THE EFFECT OF SOWING DEPTH AND MULCH ON GERMINATION AND 1+0 GROWTH OF DOUGLAS-FIR SEEDLINGS

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ABSTRACT: The effect of three sowing depths (surface, 1/4 inch, and 1/2 inch) and four mulches (sand, hydromulch, fresh alder sawdust, composted alder sawdust) on germination and 1+0 growth of Douglas-fir 252-1.0 seedlings was evaluated at International Paper Company's Western Forest Research Center near Lebanon, Oregon. Germination percent, 1+0 seedling bed density, and 1+0 diameter were best for seed sown at 1/4 inch soil depth. 1+0 seedling shoot height and oven-dry shoot weight were best for seed sown on the surface or at 1/4 inch depth. The poorest performance resulted from seed sown at 1/2 inch soil depth. Germination rate was not affected by sowing depth. Mulching with alder sawdust modified soil temperatures in the seed zone which significantly increased seed germination and 1+0 shoot development relative to other mulches tested. Seed covered with hydromulch experienced colder soil temperatures producing the poorest germination rate and percent.

INTRODUCTION

Sowing depth and mulch treatments have been shown to affect germination of slash pine seed under southern nursery conditions (Rowan 1980). Rowan (1982) also demonstrated that emergence of loblolly and slash pine seed varied according to mulch type and nursery climatic conditions immediately following sowing.

Very little information, however, has been reported regarding the effect of sowing depth and mulch on germination of Douglas-fir seed. Most northwest nurseries do not mulch Douglas-fir seedbeds and sow between 1/8 and 1/4 inch soil depth (Duryea 1984; Thompson 1984).

Sorenson (1978) found 1+0 Douglas-fir shoot height could be increased 0.5 mm per day of earlier sowing between April 23 and *May* 12.

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Several northwest nurseries begin sowing in March and continue through June (Duryea 1984; Thompson 1984). Early spring soil conditions are often cold and wet, creating an unfavorable environment for seed germination (Sutherland and Anderson 1980). Mulching has been shown to modify soil thermal and moisture properties (Cochran 1969; McDonald 1984). Mulches that produce warmer seedbed temperatures could improve germination of Douglas-fir seed and allow sowing to begin earlier in the spring.

High seedbed temperatures that occur later during the summer can retard growth by adversely affecting seedling physiological processes such as respiration and photosynthesis (Kramer and Kozlowski 1979). Again, mulching could be used to cool high seedbed temperatures and encourage growth of Douglas-fir seedlings.

The purpose of this study was to examine the effect of four mulch materials and three sowing depths on rate and amount of Douglas-fir seed germination, 1+0 seedling bed densities, and 1+0 seedling size at International Paper Company's Western Forest Research Center near Lebanon, Oregon.

METHODS AND DESIGN'

After 10 weeks of cold stratification at 2°C, Douglas-fir seed from zone 252-1.0 were sown on May 21, 1983 at three depths (surface, 1/4 inch, 1/2 inch) and at a density of 188 pure live seed per bedfoot. Sowing was done with an eight-drill Oyjord seeder. The six center drills were grouped into three paired rows representing the three sowing depths. After sowing, 20-foot sections were mulched with 1/4 inch of either sand, hydromulch,1/,2/ fresh alder sawdust, or composted alder sawdust. Study plots received normal irrigation and cultural practices throughout the growing season. The study was arranged in a split-plot design with four replicates (nursery beds). Main plots were the mulch treatments assigned in a consistent pattern, and sowing depths were the subplots.

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1/ Turfiber, R. Superior Fiber Products.

2/ Mention of trade name is solely to identify material used and does not constitute an endorsement by International Paper Company.

Germination was recorded weekly for 9 weeks from two measurement plots established in each treatment combination. The number of days between sowing and 50 percent germination was used to indicate rate of seed germination. Germination percent was calculated as the total number of germinants divided by the number of pure live seed sown. Seedling bed densities and morphological measurements were recorded in October.

Soil temperatures (1/4 inch soil depth) were recorded twice a week in the afternoons from June through September. Data were evaluated using standard analysis of variance procedures (SIPS 1981).

RESULTS

Sowing Depth X Mulch:

Total germination of Douglas-fir seed, expressed as germination percent, was significantly affected by sowing depth (table 1). Germination percent was best for the 1/4 inch depth followed by surface and 1/2 inch depths, respectively. The same pattern existed for the 1+0 bed density. Mulched surface-sown seed had better germination percent than when unmulched. Germination rate (day of 50 percent germination) was not affected by sowing depth.

Sowing depth significantly influenced 1+0 seedling size (table 1). Surface and 1/4 inch depths produced seedlings with similar height, caliper, and oven-dry shoot weight. These were consistently larger than seedlings grown from seed sown at the 1/2 inch depth.

Mulch:

Mulch treatments significantly affected germination percent, rate, 1+0 seedling density, and June soil temperatures (fig. 1 and 2). In general, the warmest soil temperatures were associated with the sawdust mulches which had the best germination percent, rate, and 1+0 seedling density. Hydromulch, however, had the lowest June soil temperatures and overall the poorest germination and 1+0 seedling density.

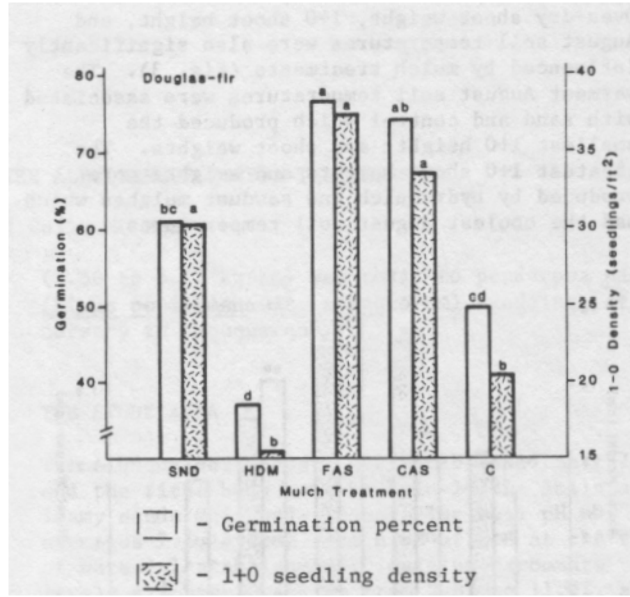

Figure 1.--Total germination percent and 1+0 seedling density for five mulch treatments; SND-Sand, HDM-Hydromulch, FAS-Fresh alder sawdust, CAS-Composted alder sawdust and C-Control (no mulch). Values with the same letter within each variable are not significantly different at p=0.05.

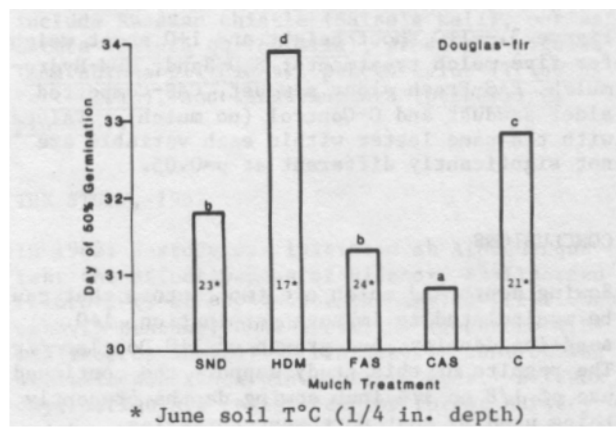

Figure 2.--Germination rate (day of 50 percent germination) for five mulch treatments; SND-Sand, HDM-Hydromulch, FAS-Fresh alder sawdust, CAS-Composted alder sawdust and C-Control (no mulch). Values with the same letter are not significantly different at p-0.0S.

Table 1.--Germination percent and rate, seedling bed density, height, diameter, and oven-dry shoot weight

DEPTH	GERMINATION PERCENT	GERMINATION RATE	DENSITY (TREES/FT^2)	HEIGHT (cm)	DIAMETER (mm)	SHOOT WEIGHT (gm)
Surface	[1]60.7 ab	32.4 a	26.7 ab	14.0 a	3.22 ab	1.30 a
1/4 inch	65.8 a	32.0 a	31.5 a	14.1 a	3.26 a	1.30 a
1/2 inch	52.5 b	32.1 a	23.5 b	12.5 b	3.09 b	1.14 b

[1] Values with the same letter within each variable are not significantly different at p=0.05.

Oven-dry shoot weight, 1+0 shoot height, and August soil temperatures were also significantly influenced by mulch treatments (fig. 3). The warmest August soil temperatures were associated with sand and control which produced the smallest 1+0 heights and shoot weights. The greatest 1+0 shoot heights and weights were produced by hydromulch and sawdust mulches which had the coolest August soil temperatures.

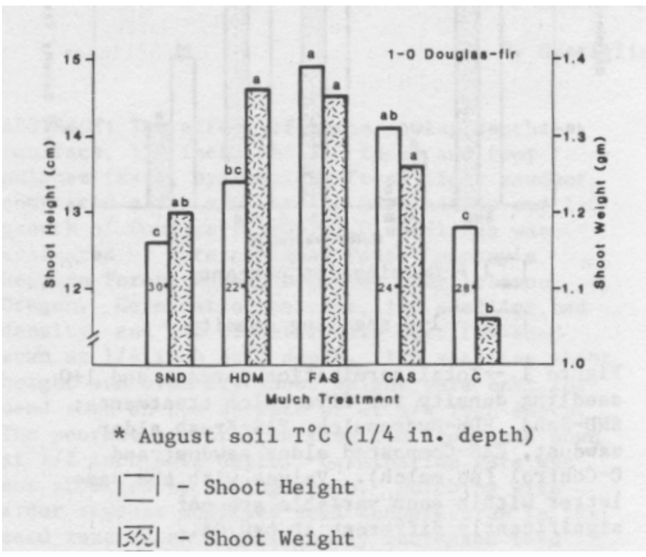

Figure 3.--1+0 shoot height and 1+0 shoot weight for five mulch treatments; SND-Sand, HDM-Hydromulch, FAS-Fresh alder sawdust, CAS-Composted alder sawdust and C-Control (no mulch). Values with the same letter within each variable are not significantly different at p=0.05.

CONCLUSIONS

Sowing depth and mulch are two factors that can be manipulated to improve germination, 1+0 seedling density, and growth of 1+0 Douglas-fir. The results of this study support the continued use of 1/8 to 1/4 inch sowing depths presently being used by most northwest nurseries. Generally, sowing Douglas-fir seed shallow is more advantageous than sowing deep.

Each nursery's soil and climatic conditions are unique and require special consideration when selecting a mulch material. For this study, mulching seedbeds with alder sawdust increased June soil temperatures which subsequently produced the best germination and seedling establishment relative to other mulches tested. Hydromulch treatments had the coldest June soil temperatures and the poorest germination and 1+0 seedling density. Later in the summer, alder sawdust provided the most favorable environment for seedling growth by producing the coolest August soil temperatures. Sawdust mulches consistently grew the largest 1+0 Douglas-fir seedlings. The sand and control plots, however, tended to have the warmest soil temperatures and grew the smallest 1+0 Douglas-fir. Northwest nursery conditions require mulch materials that increase soil temperatures in order to improve germination and seedling establishment for early spring sowing. Later in the summer, the mulch should tend to decrease high soil temperatures in order to enhance seedling growth.

REFERENCES

Cochran, P. H. Thermal properties and surface temperatures of seedbeds. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; 1969. 19 p.

Duryea, M. L., Nursery cultural practices: Impacts on seedling quality. In: Forest Nursery Manual-Production of Bareroot Seedlings (M. L. Duryea and T. D. Landis, eds.). Forest Research Laboratory, Oregon State University. Martinus Nijhoff/Dr. W. Junk Publishers; 1984. pp. 143-163.

Kramer, P.J. and T. T. Kozlowski. Physiology of woody plants. Academic Press; 1979. pp. 197-199.

McDonald, S.E. Irrigation in forest-tree nurseries: Monitoring and effects on seedling growth. In: Forest Nursery Manual - Production of Bareroot seedlings (M.L. Duryea and T.D. Landis, eds.). Forest Research Laboratory, Oregon State University. Martinus Nijhoff/ Dr. W. Junk Publishers; 1984. pp. 107-121.

Rowan, S. J. Planting depth and seedbed mulch affect germination of slash pine seeds. USDA Forest Service Res. Note SE-292, Southeast Forest Experiment Station, Asheville, NC.; 1980. 3 p.

Rowan, S. J. Effects of rate and kind of seedbed mulch and sowing depth on germination of southern pine seed. USDA Forest Service Tree Planters' Notes; Spring 1982, pp. 19-21.

SIPS. Statistical Interactive Programming System. Kenneth Rowe and Robert Bunne. Statistical computing report No. 7. Department of Statistics, Oregon State University; 1981.

Sorenson, F. C. Date of sowing and nursery growth of provenance of Pseudotsuga menziesii given two fertilizer regimes. J. Applied Ecology. 15:273-280; 1978.

Sutherland, J. R. and R. L. Anderson. Seedling disease and insect problems related to nursery soil conditions in North America. In: North American Forest Tree Nursery Workshop (L. P. Abrahamson and D. H. Bickelhaupt, eds.). State University, New York, Coll. Environ. Sci. and Forestry, Syracuse; 1980. pp. 182-190.

Thompson, B. E. Establishing a vigorous nursery crop: bed preparation, seed sowing, and early seedling growth. In: Forest Nursery Manual - Production of Bareroot Seedlings (M. L. Duryea and T. D. Landis, eds.). Forest Research Laboratory, Oregon State University. Martinus Nijhoff/Dr. W. Junk Publishers; 1984. pp. 41-49.