STORAGE TESTS WITH SEED CORN

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INTRODUCTION

Many tests have been made on the longevity of seed corn. Those described in this paper, however, differ from most others, because the seeds were stored in large test tubes with a glass seal to be absolutely sure that there was no exchange of gases between the seeds and the outside air. In most tests of longevity no attempt has been made to preclude exchange of gases. One of the objects of this test was to study the effect of different gases on the longevity of the seeds; thus it was necessary to have a perfect seal to maintain the gas content.

EXPERIMENTAL PROCEDURE

Large culture tubes, 1 by 8 inches, were used as containers for the seed. Each tube held about 100 seeds of Clarage seed corn. The procedure in sealing the tubes was rather simple. A bottleneck was drawn in the tube near the open end in a hot flame, and an opening left just large enough for a single seed to pass through easily. After the tubes were filled with seeds, a wad of asbestos fiber was placed on top of the lot and the tubes were sealed in a small hot flame. This was done quickly so that there was no danger of injuring the seed from the heat.

The tubes were filled with gas by placing a small glass tube through a two-hole rubber stopper to the bottom of the tube and forcing gas through the seeds. Carbon dioxide, oxygen, and nitrogen were used. The carbon dioxide was generated from hydrochloric acid and limestone and washed twice with sulphuric acid to adjust the vapor pressure to that of the seeds. The gas was forced through the seeds for 10 minutes. The outlet tubes were then closed with pinchcocks, and the sample was left overnight. The next day carbon dioxide was forced through the seeds for 10 minutes more and the tube was sealed while the gas was still passing into the tube. The same procedure was used in filling the tubes with nitrogen except that the nitrogen was washed twice with pyrogallic acid to remove oxygen.

Gas many times the volume of the tube was passed through each in order to remove as much of the air as possible. It is questionable whether the last trace of air could be removed without some other treatment, such as heating or a high vacuum, but these treatments could not be used because of danger of injury to the seeds. Oxygen was

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passed through the seeds for 5 minutes and the tubes were sealed while it was entering the tube. This treatment would not displace all the air in the tube but would raise the oxygen pressure very high.

The seeds were stored at several different temperatures. It was necessary to use available facilities for this work; thus, the rooms where they were stored were not at constant temperatures. Some were stored in the soil biology culture room, which is maintained at a very high temperature, somewhere around 30° C. Others were kept in a basement seed storage room whose temperature is somewhat lower. Two rooms in the animal industry refrigerator were used, one in which apples are stored, +3° C. to +4° C., and which never freezes, and another which is kept below freezing at all times, —2° C. to —9° C. The other room used was the low-temperature room in the Agronomy Service Building, which is kept at —25° C. but which may be changed at times for other experiments for a week or so to as high as —7° C.

Results

The results of these tests are shown in Tables I and II.

TABLE I

SUMMARY OF PERCENTAGE GERMINATION OF CORN SEEDS OF DIFFERENT MOISTURE CONTENT STORED AT ROOM TEMPERATURES AND BELOW 0° C.

PERCENT MOISTURE	½ YEAR		2 YEARS		4 YEARS		6 YEARS	
	Room	—0°C.	Room	—0°C.	Room	—0°C.	Room	—0°C.
7.5	92	95	89	87	96	88	80	88
11.0	98	90	91	96	82	88	81	95
14.6	88	95	0	82	69	86	15	80
18.2	0	73	0	34	0	51	0	13

Significant difference = 8.

TABLE II

SUMMARY OF PERCENTAGE GERMINATION OF CORN SEEDS SEALED WITH DIFFERENT GASES AND STORED AT THREE TEMPERATURES

GAS CONTENT	1 YEAR			3 YEARS			5 YEARS		
	30° C.	3° C.	—25°C.	30° C.	3° C.	—25°C.	30° C.	3° C.	—25°C.
Air	82	91	93	76	94	92	39	90	92
Carbon dioxide	84	87	91	84	92	92	39	95	91
Oxygen	78	84	91	0	84	94	0	90	91
Nitrogen	89	91	93	27	90	80	21	92	86
Open to air	84	93	84	88	92	86	66	83	90

Significant difference = 13.

It is rather hard to evaluate these results because any direct comparison with checks was not made. It is possible, however, to compare results when moisture content, time of storage, and storage temperature were in all combinations with each other, and when gas content, time of storage, and temperature of storage were combined similarily. A statistical analysis of these data as outlined by Brandt (2) was carried out. Since the values of germination are given in percentages and since they vary from 0 to 98, they have been changed to values of angles of equal information, as suggested by Bliss (1). The factorial analysis was carried out on the values and the error obtained converted back to percentages. The homogeneous variances of the interactions were considered as the error term in determining the significance of the main comparisons. These results show that moisture content, temperature of storage, and time of storage were the only significant main comparisons.

A summary of the main comparisons is given on page 5, and a careful examination of these results shows that there was no difference between the two low moisture contents but that great differences occurred at the higher contents. The germination of the seeds was much better at the low storage temperatures, but here also no difference was noted between those stored at —25° C. and at about 0° C.

Germination has gradually decreased with time in both lots of seed. The most interesting results are shown by the seeds sealed in atmospheres of single gases. There was no difference in germination of the seeds stored in carbon dioxide and in air, but significant decreases were shown by those sealed in nitrogen and in oxygen. From a theoretical standpoint, the seeds stored in oxygen, especially at a high temperature, should die because of increased respiration, and those without oxygen should die because of lack of respiration. This was not so, however, because those in carbon dioxide showed no decrease in germination when compared with air, whereas those sealed in nitrogen were injured some. Our idea of the respiration requirement for viable seeds may not be correct. In fact, it may be that respiration is a detriment to the longevity of seeds and that any external or environmental condition which will decrease respiration will lengthen the life of the seeds.

These data do not show that seeds were benefited by storage in carbon dioxide when compared with air, but neither do they show that they were injured. Beneficial results were obtained by Kondo (3) and Kondo and Okamura (4), (5), with rice seeds in Japan. Rice seeds which died in 7 months when stored in the air germinated 98 per cent after 4 years when stored in airtight containers with either air or carbon dioxide.

These experiments have not run long enough yet to see whether any benefit results from carbon dioxide storage, because the seeds stored in air are still germinating very high. The experiment is being continued and enough tubes are still available to continue the test for 10 to 15 years, as they will be tested for germination only every 2 or 3 years.

Summary of main comparisons of Table I:

Percentage moisture	*Percentage germination*
7.5	89
11.0	90
14.6	64
18.2	21
Temperature of storage	
Room	55
—0° C.	78
Years of storage	
½	79
2	60
4	70
6	57

Summary of main comparisons of Table II:

Gas content	*Percentage germination*
Air	83
Carbon dioxide	84
Oxygen	68
Nitrogen	74
Open to air	85
Temperature of storage	
+30° C.	57
+ 3° C.	90
—25° C.	90
Years of storage	
1	88
3	78
5	71

CONCLUSIONS

Seed corn was not injured by sealing it in glass test tubes with air or carbon dioxide, but it was injured by sealing it in oxygen or nitrogen.

Low-temperature storage of seed corn benefited germination greatly, for seed which remained viable for only 6 months at a high temperature still grew after 6 years of storage at a low temperature.

Low moisture content, as has been known for years, is necessary for proper storage of seed corn.

LITERATURE CITED

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