Proceedings of the Iowa Academy of Science

Volume 51 | Annual Issue Article 20

1944

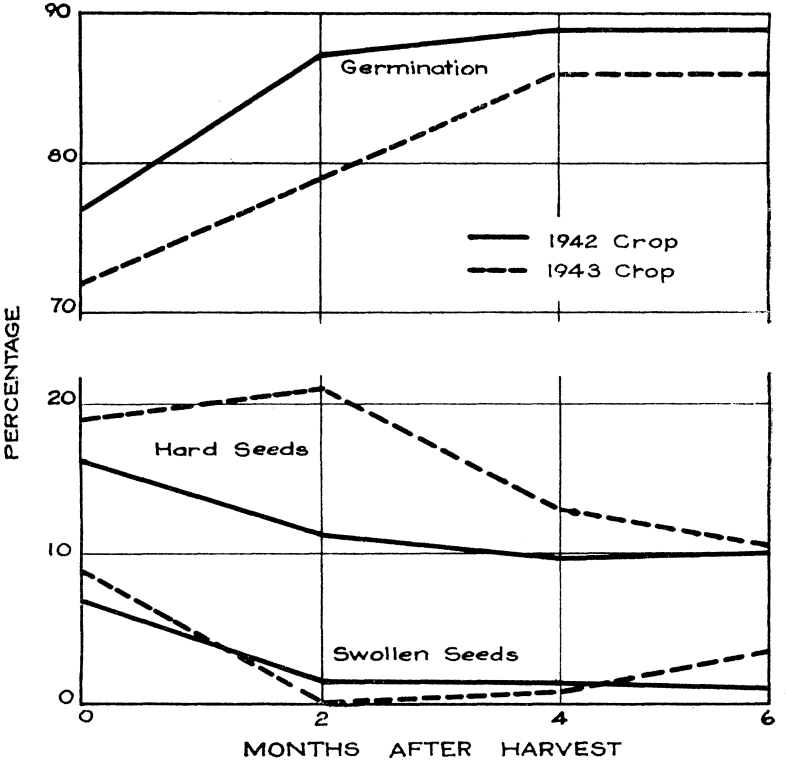
Changes in the Germination of Red Clover Seed in Storage

John N. Martin
Iowa State College

CHANGES IN THE GERMINATION OF RED CLOVER SEED IN STORAGE

JOHN N. MARTIN

Much of the red clover seed grown in the United States is cleaned and its germination and purity determined soon after it is harvested. The results of these tests are usually accepted as being descriptive of the quality of the seed at seeding time the following spring and frequently over a much longer period of storage.



Graph showing change in percentage of germination of hard and of swollen red clover seeds in storage.

Practically all the red clover seed contains a considerable number of hard seeds, the percentage varying from near zero to above 35 in seed from different sources and grown in different years. The softening of the hard seeds in storage is a cause of more or less continual change in the germination of red clover seed in storage, and more especially during the first few months following the harvesting of the seed.

A second factor which causes some change in the germination of red clover seed in storage is the hardening of some soft seeds. However, the number of seeds that harden are usually considerably less than the number that soften during the same period of storage.

A third factor that generally affects the germination of red clover seed in storage is the presence of seeds that swell but do not germinate until after a rest period. In freshly harvested red clover seed there are frequently a considerable number of these seeds. After a few months storage many of them germinate normally and thus raise the percentage germination of the sample. Of the three causes of change in the germination of red clover seed in storage, the softening of hard seeds is of greatest consequence.

At the Institute of Economic Botany in Hamburg, Germany, where the effects of various conditions of storage on the germniation of red clover seed have been rather intensively investigated by Esdorn and Stutz (1932), Behrens (1934), Stutz (1933), and others, it has been found that storage in cool moist air is decidedly favorable for the softening of hard seeds and that when stored in cold dry air, the softening of the hard seed is much more rapid than when stored in moderately dry warm air.

The investigations at the Hamburg Institute of Economic Botany show that red clover seeds harden on the mother plant and undergo, following harvest, a process of after-ripening after which their percentage germination is considerably higher. The after-ripening is most marked during the first month or two following harvest but in some lots may continue for as long as six months after harvest.

Mathematical formulas have been developed by Meyer (1928) and others in Europe by which the germination of red clover seed can be calculated for various future dates in periods of storage from data obtained by tests made soon after harvest. Meyer's formula is as follows: $y=y_o\left[1-10^{-a(t-to)^n}\right]$ in which y=the number of seeds germinating after t days of storage; yo=number of seeds involved in the calculation; to=time after harvest the actual test was made; and a and n are introduced proportional factors. In tables published by Esdorn and Stutz (2), in which a=0.43 and n=0.0131, the calculated results over a period of 200 days subsequent to harvest agree closely with those obtained by actual tests.

In the United States apparently very little attention has been given to the after-ripening of red clover seed, although the after-ripening period, if red clover seeds behave in the United States as they do in Europe, is covered by the period between harvest in the fall and the time the seed is used for seeding the following spring. The after-ripening process of red clover seed should receive consideration not only in determining the seeding value at dates of seeding but also in ascertaining the best conditions of storage of red clover seed.

OBJECT, MATERIAL, AND METHODS

The object of the investigations was to ascertain the extent of after-ripening that red clover seed grown and stored in Iowa is likely to undergo between the time it is harvested and the time it is used for seeding the following spring.

The material was obtained chiefly through the kindness of Ed Coe at Ames, Iowa, who furnished samples of seed brought to his plant for cleaning by his various customers. During the period of investigation the seeds were stored in small paper bags which were kept in a desk drawer in a college laboratory. The temperature of the laboratory fluctuates considerably during the winter, running up to 85°F and dropping as low as 40°F occasionally, but usually ranging 60° to 75°F. The humidity of the air also fluctuates greatly, but averages around 50 per cent. The temperature and humidity of the atmosphere of the laboratory in which the seeds were kept were somewhat more uniform but not greatly different from the atmospheric conditions in farm dwellings where farmers commonly store their red clover seed.

The first germination tests were started as soon as the seeds were obtained and in all cases not later than fifteen days after the seeds were harvested. The tests, each of which involved 400 seeds from each sample, were duplicated in each series of tests. Three germination tests following the first one were made at intervals of about two months, the last one being made the forepart of April. The tests were made between blotters placed in a small germinator in the laboratory.

RESULTS

The results of the germination tests obtained on 1942 and 1943 seeds are given in Table I and shown graphically in figure 1.

Table I. Percentage of germinating, hard, and swollen seeds obtained from the tests made at the dates stated in the headings of the table. The data are the results of duplicate tests of 400 seeds in each test. Fifteen days were allowed for germination.

	Two weeks after harvest			Two months after harvest			Four months after harvest			Six months after harvest		
Grower by number	% germ.	% hard	% swol-len	% germ.	% hard	% swol-len	% germ.	% hard	% swol-len	% germ.	% hard	% swol-len
					Seed Grown in 1943							
1	85	12	3	91	8	1	92	6	2	93	6	1
2	66	30	4	73	24	2	80	18	2	80	20	0
3	80	15	5	87	11	2	91	9	0	85	14	1
4	81	14	5	93	6	1	91	8	1	92	8	0
5	70	23	7	85	13	2	85	13	2	90	10	0
6	80	4	16	96	3	1	95	3	2	96	2	2
Mean	77	16	7	87.5	11	1.5	89	9.5	1.5	89	10	1
					Seed Grown in 1942							
1	49	35	16	68	32	0	83	15	2	82	14	4
2	74	26	5	70	30	0	74	24	2	68	22	10
3	78	16	12	85	15	0	92	8	0	90	8	2
4	71	21	8	80	20	0	83	15	2	90	8	2
5	78	15	7	82	18	0	88	12	0	92	6	2
6	73	13	14	80	20	0	92	6	2	89	6	2
7	80	13	7	87	13	0	89	10	1	90	8	2
Mean	72	19	9	79	21	0	86	13	1	86	10.6	3.6

As shown by the table, there was an average improvement of 14 per cent in the germination of the 1943 seeds and of 12 per cent in the germination of the 1942 seeds in storage following harvest.

The seeds from 12 of the 13 sources improved in germination during the storage period. In the germination closely following harvest, as well as in the improvement in germination during storage there was a wide difference in the behavior of seeds from the different sources. The germinations of the first tests varied from 49 to 85 per cent and the improvements in germination in storage ranged from seven to thirty-three per cent. In some instances, as in the case of the seeds from the No. 2 source in the 1943 crop and those from the No. 1 source in the 1942 crop, the seeds changed from a decidedly objectionable to a fairly acceptable grade over the period from harvest to the time of seeding the following spring.

As shown in the table, but better in the graph, the increase in germinability of the 1942 seed almost all occurred during the first two months. The increase in the germinability of the 1943 seeds was slower but all occurred during the first four months in storage.

The increase in the germination of the seeds during storage was accompanied by a corresponding decrease in the number of both hard and swollen seeds, but by a greater decrease in number of hard seeds.

The change in the germination of red clover seed during the first few months of storage following harvest, as shown by the data in the table, may decidedly affect the reliability of early germination tests as bases for ascertaining the value of red clover seed for seeding the following spring and later dates. The data upon which the discussion in this paper is based warrants the conclusion that germination tests of red clover seed are not dependable until after the seed has been in storage at least four months. After six months in storage at room temperature investigations show that the percentage germination remains fairly constant for at least two or three years.

When statistically analyzed the mean difference between the first and last test in percentage germination was highly significant. The mean difference was 13.15, standard error 2.43, and t=5.404 which with 12 degrees of freedom much exceeds 3.055 the value of t at the one per cent level.

SUMMARY

Red clover seed obtained from 13 different growers was investigated as to changes occurring in its germination between the time of its harvest and that of its use for seeding the following spring. Tests made immediately or soon after harvest, and at intervals of around two, four, and six months later showed that the percentage of germination increased in room storage by a mean of 12 per cent in the 1942 seeds and by a mean of 14 per cent in the 1943 seeds in the period of six months following harvest.

The changes in the germination of the seeds in storage from the different sources varied from zero to a maximum increase of 33 per cent. The seeds from two sources changed during the short period of

storage from a relatively low grade to a fair grade of seed as to percentage germination.

The improvement in the germination during the storage period was accompanied by a corresponding drop in the number of both hard and soft seeds, but by a greater drop in the number of the hard seeds. The results show that germination tests of red clover seed made soon after its harvest may be seriously misleading as to the germinability of the seed. For fairly reliable information only germination tests made after the seed has been at least four months in storage should be depended upon.

Statistical analysis of the data showed that the mean differences between the first and last tests of the 1942 and 1943 seeds were highly significant.

DEPARTMENT OF BOTANY
IOWA STATE COLLEGE
AMES, IOWA

LITERATURE CITED

Behrens, Heinrich. 1934. Beitrage zur Kentniss der Hartschaligkeit von Leguminosensamen. A dissertation. University of Hamburg.

Esdorn, Ilse, and Stutz, Herbert. 1932. Die Bewertung harter Leguminosensamen. Landw. Vesuchs-stationen. 114:136-149.

Meyer, Konrad. 1928. Ueber die Bedeutung der graphischen Darstellung bei der Answertung von Samenkeimversuchen. Pflanzenbau 5:117-122.

Stutz, Herbert. 1933. Ueber den Einfluss verschiedenartiger Lagerung auf die Hartschaligkeit von Kleesamen. Dissertation. University of Hamburg.