AN OPERATIONAL ROOT WRENCHING TRIAL AT HUMBOLDT NURSERY

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BACKGROUND

STOCK OBJECTIVES

Size control of Douglas-fir seedlings to be planted on the Glide Ranger District of the Siskiyou National Forest was first tried in August of 1974. At that time, the 2-0 seedlings were 56 centimeters tall (22 inches) with a small root mass; a poorly balanced seedling. It was known that seedlings with such large tops and small roots were customarily difficult to handle during outplanting, and could not be expected to survive and grow well. Therefore, a decision was made to top prune seedlings at 30 cm. (12 inches) and undercut the roots at 20 cm. (8 inches). This treatment was found to produce well-proportioned stock with good caliper, dark green foliage, and many buds.

The following year, all Glide stock was undercut in early July and wrenched in mid-August to improve balance and planting ease. One lot was wrenched at 15 cm. (6 inches), all others were wrenched at 20 cm. (8 inches). Differences could not be distinguished between seedlings from lots wrenched at different depths. Tops were not pruned. Stock was later judged to be excellent for intended planting sites. Field contract inspection records revealed near zero "J" or "L" rooting, so treatment was deemed a success from this standpoint. Survival and growth of wrench versus non-wrenched stock is being evaluated, but data is not yet available.

EQUIPMENT USED

In 1974, undercutting was done with a conventional sled type under cutter lifter. Results were satisfactory, but it was felt improvement was possible. Additional testing was done in 1975 and 1976, but very little operational undercutting or wrenching was done. In 1977, a used Marsh reciprocating undercutter-wrencher was used extensively on Siskiyou National Forest stock. Many problems were associated with use of this machine. Outside tree rows tended to fall over into the paths because sandy soil in raised beds would not hold them upright. This caused trees with angled roots. Inside rows contained many "J" and "L" rooted trees because the vibrating undercutting blade tended to displace loosened roots rather than cut them off, even immediately following sharpening.

Because of these problems, the Marsh undercutter was junked and the original stationary blade machine was returned to service. This machine does a good job if the blade is good (a veneer knife or T-5 hardened steel), 7/16 to 1/2 inch thick, hollow ground, and kept sharp to reduce dragging of roots. For sharpening, heavy grinding can be done with a coarse stone, but near the edge a fine grit vitrified stone reduces burning. Final sharpening and field touch-up (every 4 to 8 beds) should be done with a 10 inch fine file.

THE OPERATIONAL TRIAL

Data was collected in December 1977 from 2-0 seedlings of two seed sources undercut and wrenched during the previous summer. The following narrative discusses: The physical layout of the trial in the nursery; our sampling technique; the treatment schedule used; data the trial generated; timing of the sequence of top and root growth in the nursery for Douglasfir; how this sequence relates to our treatment schedule; and, how we could change our treatment schedule to achieve a different result.

METHODS

Seedling lots treated were from elevations of 1500 and 3500 feet. Control and treated beds were side by side. Treated seedlings were undercut July 17, and wrenched September 2, 22, and October 13. Control seedlings were neither undercut nor wrenched. Using a shovel, we collected 10 seedlings from each of 10 different points (located by pacing) so overall averages are based on 100 seedlings. Stem diameters, top heights, and top and root oven dry weights were recorded. Because treatment plots were not replicated, statistical tests are not possible. Conclusions reached are based on comparison of averages in the light of pertinent wrenching and other reforestation literature.

ZESULTS

Undercutting and wrenching, as conducted in this trial, resulted in smaller seedling dimensions than occurred for controls: caliper of the 1500 foot source controls was 17 per cent smaller; of the 3500 foot source controls was 13 per cent smaller; heights were respectively 35 and 22 per cent smaller; top weights were respectively 47 and 30 per cent smaller. Wrenched trees of each source experienced an 11 per cent root weight reduction relative to controls.

Table 1. Top and root dimensions of 2 seed sources of wrenched and control 2+0 Douglas-fir seedlings grown at Humboldt Nursery.

Seed Source	Seedbed Density	Diameter	Height		Oven Dry Weight Top	Root
	No./ft.^{2}	mm.	cm.	in.	gm.	gm.
1500C 1/	21	4.7	28.8	11.3	4.06	1.61
1500W 2/	27	3.9	18.5	7.3	2.15	1.44
3500C 2/	21	4.7	21.6	8.5	3.46	1.88
3500W 2/	21	4.1	16.8	6.6	2.44	1.68

1/ Control
2/ Undercut 7/17; wrenched 9/2 and 9/22

All aspects of top growth retardation were least for the 3500 foot source indicating that this source may have nearly completed top growth when treatments were applied. Table 1 contains the actual data averages.

DISCUSSION

We cannot afford such reduced caliper and root growth, because such high survival after outplanting is directly related to root mass and condition; top growth is directly related to caliper.

Therefore, virtually all of our nursery cultural efforts must be directed in one way or another to increase caliper and root mass.

Why were desirable seedling characteristics adversely affected by a treatment many of us have come to regard as beneficial? We think the main reason was timing of the treatments.

Douglas-fir meristematic systems (Cambium, and stem and root terminals) grow in the following sequence at indicated times (Fig. 1 from Krueger and Trappe, 1967; work was done at Wind River Nursery): roots start as soon as soil warms up in early April. They are followed by height growth from bud break until sometime in late June or early July. (A record height flush may occur in August or early September). As height growth slows, stem diameter growth begins and continues into early fall, at which time roots enjoy another growth surge, though not equal to the spring surge. No two systems go full bore at the same time, though considerable overlap occurs. Desirable seedling characteristics were adversely affected because timing of the treatments, July 17, September 2 and 22, and October 13, tended to interrupt and disturb growth phases, rather than stimulate them. (Fig. 2) Undercutting occurred during the time diameter growth was beginning, wrenching occurred during the time root growth was occurring. This tended to shock and stunt growth rather than stimulate it.

CONCLUSIONS

We suggest the following undercutting-wrenching schedules be tested, in small scale operational trials, to manipulate growth of 2-0 Douglas-fir seedlings: 1/ To curtail height growth and promote caliper and root growth (produce a shortened seedling with good top-root balance for sites where moisture is limiting), begin the root treatment program by undercutting before top growth starts (after the spring root surge) and end program in time for late summer and fall diameter and root growth to take place undisturbed (Fig. 3); 2/ To permit height growth and produce a taller seedling with less favorable top-root balance (for sites where moisture is not limiting), begin the program by undercutting after top growth has taken place (before diameter growth has started), and end at the same time as for recommendation 1 above (Fig. 4).

These suggested undercutting-wrenching schedules appear superior to schedules which recommend treatment when seedlings reach a specific desired height, because the desired height system ignores the natural growth rhythms of the seedlings. These schedules take advantages of the times system of highest priority. Undercutting-wrenching schedules such as these should also present record height growth flushes and promote earlier bud set and dormancy. As depicted in Figures 3 and 4, the schedules are approximations. Actual growth peaks and treatment dates will most likely vary by seed source.

FIGURE I:
Curves showing the sequence in which height (H), diameter (D), and root R growth occur in two *seed* sources of 2-0 Douglas-fir seedlings in the nursery. (From Krueger, K.W., and Trappe, J. M., Forest Science. Vol. 13, p. 196-7, 1967)

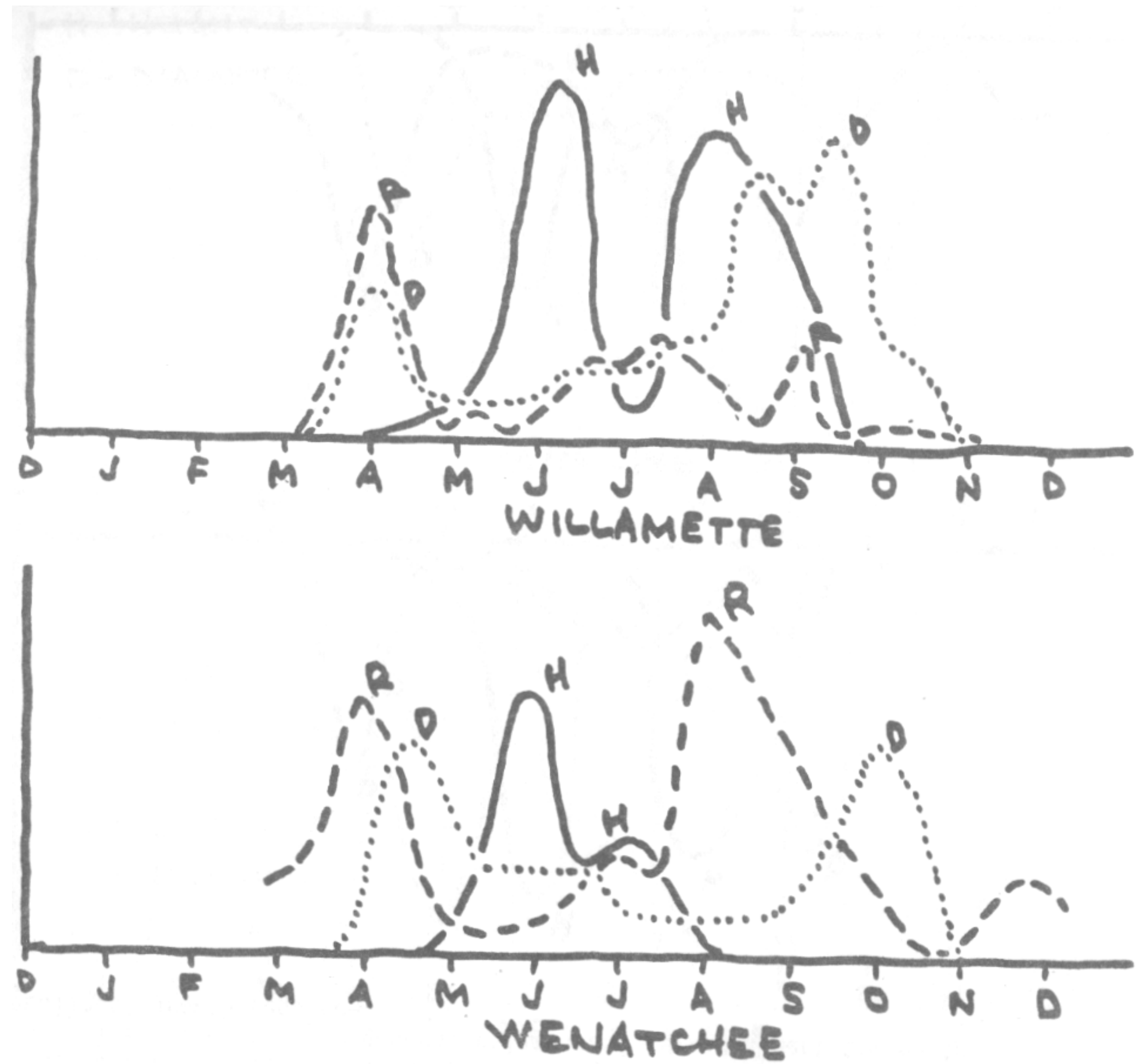

FIGURE II.
Undercutting-wrenching (U-W) schedule employed at Humboldt Nursery on Glide Ranger District stock in 1977. Krueger and Trappe's curves of Figure 1 are used to show general relationship of treatment timing to seedlings' growth sequence.

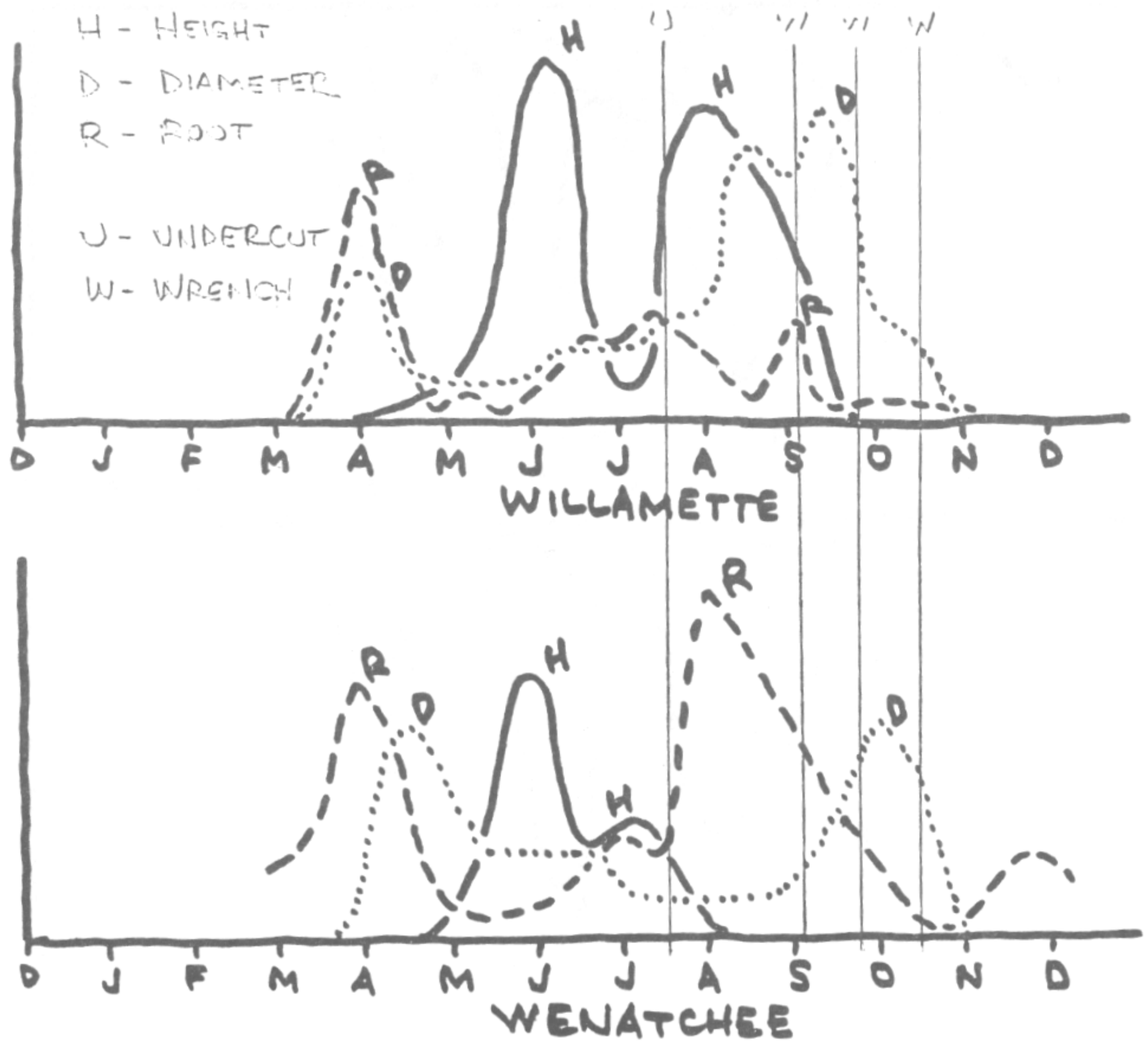

FIGURE 3.
Suggested undercutting-wrenching schedule for producing nursery stock with curtailed height growth and increased diameter and root growth.

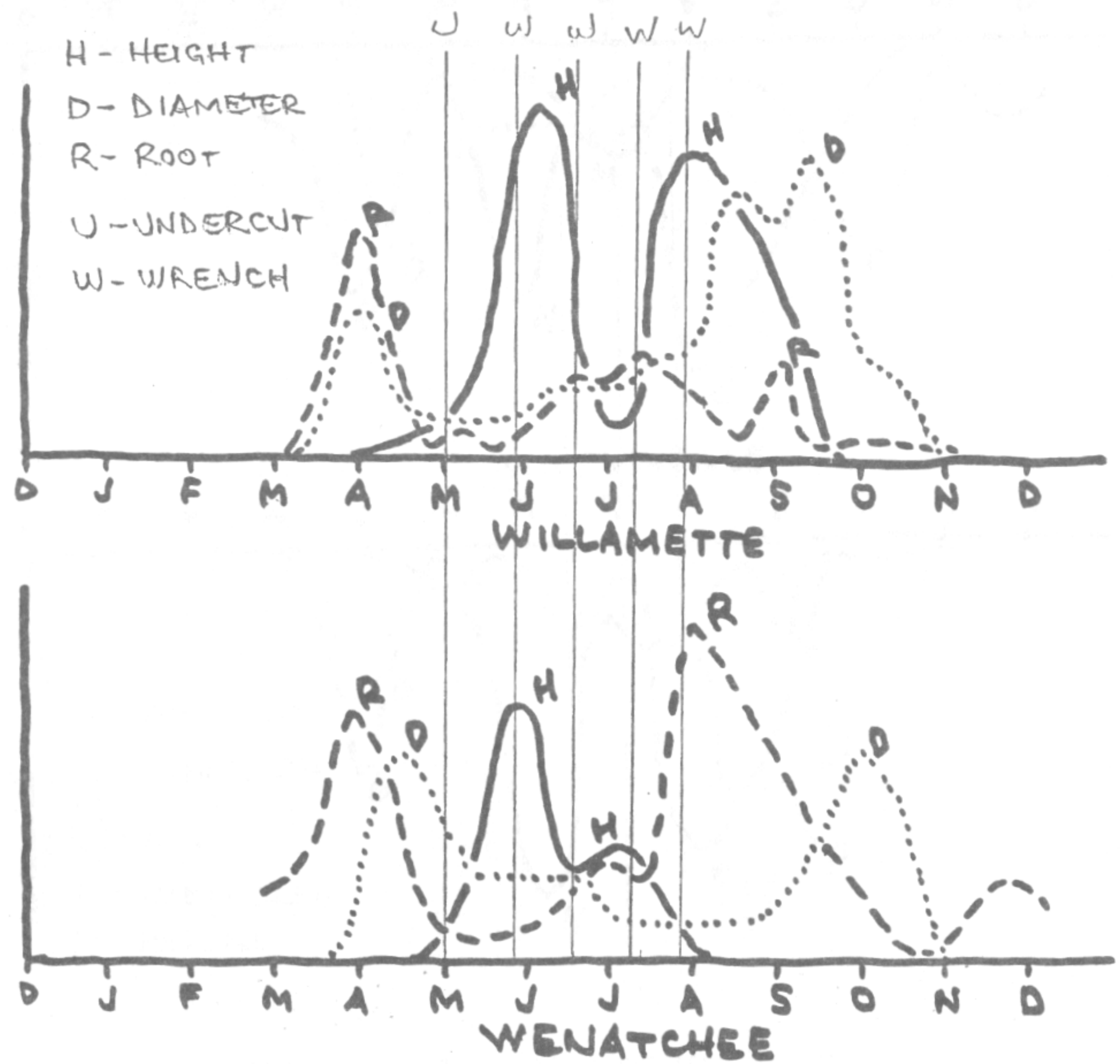

FIGURE IV.
Suggested undercutting-wrenching schedule for producing stock with normal height growth, but with increased diameter and root growth.