STORAGE OF LONGLEAF PINE SEED

B. F. McLemore
Southern Forest Experiment Station
Forest Service, U.S.D.A.
Alexandria, La.

Studies by the Alexandria Research Center show that vigor and viability of longleaf pine seed can be preserved for at least 5 years if the seed is stored at the correct temperature and moisture content.

Barton (1), Nelson (2), and Wakeley (3) found that low temperature and low moisture content are essential to longleaf seed storage. Their work did not include field germination, which is of great importance in direct seeding. Use of seed that had deteriorated in storage caused several failures in early seeding attempts and led to the widespread belief that only fresh seed should be sown. Consequently, three studies[1] were started to determine optimum conditions for longleaf seed storage and the interrelationship between temperature and seed moisture content. All studies are continuing.

Methods

The first study was installed in the fall of 1954. It consists of 12 treatments including all combinations of 0°, 25°, and 34° F. storage; 8 and 13 percent seed moisture; and winged and dewinged seed. Approximately 25 percent of the seed was empty.

The second study, installed in 1955, supplements the first. The 14 treatments include 7 moisture contents ranging from 6 to 18 percent in approximately 2-percent intervals, and storage at 0° and 340 F. All seed was cleaned to approximately 95 percent soundness and stored with wings attached.

Study number three was installed in 1957 and is essentially a repetition of the second, except that all treatments were applied to 3 separate lots of seed. The seeds were dewinged and nearly all empties removed.

Treatments in the first 2 studies were replicated 3 times; those in the third were replicated twice. All lots were stored in sealed metal cans and have retained their original moisture content reasonably well.

Laboratory germination was determined before storage and annually or biennially thereafter. At least 200 seeds from each treatment-replicate were included in each test.

The fifth-year test for the first study also determined field germination of seed treated with Arasan and endrin, the repellents used in direct seeding. The treated seeds were sown on January 22, 1960, on plots that had been spaded and raked level; the tests continued until April 4.

Results

Study one. --Moisture content was more important than any temperature under test (table 1). Seed dried to 8 percent moisture kept well for 5 years at 0°, 25°, and 34° F. That dried to 13 percent moisture kept satisfactorily only at 0 F. Variance analysis of fifth-year laboratory germination showed that differences due to seed moisture content and storage temperature were highly significant.

[1]The Louisiana Forestry Commission and the American Forest Seed Company furnished the seed for these studies.

Seed at 13 percent moisture began to deteriorate seriously during the second year if stored at 34° and during the third or fourth year if stored at 25° F. (fig. 1).

Wing condition had no significant effect on laboratory or field germination after 5 years of storage. This contradicts findings of earlier observers (2, 3). After the first, second, and fourth years, viability of winged seed was significantly higher than that of dewinged. No explanation is apparent for this reversal.

Field germination of treated seed was somewhat lower than laboratory germination of untreated seed, but the pattern was the same; i.e., seed stored at 8 percent moisture content had greater viability than that held at 13 percent.

Abnormal field germination caused the difference between laboratory and field germination: the radicle emerged from the seed coat but failed to penetrate the soil. With the Arasan-endrin coating such failures are common in the laboratory but unusual in the field. A combination of the treatment and severe weather conditions was probably responsible. During the first 45 days of field testing, when most germination occurred, minimum temperatures were below freezing on 22 days, and an 11-inch snow fell in mid-February. In spite of the adverse weather, an acceptable level of germination was obtained from 4 of the 6 seed moisture-storage-temperature combinations.

TABLE 1.--Viability of longleaf seed in first study, by treatment and year of testing

Storage temperature (°F.)	Moisture content	Wing condition	Laboratory germination after storage for--					Field germination, fifth year
			0 year	1 year	2 years	4 years	5 years	
	Percent		Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
0.....	8.....	Winged.....	65	61	62	61	70	53
		Dewinged....	62	56	53	53	66	47
	13.....	Winged.....	61	59	57	58	63	47
		Dewinged....	71	53	54	52	64	49
25.....	8.....	Winged.....	64	61	56	64	60	50
		Dewinged....	62	57	49	54	60	57
	13.....	Winged.....	63	61	58	51	50	40
		Dewinged....	68	48	52	45	47	44
34.....	8.....	Winged.....	64	61	57	54	59	53
		Dewinged....	63	49	51	54	60	49
	13.....	Winged.....	66	58	49	46	23	16
		Dewinged....	66	49	49	39	25	15

The germinations appear low because 25 percent of the seed was empty. On a fullseed basis, field germination of the 4besttreatments ranged from 64 to 71 percent. Longleaf lots having laboratory germination in this range readily produce acceptable stands when direct-seeded.

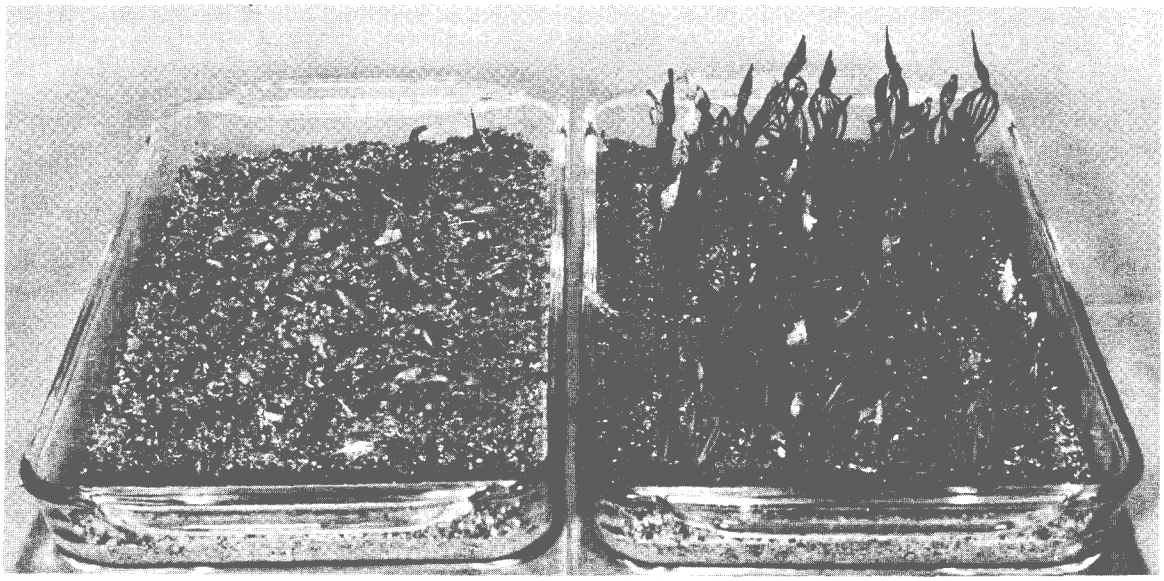

Figure 1.--Longleaf pine seed should be stored at moisture contents of 10 percent or less, and at 25'F. or below. Seed in tray at right germinated well after 5 years of storage under these conditions. That in tray at left was nearly all dead after 5 years at 34°F. and 13 percent moisture.

Study two. --Moisture content also influenced viability of seed stored at 34° F. in the second study. After 4 years, laboratory germination ranged from 0 for storage at 18 percent moisture to 82 percent for storage at 6 percent (table 2). Moisture contents of 6 to 12 percent maintained viability equally well, but each successive increase in moisture above 12 percent significantly decreased germination.

TABLE 2.--Laboratory germination of longleaf seed in second study, by treatment and year of testing

Storage temperature (°F.)	Moisture content	0 year	1 year	2 years	3 years	4 years
	Percent	Pct.	Pct.	Pct.	Pct.	Pct.
0.....	6.....	81	74	76	82	77
	8.....	87	71	78	85	77
	10.....	84	76	80	86	78
	12.....	84	75	77	84	78
	14.....	77	76	78	85	72
	16.....	80	75	80	86	76
	18.....	85	73	80	82	71
34.....	6.....	80	75	81	81	82
	8.....	82	68	78	83	78
	10.....	84	68	78	81	79
	12.....	84	75	81	84	77
	14.....	81	76	79	78	63
	16.....	81	74	76	64	32
	18.....	83	76	45	4	0

Seed stored at 0° F. kept well regardless of moisture content. Normal germination after 4 years ranged from 71 to 78 percent (table 2). The 71 percent germination for seed stored at 18 percent moisture suggests that a lower moisture content is needed to prolong viability of seed even at 0° F.

Study three. --In the third study, nearly all lots kept well for 2 years (table 3), except those stored at 34° F. and at moisture contents above 10 percent. At 18 percent moisture and 34° F. almost all seed died in 2 years.

At 0° F. viability of lots A and B was unaffected by moisture content, but lot C showed a small decrease in germination, particularly at moisture contents above 14 percent. This is probably an early indication that the seed has started to spoil.

TABLE 3.--Laboratory germination of longleaf seed in third study, by treatment and year of testing

Storage temperature (°F.)	Moisture content	Lot A			Lot B			Lot C		
		0 yr.	1 yr.	2 yrs.	0 yr.	1 yr.	2 yrs.	0 yr.	1 yr.	2 yrs.
	Percent	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
0	6	82	82	83	70	73	72	82	86	83
	8	82	82	88	74	76	76	90	84	86
	10	82	81	84	70	74	70	87	82	81
	12	82	87	83	73	76	71	90	85	82
	14	82	84	86	74	76	75	86	80	80
	16	85	81	77	76	72	77	89	79	78
	18	83	86	82	77	74	76	86	78	76
34	6	79	84	80	75	76	71	86	88	87
	8	84	88	80	68	80	71	86	89	84
	10	82	84	79	76	75	72	85	85	84
	12	86	79	61	72	65	50	86	82	76
	14	81	72	36	71	64	36	92	81	58
	16	82	68	32	69	59	17	87	76	30
	18	83	40	1	78	41	1	88	60	5

Recommendations

These studies show that moisture content is more critical than temperature in the storage of longleaf seed. Moisture content of 14 percent or higher is unsatisfactory even for short-term storage at 34° F., and 12 percent is probably unsafe. Although seed kept well for 4 or 5 years at high moisture contents and subfreezing temperatures, lots with lower initial vigor may deteriorate more rapidly. Because vigor is influenced by many factors, moisture contents of 10 percent or less are recommended.

Temperatures from 0° to 25° F. are preferable to 34° F., as they provide a safety factor for seed that may have a moisture content slightly above 10 percent. When seed is at the recommended moisture content, 0° F. is not much better than 25° F., and the latter temperature is more economical and practical.

Moisture content is less important when seed is stored at 0° F. Evidently the lowering of storage temperature accomplishes about the same thing as lowering moisture content for storage at the higher temperature; i.e., the rate of respiration is reduced and viability is prolonged.

It is still unclear if longleaf seed should be stored with wings on or off, but leaving the wings on seems to be the safest course until further research is completed. It is not believed that the wings per, se benefit storage. Because of their extremely thin, soft, coats and the persistence of the wings, longleaf seeds are difficult to dewing without cracking some of the coats. Dewingers vary considerably in the amount of damage they do, and differences in storability may be the result of injuries sustained in dewinging. Although seeds with cracked coats may germinate immediately after processing, they deteriorate rapidly in storage.

Literature Cited

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