Moisture Content Influences Dormancy Of Stored Loblolly Pine Seed

Note by B. F. McLemore and J. P. Barnett

Abstract. In *Pinus taeda* L. dormancy is greatest when seed is stored at 10 to 18 percent moisture. Seed is least dormant above this range but deteriorates more rapidly. Storage below 10 percent moisture is recommended to preserve viability and prevent deep dormancy.

AN INDICATION that moisture content during storage affects dormancy of loblolly pine seed was noted in research dealing with methods of extraction and processing. Dormancy appeared to deepen as moisture content was increased from 10.3 to 13.4 percent, but the limited range of the trial made the evidence inconclusive. Lack of literature concerning the relation of moisture content and dormancy prompted the initiation of the two studies reported here.

Methods and Results

In the first study, a single lot of fresh seed having about 10 percent moisture was divided, and sublots were stored for 1 year at eight moisture contents ranging from 6 to 20 percent in 2-percent intervals. Sublots to be stored below 10 percent were dried at 38° C; those to be stored at higher levels were spread on damp blotters until they reached the desired content. Storage was in sealed containers at 1° C, and each moisture level was replicated three times. Tests were conducted with stratified and unstratified sublots that were cleaned to 100 percent sound seed. Stratification was for 30 days at 1° C.

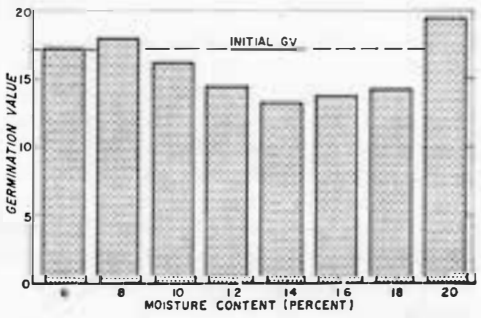

FIGURE 1. *Germination values of unstratified loblolly pine seed stored for 1 year at moisture contents ranging from 6 to 20 percent.*

Sublots stratified after 1 year of storage ranged from 96 to 98 percent in germination. Since potential germination did not vary with moisture levels, germination values of unstratified lots were used to assay dormancy. Germination value (GV) is a measure of both speed and completeness of germination and is the product of mean daily germination and peak value (Czabator 1962). Mean daily germination is computed at the end of the test; peak value is the highest number obtained by dividing cumulative germination by days of test. All tests reported here lasted 30 days.

Unstratified seed averaged 17.2 in GV before storage, with no differences between moisture levels. Values of seed stored at 20 percent moisture and below 10 percent were virtually unchanged after 1 year. Lots stored at 12 to 18 percent moisture had GV's ranging from 13.3 to 14.1 (Fig. 1). These reductions were significant at the 0.01 level.

The second study was essentially a repetition of the first, except that seeds were brought to five moisture levels ranging from 5 to 25 percent in 5-percent intervals. Tests were conducted with stratified and unstratified seed initially and after 1, 3, and 5 years of storage at 1° C.

Trends were the same as in the other study, but moisture levels had a more pronounced impact on dormancy. As Figure 2 indicates, GV declined drastically after 1 year of storage at 5, 10, and 15 percent moisture content. For storage at 25 percent GV was markedly higher than for fresh seed, but the high value masked a drop in viability: germination percent was significantly less than for storage at 20 percent moisture.

Relationships remained unchanged after 3 and 5 years of storage in that seed stored at 10 and 15 percent moisture was most dormant. Seed held at the 25-percent level had deteriorated to such an extent after 3 years that any measure of dormancy was meaningless, and after 5 years none germinated.

Germination percentages of unstratified sublots in the second study were almost identical initially

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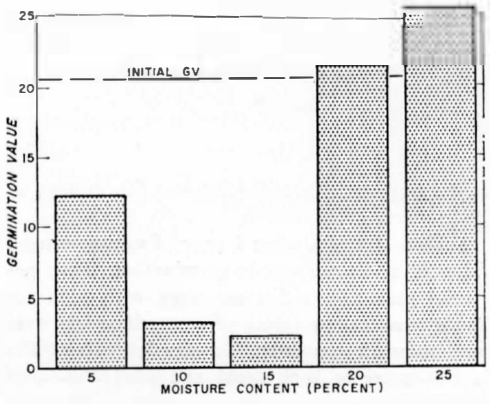

FIGURE 2. *Germination values of unstratified loblolly pine seed stored for 1 year at moisture contents of 5 to 25 percent.*

(Table 1). Large differences developed during storage and became more pronounced with time. Germination of unstratified seed stored for 5 years at moisture contents of 10 and 15 percent averaged 46 and 47 percent, as compared to 81 percent for seed stored at 5 percent moisture. After stratification, seed stored for 5 years at 5 percent moisture did not germinate significantly better than that stored at 10 and 15 percent. The inference is that the large differences in germination of unstratified seed were attributable to dormancy rather than nonviability.

There were significant decreases in viability over the 5-year period for seed stored at all moisture contents except 5 percent. Thus, drying seed to a low moisture content serves a twofold purpose: viability is preserved longer, and seed is less dormant than when stored at moisture levels of 10 to 18 percent.

TABLE 1. Germination of loblolly pine seed stored at different moisture contents.

Moisture content	Initial	After storage for: 1 year	3 years	5 years
Percent	*Percent*	*Percent*	*Percent*	*Percent*
	UNSTRATIFIED SEED			
5	95	94	95	81
10	95	79	83	46
15	94	82	76	47
20	94	98	92	72
25	94	91	11	0
	STRATIFIED SEED			
5	96	99	96	94
10	97	99	96	88
15	99	98	94	84
20	95	97	93	80
25	98	86	8	0

Discussion

The studies described here have shown that loblolly pine seed is least dormant when stored at moisture contents of 20 percent or greater. At 25 percent moisture in the second study, seed was substantially less dormant (Fig. 2) after a year of storage than when fresh. Apparently, high moisture partially simulates stratification, which normally raises moisture content to about 35 percent. Because the seed deteriorates rapidly, storage at these high levels is impractical. Conversely, storage at 10 to 18 percent moisture induces deeper dormancy than is present in freshly collected seed. The best course, then, is to dry seed to less than 10 percent, at which level germinability is preserved and extreme dormancy is avoided. Even then, cold stratification is needed for fast, complete germination.

It is seemingly a paradox that dormancy is deepened by increases in moisture up to the 10 to 18 percent range, and reduced by increases beyond the 20-percent level. This reversal may be related to rate of respiration and seed coat permeability. Thornton (1945) has suggested that dormancy of many seeds is the result of an accumulation of intermediate products, formed by partial anaerobic respiration, that act as inhibitors. These products are the results of an oxygen deficiency that is caused by the structure of the seed coat and also by external factors such as temperature, moisture, and oxygen supply. Increases in moisture content speed respiration, and thus, by increasing the amount of inhibitory products, may account for the greater dormancy of seeds stored with 10 to 18 percent moisture.

Reduction of dormancy when moisture content is increased still further may be due to increased permeability of the seed coats to gaseous exchange. Gases diffuse through moist tissue at a greater rate than through dry tissue (Fuller and Tippo 1949, p. 49, Gladstones 1958, Kozlowski and Gentile 1958). When loblolly pine seeds are raised above the 18- to 20-percent range of moisture, their coats are distinctly softer than at lower moisture contents, and hence probably more permeable to oxygen.

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