Storing Stratified Seeds for Extended Periods

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This study evaluates the viability of loblolly pine, slash pine, and Douglas-fir seeds after the moisture content of the stratified seeds has been reduced. The results warrant further tests on a production scale to determine practical potentials for this treatment.

Uncooperative weather during the sowing season may cause nursery personnel to delay sowing seeds. If the seeds are stratified, delays can result in their germination during storage. Prolonged storage of stratified southern pine seeds consistently decreased germination of all species (*3,4*). In the past, anticipated long delays resulted in redrying of stratified seeds. This often led to the loss of the benefits of stratification (1) and required restratifying. Danielson and Tanaka (*2*) found that the stratification effect was retained for up to 9 months in Douglas-fir Pseudotsuga menziesii) when the moisture content of stratified seeds was reduced to about 15 percent.

Increasing the moisture content of nonstratified loblolly pine (*P. taeda*) seeds may decrease dormancy (*3*). The greatest dormancy occurred at moisture contents between 10 and 20 percent and the least above 20 percent.

Materials and Methods

Three lots of loblolly pine, two lots of slash pine (*P. elliottii*), and one lot of Douglas-fir were selected from seed stores. The loblolly lots represented a Georgia seed orchard and two wild collections (coastal plain and Piedmont sources). The slash pine lots represented a Georgia seed orchard and a comparable wild collection source. The source of the Douglas-fir is unknown.

Each lot was thoroughly blended and subdivided into 12 sublots. Two sublots were used for the stratified and nonstratified controls. Four seed samples (each containing 100 seeds) were selected by a vacuum counter for these tests. The seeds were placed on moistened crepe cellulose paper (Kimpak) in plastic boxes. The nonstratified seeds were placed in a germination chamber for 28 days at 22° C with 16 hours light and 8 hours dark. Germination was recorded on Monday, Wednesday, and Friday for the duration of the test. Before germination, the stratified tests were placed in a cold-room at 3° C. The slash pine seeds were stratified for 22 days and the loblolly and Douglas-fir seeds for 30 days. The remaining 10 subsamples were soaked for 24 hours in tap-water, drained, and stratified in plastic bags at 3° C. Following stratification, each treatment was blotted to remove excess moisture and then placed in a column blower for 10 minutes of further drying. A 20-gram sample was dried in an oven to establish the moisture content. The remaining seeds were placed in small jars, capped, and stored at 3 to 5° C. One jar was removed every 30 days, and a germination test was prepared with the seeds.

Analyses of variance were made on the 28-day germination of the filled seeds and on the days required to reach 90 percent of the total germination. Duncan's multiple range test was used to determine differences among treatment means.

Results and Discussion

The average moisture contents, derived by drying after stratification, are given in table 1. They were all between 20 and 27 percent.

Loblolly pine. Germination at 28 days (table 2) indicated differences in seed vigor among the three lots. Lot A was strong and nondormant; lot B was strong and slightly dormant; and lot C was weak and nondormant. The stratified germination of lot C at 28 days was depressed.

Table 1.—*Moisture content of stratified seed after 10 minutes of drying in a column blower*

Sample	Moisture content
Loblolly (lot A)	23.7
Loblolly (lot B)	21.7
Loblolly (lot C)	22.8
Slash pine (lot D)	25.9
Slash pine (lot E)	28.3
Douglas-fir (lot F)	23.8

Table 2.—*Germination of stored stratified seeds at the end of a 28-day germination test*

	Loblolly pine			Slash pine		Douglas-fir
	seedlots			seedlots		seedlot
Length of storage	A	B	C	D	E	F
Months						
			Nonstratified			
0	88a[1]	80a	78a	91a	87a	94ab
			Stratified			
0	89a	84a	64abc	81ab	74ab	86ab
1	99a	95a	74ab	86ab	62bc	100a
2	100a	94a	68ab	79ab	51cd	83ab
3	100a	95a	72ab	72b	54cd	85ab
4	98a	86a	57bc	75b	66bc	79b
5	100a	81a	50c	72b	47de	79b
6	99a	89a	57bc	48c	39de	80b
7	96a	90a	63abc	50c	36e	83ab
8	100a	92a	58bc	54c	32e	79b
9	100a	88a	59bc	52c	35e	85ab
10	99a	85a	54c	37c	43de	85ab

[1]Within each lot, numbers followed by the same letter are not statistically different et the 1-percent level of probability.

Stratification normally depresses germination when vigor begins to decrease because of the aging process or possible seed injury. While lots A and B maintained strong viability, lot C significantly decreased in viability after 4 months of storage. The rate of germination (table 3) remained consistent during storage for lots A and B, but increased with storage of lot C.

Slash pine. The two slash pine lots possessed no dormancy. In fact, they showed signs of low vigor by the depressed germination after stratification (table 2). A significant decrease in viability occurred after 5 months for lot D and 1 month for lot E. A more dramatic decrease occurred after 4 months of storage for lot E. The rate of germination was increased by stratification in lot D and decreased in lot E. In general, the rate decreased with length of storage time to 2 months and then increased. Statistical differences were quite variable. Although the reasons for these variations have not been identified, they may relate to a biological rhythm.

Douglas-fir. The results supported the findings of Danielson and Tanaka. After 10 months of storage, germination was equal to that of the control samplues. The rate of germination was consistent with two exceptions. For unknown reasons, samples stored 3 and 10 months germinated much faster than other samples.

Overall, the most noticeable effect observed in the laboratory was the growth of seed mold. It increased with length of storage and declining vigor. Mold was observed on the seeds both in the storage containers and during the germination tests. In a practical application, seeds should probably be treated with a fungicide before sowing. Although treatment before storage may be possible, unpublished laboratory results indicate that toxic effects of the fungicides on seed viability increase with length of storage.

Conclusion

These results indicate that stratified slash pine, loblolly pine, and Douglas-fir seeds can be dried to between 21- and 26-percent moisture content and held at 3° C. Loblolly and Douglas-fir seeds were

Table 3.—*Days to reach 90 percent of total germination, after different lengths of storage of semidried, stratified seed*

	Loblolly pine			Slash pine		Douglas-fir
	seedlots			seedlots		seedlot
Length of storage	A	B	C	D	E	F
Months						
			Nonstratified			
0	22b[1]	23b	22d	7a	14bc	12bc
			Stratified			
0	14a	14a	16c	12bc	11ab	10abc
1	12a	13a	14bc	9ab	10ab	12bc
2	10a	12a	12b	7a	8a	13bc
3	10a	11a	12b	7a	12bc	9ab
4	12a	12a	12b	11abc	11ab	14c
5	12a	13a	15bc	14cd	15c	14c
6	13a	14a	13bc	17d	14bc	13bc
7	13a	14a	14bc	14cd	14bc	13bc
8	10a	12a	7a	12bc	11ab	10abc
9	11a	13a	11ab	7a	7a	12bc
10	12a	14a	13bc	14cd	14bc	7a

[1]Within each lot, numbers followed by the same letter are not statistically different et the 1-percent level of probability.

stored for 10 months and slash pine for 5 months without a significant decrease in germinability. These results also suggest that seeds with low germination percentages will not retain viability as well as those with high germination percentages. Such lots may also produce more seed mold. Caution should be exercised in production implementation of these results. Spontaneous heating may take place if large lots of moist seeds (moisture contents in excess of 20 percent) are sealed in containers, even in a refrigerator. Further tests are needed to investigate use of this technique on a production basis.

Literature Cited

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