the same. Photographs should be taken when no strong shadows are cast on the board.

An obvious limitation is the size of the board. This limitation could easily be overcome by using a larger board together with correlation analyses developed from larger plants. Differences in growth form—particularly short, compact plants or those with considerable horizontal spread—might cause complications. The technique could be modified, however, to fit many different species and situations.

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Winterfat Seeds Viable after 8 Years Refrigerated Storage

H. W. SPRINGFIELD

Highlight: *Five collections of winterfat seeds from New Mexico were stored in cans under refrigeration (34–42°F) and ordinary temperatures (55–95°F). After 8 years of storage, viability ranged from 51 to 80% for the refrigerated seeds, but practically no seeds remained viable under the warmer storage temperatures.*

Although the early literature states winterfat (*Eurotia lanata* (Pursh) Moq.) seeds lose most of their viability in 1 or 2 years (Hilton, 1941; U. S. Forest Service, 1948), our preliminary results showed viability is retained 2½ to 3 years under cold storage (Springfield, 1968).

The purpose of this note is to report the results of storing five collections of winterfat seeds under refrigeration for 8 years.

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Table 1. Percent germination of five sources of winterfat seeds after 2½ and 8 years of storage under refrigeration and at ordinary temperatures.

Seed source	Stored at 55–95°F		Stored at 38–42°F	
	2½ yr	8 yr	2½ yr	8 yr
Mountainair	80	0	94	80
Silver Hill	64	4	92	71
Willard	80	0	88	60
Santa Fe	71	0	88	73
Corona	68	0	86	51
Average	73	1	90	67

Winterfat fruits were collected at five sites in New Mexico during November, 1964. Half of the fruits were stored in a heated garage (55 to 95°F) and half in a refrigerator (34 to 42°F) beginning in December, 1964. Storage was in 1-quart metal cans with quarter-turn lids; these containers were not airtight.

Viability was checked after 2½ years (as reported in Springfield, 1968), and again after 8 years. At the start of each viability check, whole fruits were threshed by hand to insure comparability among collections; percentage of fruits with seeds varied from 67 to 95 among the five collections. For each storage situation and each collection, four replications of 50 seeds were put in petri dishes filled with 100 ml vermiculite and 60 ml distilled water. Two layers of germination blotter were put on top of the vermiculite. Seeds were placed on the blotters, which remained moist throughout the test. All tests were made in a refrigerator modified to provide a temperature of 56 ± 2°F without light.

Seedlings were counted at 1- or 2-day intervals. Seeds were considered germinated when cotyledons and radicles together measured at least one inch and both were detached from the seedcoat.

Viability of refrigerated winterfat seeds stored 8 years remained much higher than expected (Table 1). Declines in viability between the 2½-year-check and the 8-year-check averaged only 23 percent. The Santa Fe collection, in fact, dropped only 15% during the additional 5½ years of storage. On the average, about two-thirds of the seeds still were viable after 8 years of refrigerated storage. More than half the seeds of even the poorest of the five collections—the Corona collection—were viable the 8th year.

As expected, viability of seeds stored at 55-95°F was practically zero after 8 years. Viability of these seeds already had begun to decline at the time of the 2½-year check.

Results of this study clearly show the advantage of refrigerated storage of winterfat seeds for long-term retention of viability.

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Effect of pH on Germination of Three Grass Species

J. STUBBENDIECK

Highlight: *Hydrogen-ion concentration (pH) affected the percent germination of weeping lovegrass, sand bluestem, and blue panic in laboratory tests. The latter two species exhibited the ability to germinate over a wide pH range but showed repressed germiantion at pH levels near neutrality. Tests using water of unknown pH may not provide a true indication of potential germination.*

Many factors influence the processes of germination and seedling establishment. One factor that has received little attention is the effect of hydrogen-ion concentration (pH). Soil pH was found to determine species distribution by affecting germination (Justice and Reece, 1954). A slightly acidic condition was found to be most favorable to germination of several forage crops (Promsy, 1911). Breazeale and LeClerc (1912) concluded that the depressant effect of acidity was greater on the germination than the subsequent growth of wheat. Salter and McIlvaine (1920) germinated seeds of

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