TRUE FIR STRATIFICATION - A FIELD TEST

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ABSTRACT

In 1981 white fir and Shasta red fir seeds were stratified for 2 or 4 weeks, dried to 3 moisture levels (white fir - 32%,37%, 38%; Shasta red fir - 26%, 33%, 43%), restratified for 0, 2, 4, or 6 weeks and sown in a nursery. In a similar study in 1982, seeds were stratified for 2 weeks, dried to 3 moisture levels (white fir - 20%, 30%, 40%; Shasta red fir - 13%, 25%, 37%), restratified for 0, 2, 4, 6, 8, or 10 weeks and sown in a greenhouse and nursery. Results indicate that in most cases drying and longer restratification significantly increased total germination or rate of germination. Dried seed, also, suffered less fungal contamination and germination during the restratification period.

INTRODUCTION

True fir seed typically exhibits poor germination and is more difficult to store than seeds of other conifers. Some decrease in germanative capacity can be attributed to the development of fungal contamination and germination during stratification. Nurserymen need a stratification procedure that consistently insures maximum germination, and allows them to synchronize completion of stratification with sowing date.

Recent studies (Danielson 1976; Danielson and Tanaka 1978; Edwards 1980) have shown that after initial stratification, air drying of true fir seeds allows continued stratification for up to 12 months without significant losses in total germination. Air drying may even stimulate germination to levels unattainable by conventional methods alone (Edwards 1980). Studies with ponderosa pine seeds air-dried to approximately 26% moisture content show seeds could be stored at 2°C for 9 months without losing viability or the initial stratification effect (Danielson 1976; Danielson and Tanaka 1978). Douglas -fir seed air-dried to 37% moisture level after stratification had the advantage that it would not germinate for 3 months while in cold storage (Danielson 1976; Danielson and Tanaka 1978). In 1981 and 1982 we conducted a study to field test these new stratification procedures.

MATERIALS AND METHODS

White fir and Shasta red fir seeds were initially stratified for 2 or 4 weeks in 1981 and for 2 weeks in 1982. In both years

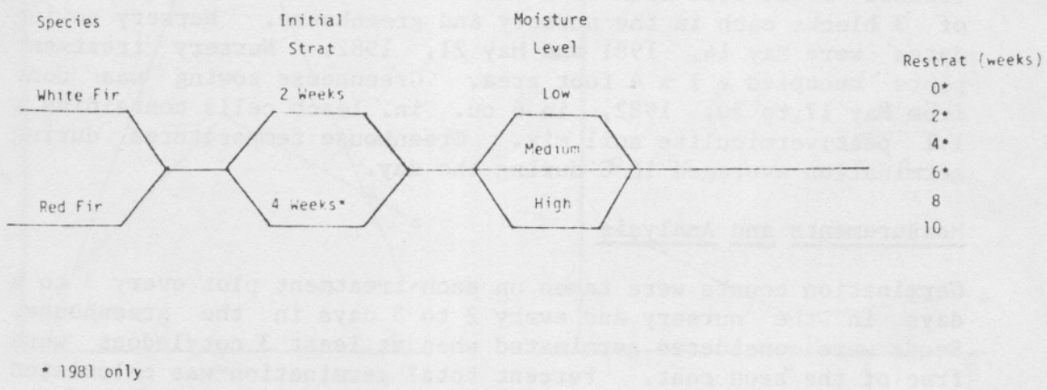
seeds were dried to 3 moisture levels (Table 1) and restratified for 0, 2, 4, or 6 weeks in 1981 and for 0, 2, 4, 6, 8, or 10 weeks in 1982 (Figure 1). Commercially processed seeds were used to stimulate operational nursery practices, and no attempt was made to improve seed quality by x-raying and removing empty or damaged seed. A mean fresh weight was determined for each species and was used to weigh out lots of 250 white fir and 230 Shasta red fir seeds for sowing in the nursery. Greenhouse seedlots contained 100 seeds counted individually.

Table 1. Moisture levels for restratified white fir and Shasta red fir seed.

SEED MOISTURE LEVELS

1981		MOISTURE LEVELS(%)		
		LOW	MEDIUM	HIGH
WHITE FIR 521	1.0	32	37	48
SHASTA RED FIR 516	6.0	26	33	43
1982				
WHITE FIR 741	5.5	20	30	40
SHASTA RED FIR 741	6.0	13	25	37

Figure 1. Diagram of experimental design for 1981 and 1982 True Fir Stratification study.



* 1981 only

Initial Stratification

Seeds were soaked for 24 hours in water at 21°C, with at least 3 water changes. After soaking, the seeds were drained, placed in plastic bags, and stratified at 2°C for 2 or 4 weeks.

Moisture Levels Adjustments

Four lots of 100 seeds were oven-dried at 85°C for 24 hours to determine a mean dry weight (d.w.) for each species. The mean dry weight was used with each "target" moisture content (m.c.) to calculate the desired fresh weight (f.w.) to which the seeds had to be dried (Edwards 1980). Moisture levels were calculated on a fresh weight basis using the formula:

$$m.c.(\%) = \frac{f.w. - d.w.}{f.w.} \times 100$$

In 1981 seeds were air-dried to the "target" moisture levels within 12 hours, but oven-drying at 30 C for 16 to 24 hours was necessary to reach the medium and low moisture levels in 1982. Dried seeds were placed in plastic bags to prevent further changes in moisture level.

Restratification

Seeds were returned to cold storage at 2°C for continued stratification after drying. Seeds were checked frequently for fungal contamination. Individual lots were treated so stratification was completed and seeds sown on the same day.

Sowing

Treated seeds were sown in a randomized block design consisting of 3 blocks each in the nursery and greenhouse. Nursery sowing dates were May 14, 1981 and May 21, 1982. Nursery treatment plots occupied a 1 x 4 foot area. Greenhouse sowing was done from May 17 to 20, 1982, in 6 cu. in. leach cells containing a 1:1 peat:vermiculite soil mix. Greenhouse temperatures during germination averaged 18°C during the day.

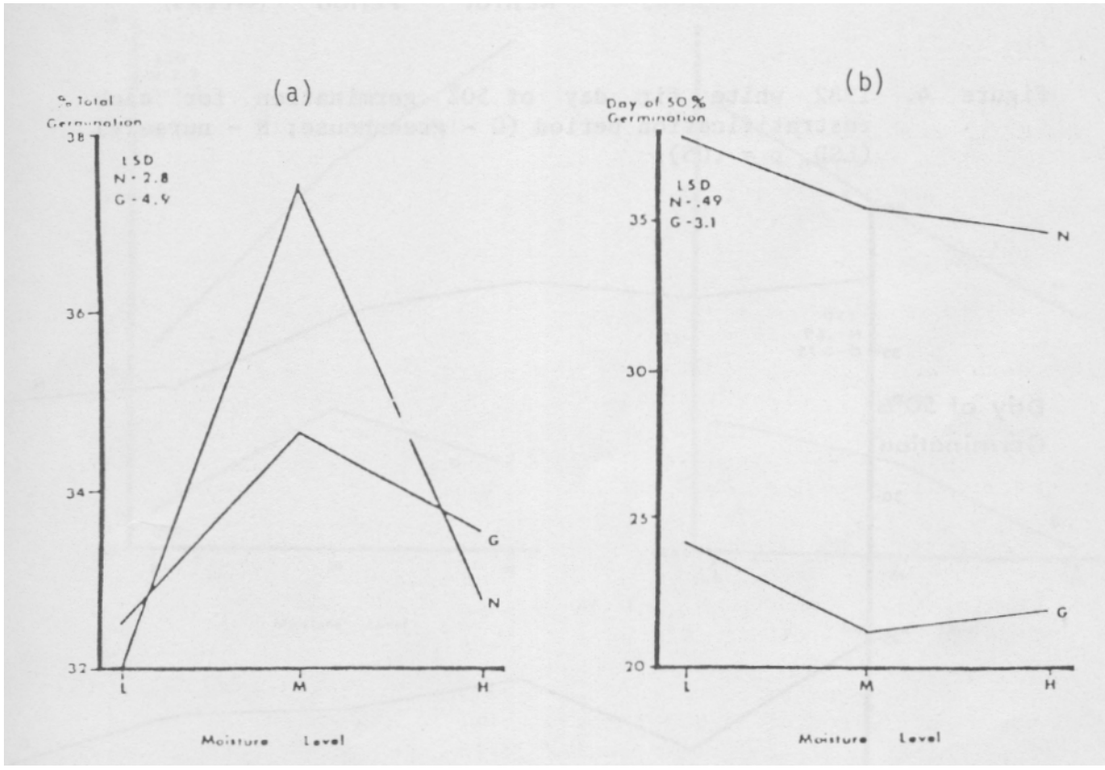
Measurements and Analysis

Germination counts were taken on each treatment plot every 3 to 4 days in the nursery and every 2 to 3 days in the greenhouse. Seeds were considered germinated when at least 3 cotyledons were free of the seed coat. Percent total germination was calculated based on the number of seeds sown. Day of 50% germination (i.e. the number of days from sowing until 50% germination) was determined based on the final number of germinants. Both percent total germination and day of 50% germination were subjected to analysis of variance.

RESULTS

Total germination in 1981 was low due to cold wet conditions during the spring. Results, however, were similar for the two years. Total germination in 1981 and 1982 was significantly ($p = .01$) greater for nursery sown white fir seed at the medium moisture level (Figure 2). Moisture level was not significant for greenhouse sown white fir, but the medium level tended to have slightly better germination (Figure 2). Day of 50% germination was significantly ($p = .05$) less for white fir at the higher moisture levels in the greenhouse and nursery (Figure 2). Also, for both years restratification period significantly ($p = .01$) affected total germination of white fir in the nursery and greenhouse. Longer restratification periods (6 weeks in 1981 and 8 and 10 weeks in 1982) increased ($p = .05$) total germination (Figure 3). Day of 50% germination for greenhouse and nursery sown white fir was significantly ($p = .05$) earlier for 10 weeks restratification in 1982 (Figure 4).

Figure 2. 1982 white fir germination results. (a) Percent total germination of seed sown in the greenhouse (G) and nursery (N). (b) Day of 50% germination of seed sown in the greenhouse (G) and nursery (N) (LSD, $p = .05$).



In contrast to white fir, total germination in the nursery was significantly (p = .05) better for Shasta red fir seed restratified at the highest moisture level. Greenhouse germination did not vary with moisture level (Figure 5). Day of 50% germination was significantly (p = .05) earlier for the highest moisture level (Figure 5). Restratification period, significantly (p = .05) affected total germination and day of 502 germination of Shasta red fir sown in the nursery but not in the greenhouse (Figures 6 and 7). The longest restratification periods produced the best total germination in the nursery in 1981 and 1982 (Figure 6). Overall, total germination was higher in the nursery and day of 50% germination was earlier in the greenhouse.

Figure 5. 1982 Shasta red fir germination results. (a) Percent total germination of seed sown in the greenhouse (G) and nursery (N). (b) Day of 50% germination of seed sown in the greenhouse (G) and nursery (N) (LSD, p = .05).

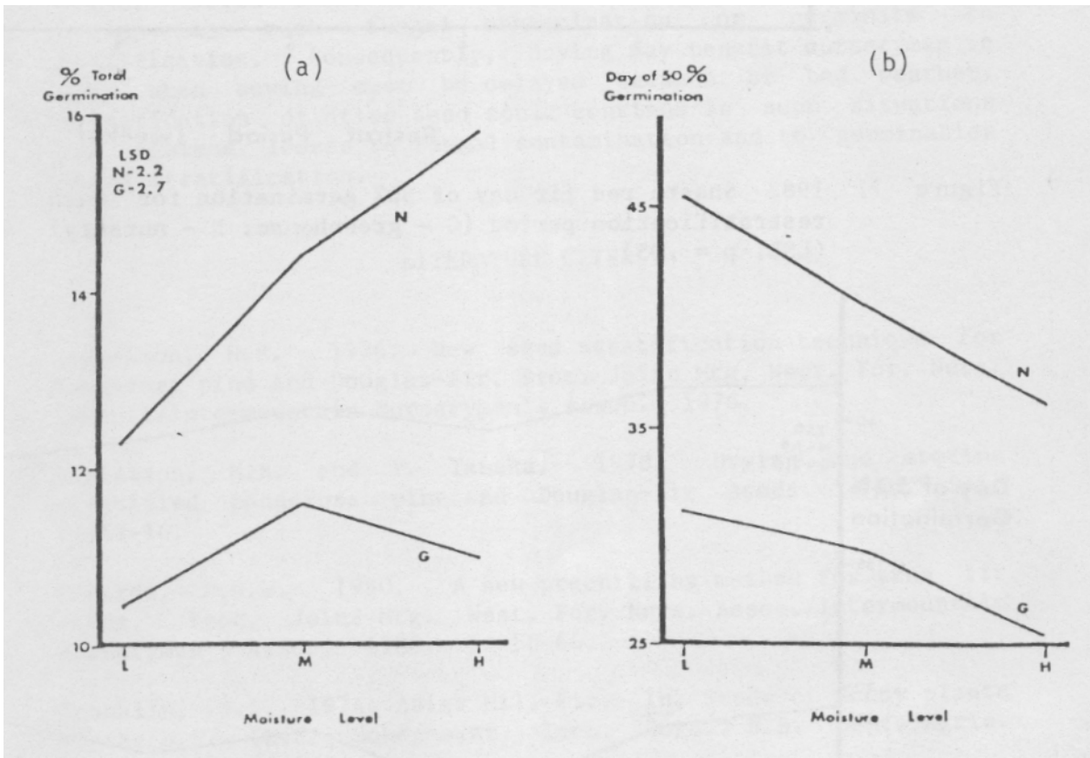


Figure 6. 1982 Shasta red fir percent total germination for each restratification period (G - greenhouse; N - nursery) (LSD, p = .05)

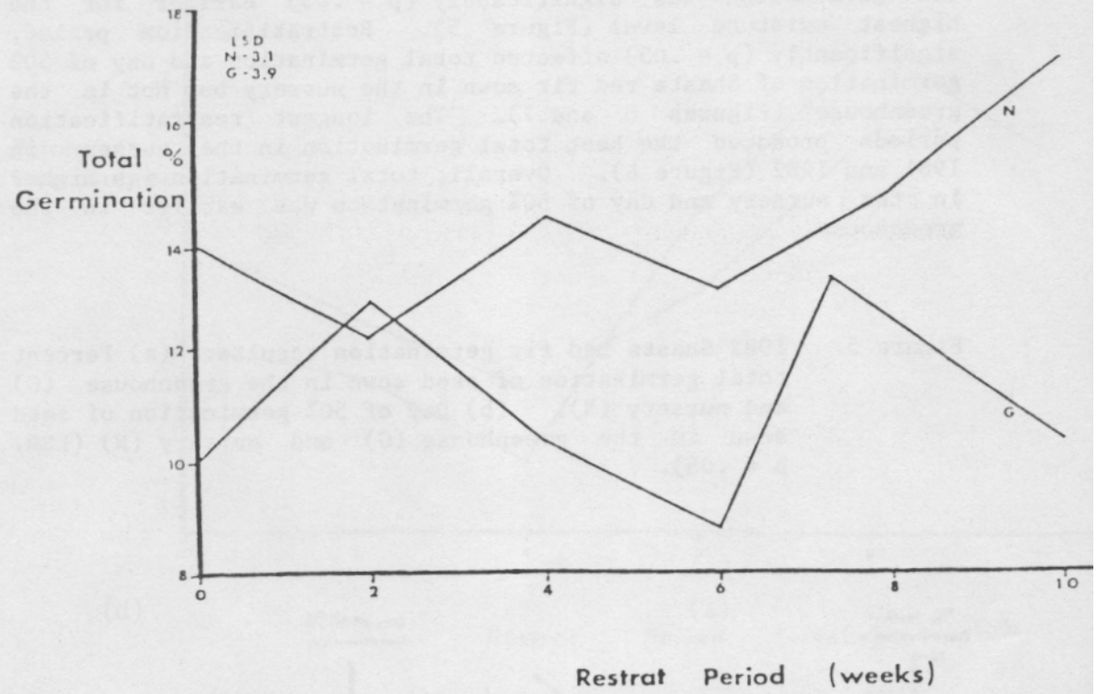
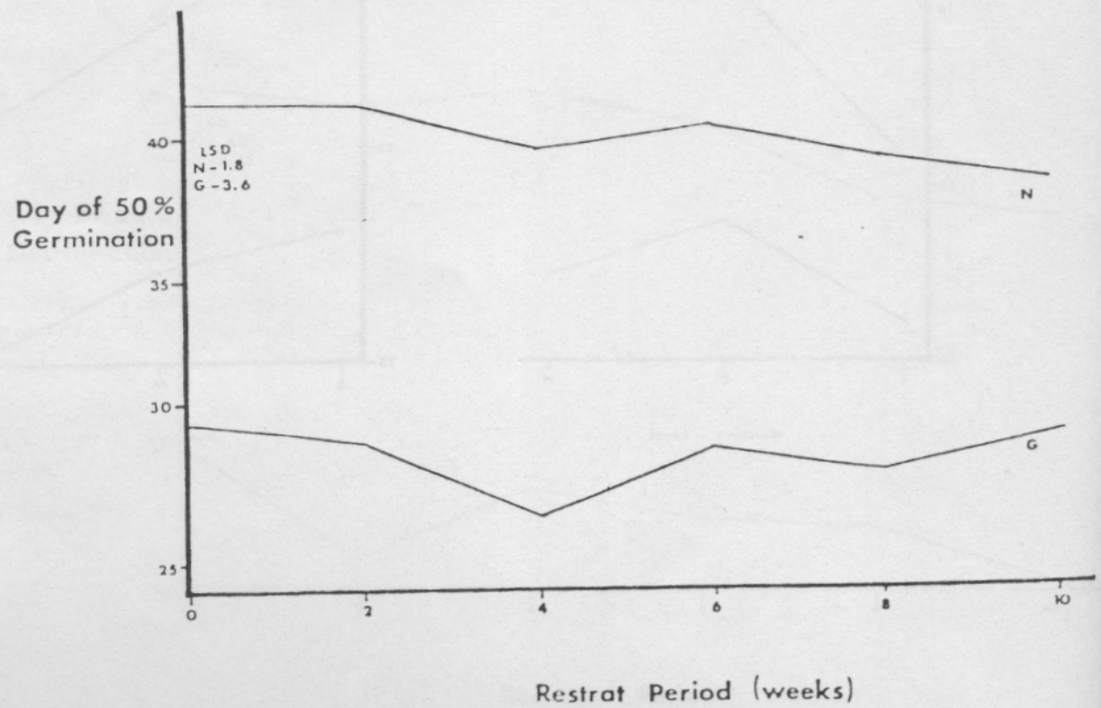


Figure 7. 1982 Shasta red fir day of 50% germination for each restratification period (G - greenhouse; N - nursery) (LSD, p = .05).



DISCUSSION AND CONCLUSIONS

The measured germinative capacity of white fir and Shasta red fir seed is typically low and may vary from 20% to 50% among seedlots (Franklin 1974). This makes it difficult for nursery growers to know how much seed to sow to obtain required numbers of seedlings. An improved stratification procedure that consistently provides maximum germination would benefit growers.

Results of this study indicate drying white fir seed to a medium moisture level (25%-30%) tends to increase total germination roughly 5i.. Drying Shasta red fir seed decreased total germination about 4%. This small increase in white fir germination may not warrant the time and effort required to dry large lot of seed. To increase germination nurserymen might better concentrate on seed quality rather than stratification procedures.

Drying, however, does have some advantages. When seed is stratified for extended periods of time and at higher moisture levels, fungal contamination often develops. Seed germination while in stratification is also a problem at high moisture levels. Dried seed, as demonstrated in this study, does not develop as much fungal contamination or germinate in stratification. Consequently, drying may benefit nurserymen in years when sowing must be delayed because of bad weather. Stratification of dried seed could continue in such situations with minimum losses to fungal contamination and to germination during stratification.

LITERATURE CITED

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