

# Stratification and Germination of Western White Pine Seeds<sup>1</sup>

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Abstract.--Techniques of stratifying Western white pine seeds were compared as was length of stratification. Speed of germination increased with increased stratification periods. Layered peat moss stratification and stratification on top of peat/vermiculite substrate were equally effective. Soaking seeds in water prior to layered peat stratification and layering dry seeds produced conflicting results, indicating a need for further study.

## INTRODUCTION

Western white pine is an important timber species of the Western United States. Although germination methods have been published in both U.S. and international seed testing rules, the species is very dormant and often firm, ungerminated seeds remain at the conclusion of laboratory germination tests.

Firm seeds are dormant and indicate that pretreatment has not been sufficient to overcome seed dormancy. Even after very lengthy stratification periods, dormancy is not always overcome. Seeds of Western white pine have been reported to germinate in the nursery bed a year after sowing (Kathy Wolfe, 1985, personal communication).

Investigators have begun to look at alternative and more effective methods of pretreating Western white pine seeds. For example, a method utilizing laundry bleach was shown to increase germination and reduce stratification time by 50 percent (Advincula, et al, 1983). A combination of warm and cold stratification was also reported as being effective in overcoming dormancy in Western white pine seeds (Anderson & Wilson, 1966).

J. Herbert Stone Nursery stratification procedures for Western white pine seeds involves soaking seeds in water for 48 hours and then layering the seeds in nylon mesh bags between peat moss at 3C for 13 weeks. They have used this same procedure in their seed laboratory and believe that it gives more rapid germination results than those obtained when following AOSA rules.

This paper is a preliminary report of a cooperative study between J. Herbert Stone Nursery and Oregon State University Seed Laboratory to evalu-

ate the J. Herbert Stone Nursery procedure as a laboratory method for measuring seed germination. It was felt that if stratification procedures between the laboratory and nursery were the same, laboratory results may more closely predict actual field emergence. In addition, it was hoped that speed of emergence would improve, resulting in lower firm seed counts at the conclusion of the germination test.

## MATERIAL AND METHODS

Ten seed lots of Western white pine harvested in 1984 from locations throughout Oregon were used in this study. Seeds were tested immediately after extraction and cleaning without any storage period. Germination tests were conducted by placing seeds on media contained within covered plastic boxes measuring 12 cm square x 2.8 cm deep. Each germination treatment consisted of four replicates of 50 seeds. Germination media was a peat/vermiculite mix. Germination temperatures were alternating 20-30C with cool white fluorescent light during the 8 hour 30C period; constant 25C with 16 hours of light daily; and room temperature with 16 hours of light daily. Light at 25C and room temperature was from Sylvania Grow-lux fluorescent tubes. Stratification was conducted by imbibing seeds on top of a peat/vermiculite mix or by layering dry and presoaked seeds between wet Canadian sphagnum peat moss. Seeds that were soaked were placed under running tap water for 48 hours at room temperature. Stratification temperature was 3C. Germination counts were made every 7 days up to 49 days. Remaining ungerminated seeds at the Oregon State University laboratory were cut to determine presence of firm seeds. AOSA Rules for Testing Seeds (1981) were used to evaluate seedlings. Design of the experiment was a split plot.

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Table 1.--Percent germination at 28 and 49 days of western white pine seeds stratified on top of and layered between media following soak and no soak treatments. Germination temperatures were 20-30 and 25C. (OSU data)

Sample #	Seeds imbibed on							
	top of peat/vermiculite				Seeds layered between peat			
	20-30C/8 hrs light				25C/16 hrs light			
	No soak		48 hr soak		No soak		48 hr soak	
8 wk ch	13 wk ch	8 wk ch	13 wk ch	13 wk ch	13 wk ch	13 wk ch	13 wk ch	
28	49	28	49	28	49	28	49	
3903	3	29	17	59	70	78	83	89
4837	18	49	76	83	41	61	65	79
4838	20	38	52	67	35	50	50	69
4839	29	55	70	79	43	69	65	80
4840	6	42	29	63	22	57	32	55
4841	30	64	63	78	43	79	58	82
6003	30	69	70	85	29	44	54	63
6004	15	54	62	80	26	58	38	59
6005	1	42	13	40	14	24	30	39
6006	-	-	33	67	6	21	29	42
$\bar{X}$	16.9	49.1	48.5	70.1	32.9	54.1	50.4	65.7
$\bar{X}$ Firm seeds*	-	36.7	-	19.3	-	33.4	-	22.4
$\bar{X}$ Viability**	-	85.8	-	89.4	-	87.5	-	88.1

\* Firm seed refers to firm ungerminated seed.

\*\* Viability refers to total germination plus firm ungerminated seed.

Data was analyzed at the 5% level using both a paired t test and analysis of variance.

#### RESULTS AND DISCUSSION

Data in Table 1 summarizes Oregon State University results of this study. Total viability, including percent germination plus firm ungerminated seed, remained relatively constant regardless of the treatment. Viability of the seed lots was near 90 percent.

Speed of germination increased with longer stratification periods. Average germination at 28 days was about 17 percent after 8 weeks stratification compared to figures double that after 13 weeks stratification. Speed of germination was not greatly affected by method of stratification. It was felt that stratification in peat moss would increase speed of germination. Only one sample showed a significant response to stratification treatment. Germination percent of sample 3903 was 83 at 28 days when soaked and stratified in peat compared to only 17 percent when seeds were stratified on top of media. One sample showed significantly higher germination at 28 days following stratification on top of media than when soaked and stratified between peat moss. Sample 6004 germinated 62 percent at 28 days following stratification on top of media compared to 38 percent when soaked and stratified between peat moss.

Soaking seeds prior to stratifying between peat increased both speed of germination and total germination on tests at the Oregon State University laboratory, but not at J. Herbert Stone. Average Oregon State University germination results of soaked seeds at 28 days was about 50 percent compared to about 33 percent without soaking (Table 1). Results at J. Herbert Stone (Table 2) were

Table 2.--Percent germination at 28 and 49 days of western white pine seeds stratified layered between peat moss following soak and no soak treatments. Germination temperature was room temperature. (J. Herbert Stone data)

Sample #	Room temperature/16 hrs light			
	No soak		48 hrs water soak	
	13 wk chill		13 wk chill	
	28	49	28	49
3903	34	77	34	66
4837	61	86	27	64
4838	19	68	39	64
4839	45	73	35	61
4840	7	52	23	48
4841	45	79	31	74
6003	39	73	31	63
6004	16	63	42	74
6005	12	40	13	28
6006	9	32	11	32
$\bar{X}$	28.7	64.3	28.6	57.4

almost identical regardless of treatment. Their average germination percent without soaking prior to stratification between peat moss was 28.7 compared to 28.6 when seeds were soaked prior to stratification between peat moss.

Similar studies are being conducted on the same seed lots after having been in frozen storage for 6 months. To date the results of tests on seeds without storage indicate that speed of germination increases with increased length of stratification. No one method of stratification produced superior results. Stratification procedures used at the Oregon State University Seed Laboratory compared favorably with nursery practices at J. Herbert Stone Nursery. Additional testing will be required to determine whether soaking prior to stratification in layered peat moss influences speed of germination.

#### LITERATURE CITED

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