12 cm) is suggested for this species.

Root pruning is also effective in loosening the soil so that the roots can be freed with less effort and damage at lifting time.

An identical pruning schedule will not suit all nurseries because of variation in climate, soil, and growth pattern of the species. By using the suggested schedule as a starting point, each nursery should experiment with timing of root pruning and modify the schedule accordingly.

Root pruning, a relatively inexpensive operation, is now a standard practice in all British Columbia forest nurseries. Depending on the nursery size, each operation costs approximately 6 to 7 dollars per acre, which in the production of 600,000 acceptable 2 + 0 Douglas fir seedlings is approximately 1 percent of the total cost. If the quality of only 25 percent of the seedlings could be improved, thereby increasing the numbers of acceptable seedlings by 10 percent to 660,000 (4) and reducing the numbers of culls from 300,000 to 240,000, the savings would be substantial.

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