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STRATIFICATION OF SHORTLEAF PINE SEEDS

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Abstract

Tests with 16 separate lots of shortleaf pine (*Pinus echinata* Mill.) seeds, representing various sources and years of collection, indicate that the greatest increase in speed of germination occurred after stratification for 56 to 70 days. Stratification increased total germination over that of the control, but there were no differences between treatments for periods of from 14 to 84 days.

Since shortleaf pine (*Pinus echinata* Mill.) seeds are usually dormant, cold stratification for 30 to 60 days has been recommended for prompt, complete germination (*2, 7, 8*). These recommendations were based on completeness rather than speed of germination. Seidel (*6*), on the other hand, working with a single seed lot, found that germination speed increased progressively with lengths of stratification up to 60 days.

This paper reports speed and completeness of germination after stratifying seeds of varying ages for periods from 14 to 84 days.

Methods

Of 16 lots tested, 11 had been stored for at least 1 year. Of these, three were 12 years old, one had been stored 1 year, and the other seven had been held 2 or 3 years. Seeds of all five *fresh* lots were collected from individual trees in central Louisiana. The *stored* seeds were composite lots from Arkansas, Kentucky, and Mississippi, and all had been stored for the last few years at 25° F.

Seeds were stratified at 34° F. in covered dishes containing a 1:2 mixture of moist sand and peat moss for 0, 14, 28, 42, 56, 70, and 84 days. Treatments were timed to end on the same day, at which time all germination tests were begun.

Duplicate 100-seed samples from each lot and length of stratification were germinated at 72° F. and a 16-hour photoperiod for 28 days. Emerging seedlings were counted every 2 or 3 days to determine when peak germination occurred. A germination value (*3*) was computed for each sample by obtaining the product of peak value and mean daily germination. Germination percentages were transformed to arc $\sin\sqrt{\text{percent}}$ for analysis. Differences in transformed percents and in germination values were tested for statistical significance at the 0.05 level. Separate and combined analyses were run for the fresh and stored seeds.

Results

Stratification increased both speed and completeness of germination. Treatment for 14 days was, however, as effective as that for 84 days in increasing total viability (table 1). The increases occurred primarily in stored lots, in which germination was increased 8 percentage points by stratifying for 14 days. Viability of these seeds was highly variable before treatment, ranging from 34 to 92 percent. In contrast, the fresh seeds had uniformly high germination averaging 97 percent with no differences due to length of treatment. Obviously, stratification could not improve this performance appreciably.

Germination of only two lots was markedly depressed by stratification, and for these, short periods were as detrimental as long ones. Viability of seeds of one lot was unaffected by treatment.

TABLE 1.—*Germination of shortleaf pine seeds stratified for seven different periods*

Days of stratification	Stored seeds	Fresh seeds	All seeds
	Percent	*Percent*	*Percent*
0	74	97	81
14	82	96	87
28	84	97	88
42	81	98	86
56	83	96	87
70	85	97	88
84	84	97	88

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Germination values (*3*) generally increased with each increase in length of stratification up to 70 days (table 2). The increase in germination values from 14 to 70 days indicates mainly changes in speed of germination, since total viability changed little between these times. Of the two components making up the formula for germination value, peak value primarily reflects speed. Comparing the days required to reach peak values indicates the effect of the treatments on speed of germination:

Days of stratification	*Days to peak value*
0	14
14	10
28	9
42	9
56	7
70	6
84	7

TABLE 2.—*Germination values of shortleaf pine seeds stratified for seven different periods*

Days of stratification	Stored seeds	Fresh seeds	All seeds
0	11.4a[1]	23.7a	15.3a
14	20.8b	35.1b	25.3b
28	21.5b	38.0b	26.6bc
42	22.1b	37.7b	27.0bc
56	29.3c	46.5c	34.6cd[1]
70	33.6d	51.7d	39.3d
84	30.2c	48.1cd	35.8d

[1]Within columns, values followed by the same letter do not differ significantly at the 0.05 level according to Duncan's multiple range test.

In all lots, about half of the increase in germination values occurred with 14 days of treatment and the other half was spread over the remaining 70 days (table 2). Values increased threefold in old lots and about twofold in fresh ones. Statistical analyses of germination values of the 11 stored lots showed that all treatments were better than the control and that stratification for 70 days was best. Differences in values for lots stratified 56 and 84 days were not significant, but both were higher than for seeds stratified 14, 28, or 42 days. Although the differences among treatments were not as great with the fresh seeds, the pattern of response was essentially the same as in the older lots. The major exception was that the germination values for the 70-day treatment were not significantly better than those for 84 days.

With or without treatment, germination values of the stored lots varied considerably, indicating that stratification needs of individual lots differed. Paired germination tests should be made to accurately determine the need of a particular lot. However, almost all lots benefited from stratification. The differences in dormancy between the fresh and older seed lots is not unusual. Previous studies with loblolly pine seeds have indicated that processing techniques, which varied in the present study, can influence seed dormancy (*1*, *4*) and that storage, particularly at moisture contents of 10 to 18 percent, can increase dormancy (*5*).

Stratification for less than 70 days is probably sufficient for some purposes. Response was nearly as great at 56 days, which was better than shorter periods. There were no significant differences between treatments for 14, 28, and 42 days. In direct seeding, where fast germination is desirable to reduce losses to predators, stratification for at least 56 days is recommended unless paired germination tests indicate that a shorter time is sufficient.

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