Studies on Aged Seeds I
Relation of Age of Seed to Germination and Longevity

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DURATION of vitality is one of the most important phenomena of plant life. The maximum time that seeds can remain in the ground or in storage in a dormant but viable condition is of much interest to agriculture from the standpoint of survival of weed as well as of crop seeds.

The present study deals with seeds which have been stored under conditions that apparently are extremely favorable for the retention of viability. Many are still viable after 33 years. This material has provided an unusual opportunity for the study of (1) the relation of age to viability of a large number of species and varieties of crop seeds; and (2) the influence of hulls, or chaff, of cereals on longevity and on mold development during germination.

REVIEW OF LITERATURE

Longevity of seeds has for long been a subject of great interest and of numerous publications. Some of the more important factors which influence longevity of seeds are (1) species or kinds of seeds; (2) storage conditions, particularly humidity and moisture; (3) method of harvesting and processing of the seeds.

Many workers have noted striking differences between genera, species and even strains with respect to longevity of seeds. Apparently seeds of most cultivated plants lose their vitality quickly as was shown by Barton (4, 5) who believed that the longevity of any particular seed was a function of the storage conditions under which it was kept rather than of its actual age. However, seeds of high vitality were much more resistant to unfavorable storage humidities and temperatures than were weak seeds. Morison (11) and Beattie and Boswell (6) concluded that the best method for storage of most seeds included low and constant moisture and temperature, and a lack of atmosphere, particularly oxygen. These ideal conditions are found deep in the earth and probably account for the longevity of buried seeds (8, 25).

Several studies have shown that hulled or shelled seeds lose their germinability and vigor much more rapidly than do seeds with the hulls or chaff retained (14, 16, 17, 18, 19). In addition, hulls or chaff have been reported to inhibit germination (4, 9, 10, 11, 18) and growth of mold and bacteria on germinating seeds (9, 18, 19, 27). This has led to the belief that a soluble growth-inhibiting substance is present in the chaff or hulls of many seeds. More complete reviews may be found elsewhere (7).

MATERIALS AND METHODS

History of Seeds

Seeds used in this study included those of wheat, oats, barley, rye, corn, alfalfa, peas, sainfoin, vetch, sweetclover, soybeans, flax, mustard, and grass. They had been harvested at the Dry Land Experiment Station at Lind, Wash., (principal in varietal nursery plots) from 1917 to 1950. M. A. McCall, as the first superintendent of this station (1916–1924), tested a wide selection of crop plants, particularly in the years 1918 and 1919. Many of the cereals were stored as spikes as well as threshed seeds in 1918 and 1919. From this beginning it has been a more or less uniform practice to store samples of the materials tested on the station each year. Seeds were stored in metal boxes, metal cans, cloth bags, and paper envelopes in a wooden shed which also served as a stable and for other purposes.

This experiment station also functions as a U. S. Weather Bureau; thus, complete temperature and rainfall data are available. The mean yearly total precipitation for the period 1917–1950 was 11.4 inches. Very little of this precipitation occurred in the summer months. The only exception was June, 1923 when 3.69 inches of rain fell. This amount was well over five times the June average. The mean yearly temperature for this same period (1917–1950) was $49.7^\circ$F, with a mean yearly high of $104.6^\circ$F, and a mean yearly low of $-4.3^\circ$F.

Germination Tests

Germination tests were conducted during 1950 with strata and temperature specified in the rules and regulations under the Federal Seed Act, 1950 (26), and the rules for testing seeds adopted by the Association of Official Seed Analysts, 1950 (3). The methods used for each type of seed are as indicated in the above listed rules (3, 26) with the following two exceptions. Methods are not specified for *Agropyron elongatum* or *Bromus inermis*. These two types of seeds were germinated in the same manner as *Dactylis glomerata*. In a few instances, the rules were not followed exactly, because the age of the seed and the condition of the samples required special treatment. Only 100 seeds per test were used because of the limited supply of seeds available in some instances. Classification into strong and weak sprouts was made in accordance with the procedures established under the Federal Seed Act and the Association of Official Seed Analysts. The germination percentages are based on strong sprouts only. Weak sprouts were recorded merely for information. Weak sprouts did not possess the necessary structures for continuing growth, or the structures were of an abnormal nature. In general these abnormal sprouts had normal-appearing roots, but the coleoptiles and/or first leaves appeared twisted and watery. When some of the seeds between two blotters began to grow, the top blotters was discarded in order not to retard the development of the seedlings.

Relation of Chaff to Seed Longevity and to the Development of Mold

Three different tests were conducted on each variety of cereal seed studied, following the procedure of Smith (18): (1) on seeds stored in the hulls for the entire storage period and germinated without removing these hulls; (2) on seeds stored with the hulls on and then threshed immediately prior to testing; and (3) on seeds threshed in the usual manner at the time of harvest and then stored. Seeds of Rosen rye, Banner oats and several varieties

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