GERMINATION OF WESTERN WHITE PINE SEED

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ABSTRACT: Two series of germination tests were conducted to compare different stratification techniques for western white pine seed. The first series of tests compared stratification in moist peat moss, naked stratification, and stratification on media in Ray Leach pine cells. The second series of tests added a fourth treatment involving a chlorine soak. Stratification in pine cells yielded the most promising results in both trials.

INTRODUCTION

Western white pine (Pinus monticola Dougl.) is one of the most productive timber species in the Inland Empire. In northern Idaho and western Montana, western white pine is planted for reforestation of federal, state, and private lands.

In 1968, the Northern Region of the Forest Service discontinued planting of western white pine due to the devastating effects of the pathogen Cronartium ribicola Fisch., white pine blister rust. But tree improvement research has since led to development of western white pine seed sources which are resistant to blister rust. The majority of the resistant seed is produced in three seed orchards located in Idaho. The white pine cooperators in the Inland Empire Tree Improvement Cooperative have established additional seed orchards, but most are not yet producing seed, and cone and seed insects in the three producing orchards are seriously reducing yields. Furthermore, as the orchard yields decrease, the demand for western white pine planting stock is increasing (table 1). So, western white pine seed is not only very valuable in terms of the research that has gone into the production of improved seed, but it is also in high demand and short supply. This situation makes it essential for the grower to come as close as possible to the "one seed per seedling" ideal.

Table 1.--Western white pine grown at Coeur d'Alene Nursery, 1982-1986

Bareroot		Container	
Date to ship	Thousands	Date to ship	Thousands
Spring 82	362	Fall 82	394
Spring 83	629	Spring 83	101
Spring 84	666	Fall 83	370
Spring 85	[1]1014	Spring 84	[3]482
Spring 86	[2]635	Fall 84	[4]269
		Spring 85	27

[1] Total request from Region 1 Forests
[2] Adjusted request to account for seed shortages (original request 1MM +)
[3] Adjusted request to account for seed shortages (original request 294 M)
[4] Adjusted request to account for seed shortages (original request 259M)

Two problems which plague the western pine grower are 1) the lack of consistent, high correlation between laboratory germination tests and operational sowings, and 2) the length of time over which new germination will occur. The first problem causes many growers to oversow white pine more than other species to guarantee that they will meet requests. The second problem, the tendency of western white pine to delay germination until the second season after sowing, results in non-uniform seedbed densities and heavy culling during the grading operation. Both situations make less than optimal use of the small amount of available seed.

Numerous trials have been conducted with both eastern and western white pines to develop a presowing treatment that would consistently give rapid, uniform germination. Wahlenberg (1924) advocated fall sowing of western white pine to avoid what he called the "hold-over characteristic," the tendency of the five-needled pines to not germinate all their viable seed the first season after spring sowing. Larsen (1925) believed that the delayed germination was caused by the presence of an impermeable seed coat, and suggested various stratification techniques, chemical and mechanical scarification, and exposure to freezing temperatures, as solutions. Studies with eastern white pine seed tested the value of

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plant growth regulators (Kozlowski 1962a) and other chemicals (Kozlowski 1962b). The responses of eastern white pine seed to light (Toole and others 1962), and western white pine to infrared irradiation (Works and Boyd 1972) have been tested, as have the effects of an oxygen-enriched stratification environment (Kidd 1982). Some of these techniques have been successful, and some have not, but none has given satisfactory results with each repetition.

In the past three years, the Coeur d'Alene Nursery has conducted a number of administrative studies and operational sowing trials with western white pine seed, comparing different stratification treatments and durations. The objective of these trials has been to develop a pre-sowing treatment for this species that gives consistent, rapid germination, and yields the maximum number of seedlings per unit of viable seed.

This paper presents the results of two series of germination tests conducted by the seed laboratory at the Coeur d'Alene Nursery.

1983 WESTERN WHITE PINE STUDY

Methods

The first series of germination tests consisted of three treatments and nine seed lots. The seed lots were all collected in 1980, they had all been in freezer storage at 0 F (-18 C), and they had all been tested previously (table 2). The three treatments consisted of 1) stratification in moist peat moss (Peat), 2) naked stratification (Naked), and 3) stratification on premixed growing media in pine cell containers (Container). Each stratification treatment was initiated following a 48-hour running water soak Stratification was 100 days at 34° to 36° F (1ª to 2° C).

Treatment #1, Peat.--At the time of this test, stratification in peat moss was the normal operating procedure for western white pine at the Coeur d'Alene Nursery. This treatment may therefore be considered the control (the previous tests for each of the nine seed lots had been stratified in this manner). Following the 48-hour soak, the seed, in nylon mesh bags, was buried between two layers of moist peat moss. The peat moss was moist enough that water could be squeezed out without difficulty. The tray containing the peat was put into a plastic bag and closed loosely with a twist tie. At 3week intervals the seed was uncovered, the mesh bags dipped in water to maintain a surface film of moisture on the seed, and reburied in the peat.

Treatment $2, Naked.--Following the 48-hour soak, the mesh bags (one per seed lot) were placed in plastic bags and loosely closed with twist ties. The bags were removed from stratification once a week and soaked for 1 hour in running water. They were then reinserted in the plastic bags, and put back into the stratification room.

Treatment M3, Container.--Following the 48-hour soak, the seeds were hand sown on pine cells filled with the standard, 50% peat/50% vermiculite growing media used in the Coeur d'Alene greenhouses. The seeds were covered with a thin layer of perlite, and watered until water ran out of the bottoms of the containers. The trays (200 cells each) were placed inside large trash bags and put in the stratification room.

Following the 100-day stratification period, the peat and naked treatments were removed from the stratification room, and the seed spread on paper towelling to surface dry. The seed was sown with a vacuum counter in square plastic germination dishes; the media used was kimpak, moistened with tap water. Each treatment was repeated four times for each seed lot (four replications of 100 seeds, each germination dish being one replication). The germ dishes were placed in the germinator, which was set at the standard temperature regime, 8 hours at 86° F (30° C) with light, 16 hours at 68° F (20° C) in darkness. Counts were made at 7-day intervals for 28 days.

On the same day that the peat and naked treatments were put in the germinator, the container treatment was moved from the stratification room to the small glass greenhouse. Each seed lot had two trays of 200 containers each (four replications of 100 seeds). The trays were arranged randomly on the bench, and the temperature was set to maintain about 70° F (21° C). Bottom heat was not used, and the bench was directly against the glass. Counts were made at 7-day intervals for 28 days.

Results

Table 2.--1983 western white pine germination

SEED LOT	NO. DAYS	28-DAY GERMINATION %			PREVIOUS TEST	
ID	STRAT	PEAT	NAKED	CONT	DATE	GERM %
3379	100	85	83	93	81	87
4305	100	85	82	97	81	86
4611	100	65	37	79	81	79
4612	100	82	83	83	81	54
4613	100	60	55	81	81	73
4616	100	70	70	92	81	62
4621	100	44	34	73	81	77
4622	100	57	59	84	81	63
4654	100	22	9	64	81	44

1984 WESTERN WHITE PINE GERMINATION STUDY

Methods

The test conducted in 1984 was similar to the 1983 test except there were fewer seed lots (six) and one additional treatment (table 3).

Treatment #1, Peat.--This treatment was the same as in the 1983 test.

Treatment #2, Naked.--This treatment was the same as in the 1983 test.

Treatment #3, Container.--This treatment was the same as in the 1983 test with one exception: The small glass greenhouse was not kept as warm during this study. Because of the slow response of the seed the first two counts (two weeks), one additional count was taken on day 35.

Treatment #4, U of I.--The "University of Idaho" treatment was developed by Benny Advincula, Art Partridge, and John Woo. The method is explained in detail in the Coeur d'Alene Nursery's 1983 Annual Report. The seed was soaked for 10 minutes in a solution of two parts bleach, three parts tap water. It was then washed in running water for 4 days. The seed (still in mesh bags) was wrapped in wet paper towelling, and each seed lot was placed in a plastic bag. The seed was stratified in the stratification room with the other treatments, but for only 45 days, instead of 100 days.

Results

Table 3.--1984 western white pine germination

SEED LOT ID	NO. DAYS STRAT	28-DAY GERMINATION % PEAT	NAKED	CONT	U OF I	PREVIOUS TEST DATE	PREVIOUS TEST GERM%
4779C	100	41	75	87		83	50
	45				83		
4779I	100	43	71	90		82	45
	45				78		
4779K	100	60	66	84		82	40
	45				76		
4780I	100	60	60	90		82	57
	45				84		
4684C	100	44	61	96		82	67
	45				79		
2044L	100	59	70	86		82	57
	45				77		

DISCUSSION

The first observation to be made from these tests is that the western white pine seed lots germinated better when stratified in containers than when stratified by any of the other methods. In general, the University of Idaho treatment was the second best treatment. The most striking observation to be made from the peat moss and naked stratification treatments in both studies is that they consistently resulted in much poorer performance than the container and U of I treatments. With a few exceptions, there did not appear to be a marked difference between the peat and naked treatments.

There are a number of possible explanations for these results. The superior performance of the seed stratified in containers may result from the individual environment in which each seed was stratified. If there are water-soluble inhibitors within the seed, this method would preclude them from affecting adjacent seeds. The concentration of oxygen may also be higher around the individual seed under a thin layer of perlite, than in the center of a mesh bag containing 500 seeds. It is also possible that the temperature of the greenhouse in which the containers were germinated was more favorable than the higher temperatures of the germinator.

The University of Idaho treatment is significant in that it resulted in germination percentages nearly as high as those of the container treatment, and in less than half the stratification time. This treatment destroys mold spores on the surface of the seed coat, and its developers feel it may also affect the physical structure of the seed coat.

It does not appear that genetic differences are reflected in these results. The mixture of seed lots used for the two studies contains seed from both seed orchards and seed production areas (open-pollinated wild stands that have been rogued and managed for seed production). We do know from tree improvement research that individual families behave very differently in terms of germination rate and percent, but all the seed lots tested here reacted similarly.

The obvious problem with the container method is that it cannot be used in a bareroot operation, and takes considerable cooler space to implement for a container operation. The University of Idaho method has not given totally consistent results when repeated, but is much easier to implement on an operational scale. Both treatments appear more promising than the traditional peat or naked stratification methods.

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