Storing sand pine seeds and cones

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Viability of seeds from new and 1-yearold Ocala sand pine cones remained essentially unchanged after 10 years of storage at all combinations of 6-, 9-, 12-, and 15-percent moisture contents and 0° and 34° F. temperatures. Only an average of 72 percent of Choctawhatchee seeds germinated after 10 *years*. In retaining viability, temperature had greater impact than moisture content. Viability of seeds in stored, serotinous Ocala cones remained high for 3 years, but decreased steadily during the following 6 years.

Sand pine *(Pinus clausa* [Chpm.] Vasey) of the Ocala *(clausa)* variety occurs on the Florida Peninsula and produces serotinous cones that normally open only after fire. The Choctawhatchee *(immuginata)* variety occurs in northern Florida, and its cones open on the tree. Viability of seeds of the two varieties after 1, 3, and 5 years of storage was reported earlier (1). This note gives results of storing extracted seeds for 10 years and data on the viability of Ocala seeds stored in the cones.

Methods

Cones from trees of both varieties were collected in the fall of 1962; Ocala cones were separated into fresh and 1-year-old. Choctawhatchee seeds were extracted in a forced-draft kiln at about 100°F. Ocala seeds were extracted by dipping the cones in boiling water for about 15 seconds and then kilning normally. Seeds of both varieties were dewinged, cleaned with an aspirator, and held in polyethylene bags at a, moisture content of 6 percent and temperature of 25°F. until the fall of 1963.

Initial germination tests were made immediately after moisture treatments of 6, 9, 12, and 15 percent were imposed. Eight storage treatments that consisted of all combinations of these moisture contents and temperatures of 0° and 34'F. were evaluated after 10 years. Germination tests were conducted for 28 days with 200 seeds from each replicate. All seeds were unstratified, and germination is expressed on a soundseed basis.

In a separate test, 100 to 200 fresh Ocala cones from each of three trees were placed in open paper bags and held at a constant temperature of 72"F. Samples of cones were drawn and seeds were extracted, cleaned to 100-percent soundness, and 200 seed samples were tested initially and after 3, 6, and 9 years.

Results and Discussion

Choctawhatchee seeds are sensitive to storage conditions and begin to lose viability between the 3rd and 5th years, especially when stored at 31,°F. (l). Initial germination was 86 percent, but germination averaged 80 percent after 10 years when stored at 0° and 64 percent when held at 34° (table 1). Moisture contents had no meaningful effect on storability.

Viability of all Ocala seeds remained essentially unchanged during 10 years of storage (table 1). Average germination from new cones was 97 percent after 10 years and 96 percent before storage. With seeds from 1-year-old cones, initial germination was 88 percent and germination after 10 years of storage averaged 87 percent.

The Ocala cone storage tests indicate that germinability remains high during the first 3 years (table 21. However, by the sixth year viability dripped from the initial 93 percent to 54 percent, and in the next 3 years it dropped to 26 percent. Viability of seeds from tree 3 was much greater

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Table 1.—Viability of sand pine seeds after 10 years of storage [1]

Storage conditions				
Temperature (° F.)	Percent moisture content	Choctawhatchee	New Ocala	1-Year Ocala
		Percent		
0	6	88	98	90
	9	72	97	90
	12	76	97	86
	15	86	97	90
34	6	60	97	82
	9	60	96	84
	12	64	97	87
	15	74	98	89
	Average	72	97	87

[1] Initial viability for Choctawhatchee, New Ocala and 1-year Ocala seeds was 86, 96, and 88 percent respectively.

Observations

In the fall of 1974 the entire stock of both tree species showed an inferior development; particularly stunted trees were confined to the lower areas of nursery beds accumulating the eradicant-laden runoff water. In June of 1975 the stock was treated with NPK liquid fertilizer, but near the end of the growing season about 20 percent of either white or red pine seedlings remained far below the plantable size. Figure 1 illustrates the morphology of seedlings from the elevated and the depressed parts of nursery beds; the former attained fair dimensions and exhibit some development of mycorrhizal short roots, induced by the fungus *Cenococcum graniforme;* the latter are of grossly retarded growth and are lacking mycorrhizae.

Discussion

A partial or a delayed and a prolonged, nearly complete immobilization of the mycorrhiza formers was inflicted by a combination of two adverse conditions: a too brief detoxification period and an accumulation of the eradicant in a near-lethal concentration by runoff water. It is probable that the process of the detoxification was retarded by the low temperature of the pre-seeding period.

The pesticide label usually pro. vides reasonably reliable information on the periods which should elapse between the application of various eradicants and the seeding or transplanting. However, these estimates do not take into account several unpredictable conditions, such as an accumulation of the toxic chemicals by the lateral movement of water in concentrations greatly exceeding the prescribed rates of application, the supply of soil organic matter and the soil's biodegrading potential, and the state of climatic factors during the detoxification period. Under Wisconsin conditions, a nursery soil with a plowed-under green manure has a far greater rate of detoxification during 30 days of August than has a fallowed soil during 60 (lays of September and October.

It should be mentioned that during the past ten years a critical deterioration of mycorrhiza-forming fungi in Wisconsin was observed predominantly in nursery soils with a low supply of organic matter (less than 1.5 percent in the 6-inch surface layer).

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than from tree 1 or 2 after 6 and 9 years of storage.

Although sand pine seeds stored well under a wide range of conditions, subfreezing temperatures and moisture contents of 10 percent or less are suggested for long-terns storage. These conditions will allow a margin of safety for seed lots weaker than those tested. Serotinous cones provide a suitable environment for maintenance of viability for several years (2, 3) but longterm cone storage is definitely inferior to extracting and storing seeds.

Table 2.—Germination of Ocala sand pine seeds initially and after cone storage for 3, 6, and 9 years at 72°F.

Tree number	Germination when tested after—			
	0 years	3 years	6 years	9 years
	Percent			
1	93	87	48	16
2	94	92	42	12
3	92	91	73	49
Average	93	90	54	26

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