

# Longevity of Sugar Beet Seed<sup>1</sup>

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It is common knowledge that the viability of most cereal seeds remains higher when stored at low humidity than when stored at high humidity. The same relationship holds in general for sugar beet seed viability when stored under similar conditions of humidity. However, few data are available on the germination performance of processed (segmented) sugar beet seed when stored for an extended period under conditions of low humidity. The objective of this study was to determine whether or not segmentation had any deleterious effect on the germination of sugar beet seed after storage in cloth sacks for varying periods of years.

## Review of Literature

In 1928 two lots of sugar beet seed were placed in a commercial refrigeration storage house in Salt Lake City, Utah (Park and Owen)<sup>3</sup>. The temperature during the test period ranged from +10° F to -10° F. Germination tests were made at intervals from 1928 to 1950. The germination percent in 1928 was 83.5, whereas in 1950 it was 75.0, or a drop of only 8.5 percent. Under normal storage conditions, US No. 1 sugar beet seed showed 27 percent germination after storage for 19 years, as compared with the original germination of 80 percent.

## Materials and Methods

The sugar beet seed used in this investigation was obtained from The Great Western Sugar Company Experimental Station, Longmont, Colorado. One lot each came from the crop years of 1943, 1945 and 1946 and two lots from 1944. Each of these five lots is represented by two sub-lots. One sub-lot consisted of whole seed, while the other sub-lot represented the same seed in segmented form. The seeds were stored in the original sacks in a dry, unheated room at the Colorado Agricultural Experiment Station, Fort Collins, Colorado. Each year, from 1943 to 1963, samples were drawn from the whole and segmented seed lots and germination tests were made. Both ball and sprout counts were recorded.

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<sup>3</sup> Park, D. A. and F. V. Oven. 1950. Viability of sugar beet seed held in cold storage for 22 years. Proc. Sixth General Meeting, Am. Soc. Sugar Beet Technol.

Table 1.—Germination percentages of whole and segmented sugar beet seed stored for one to twenty years.

Years	Designation	Percentage germination																			
		Age in years																	18	19	20
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17			
Whole seed																					
1943	GW 59 L-5.43 N.M.	67	66	70	63	75	73	62	58	72	66	67	69	68	68	64	60	61	71	60	65
1944	GW 92	92	91	93	94	91	95	93	90	92	90	96	98	95	96	94	93	96	94	94	
1944	GW 59 N.M.	73	72	72	82	70	77	66	77	71	70	67	68	67	68	63	64	73	66	64	
1945	GW 95-43 N.M.	75	69	78	77	70	81	73	72	75	76	76	75	72	69	70	76	74	76		
1946	GW 72-46 O.W.	84	98	87	85	85	78	79	88	80	88	88	86	84	86	85	90	91			
	Average:	78	79	80	80	78	81	75	77	78	78	79	79	77	77	75	77	79	77	73	65
Segmented seed																					
1943	GW 59 L-5.43 N.M.	73	76	76	69	76	73	69	64	63	67	64	67	73	55	66	60	65	70	64	64
1944	GW 92	84	96	85	93	86	92	80	82	85	88	88	93	91	80	80	84	86	83	81	
1944	GW 59 N.M.	72	74	73	76	74	70	62	64	61	67	60	70	60	59	64	64	63	62	47	
1945	GW 95-43 N.M.	68	64	87	64	62	58	58	56	68	62	70	58	60	67	62	62	60	63		
1946	GW 72-46 O.W.	70	88	69	77	73	59	67	72	66	76	69	64	62	63	62	64	59			
	Average:	73	80	78	76	74	70	67	68	69	72	70	70	69	65	67	67	67	69	65	64

Table 2.—Adjusted germination percentages assuming the original germination to be 100 percent.

Years	Designation	Original germs %	Percentage germination																	Final Germination			
			Age in years																	18	19	20	Final Germination
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17				
Whole seed																							
1943	GW 59L5-43 N.M.	67	100	99	104	94	112	109	93	87	107	99	100	103	101	101	96	90	91	106	90	97	65.0
1944	GW 92	92.5	100	98	101	101	99	103	101	97	99	97	103	105	103	104	102	101	104	102	102		94.0
1944	GW 59 N.M.	72.8	100	99	99	112	96	105	90	105	98	96	92	94	92	94	86	88	100	91	88		64.0
1945	GW 95-43 N.M.	75.0	100	92	104	103	93	108	98	96	100	102	102	99	97	92	93	101	99	101			76.0
1946	GW 72-46 O.W.	84.0	100	117	104	102	102	93	94	105	94	104	105	102	101	102	101	107	108				91.0
	Average:	78.0	100	101	102	102	100	104	95	98	100	100	100	101	99	99	96	97	100	100	93	97	78.0
Segmented seed																							
1943	GW 59L5-43 N.M.	73	100	104	104	95	105	100	94	88	86	92	87	92	100	75	90	82	89	96	88	88	64.0
1944	GW 92	84	100	114	101	111	103	110	95	98	102	104	105	111	110	95	95	99	102	99	101		84.0
1944	GW 59-N.M.	72	100	103	101	105	103	98	86	89	85	93	84	97	83	82	89	88	88	87	65		47.0
1945	GW 95-43 N.M.	58	100	94	124	94	91	86	86	82	100	90	104	85	89	99	92	92	88	93			63.0
1946	GW 72-46 O.W.	70	100	126	98	109	105	84	95	103	95	109	99	91	88	90	89	92	84				59.0
	Average:	73	100	108	106	103	101	96	91	92	94	98	96	95	94	88	91	91	90	94	85	88	62.0

### Experimental Results

Actual germination results are presented in Table 1. In order to determine the percentage decrease from the original tests, all germinations were converted to percentages of the original germination, that is, the original germination was considered as 100 percent (Table 2).

A statistical analysis of the first 17 years of the test (Table 1) was made to determine the significance of the data.

The statistical analysis showed (a) that there was a significant difference in germination between the whole and segmented seed (Table 3), (b) there was no significant difference between years for the whole seed, but a very significant difference in years for the segmented seed. (Tables 4 & 5), (c) there was a significant difference in samples within each treatment for the period of the study, (Table 4 and 5).

Table 3.—Analysis of variance for both treatments.<sup>4</sup>

Source of variance	Degrees of freedom	Mean square	F
Treatments	1	2335.0	75.10**
Years	16	73.7	2.37**
Error (a)	16	31.1	
Samples	4	3125.0	NS
Error (b)	4	1026.0	
Samples x years	64	30.4	3.49**
Error (c)	64	8.7	
Total	169		

<sup>4</sup> Le Clerg, E. L., W. H. Leonard, and A. G. Clark. 1962 Field Plot Technique. Burgess Publishing Company. Second edition.

Table 4.—Analysis of variance for whole seed.

Source of variance	Degrees of freedom	Mean square	F
Years	16	13.9	NS
Samples	4	2161.0	120.7**
Error	64	17.9	
Total	84		

Table 5.—Analysis of variance for segmented seed.

Source of variance	Degrees of freedom	Mean square	F
Years	16	90.8	3.33**
Samples	4	1405.0	51.5**
Error	64	27.3	
Total	84		

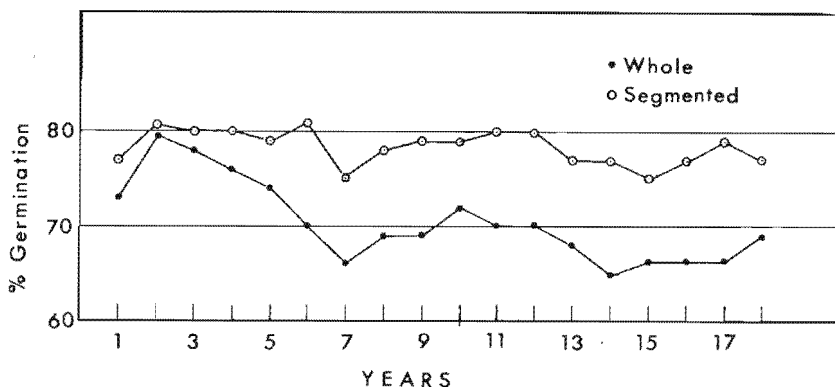


Figure 1.—Percentage germination of whole and segmented seed by years for a period of 17 years.

There was a drop in germination when the segmented seed was compared to the whole seed. The difference in the original germination was 5, or a decrease of 6.4 percent. The final germination of the one lot of whole seed that was stored for 20 years was 97 percent of the original germination. At the end of 17 years, when the average of all five samples is considered, there was no drop in germination for the whole seed. With the segmented seed there was a slight drop in the average germination after six years (Table 2, Figure 1). After this drop, the germination increased and held fairly constant for the next 6 years, after which it dropped to 10 percent below the original germination. The final germination of the one lot that had been stored for 20 years was 88 percent of the original germination. These results indicate that segmented seed loses viability to a greater extent than does whole seed when stored from six to 17 years.

In sugar beets, the "seed" normally is a ball which contains several seeds; when germinated more than one sprout may emerge from each seed ball. Table 6 represents the actual number of sprouts per 100 seed balls for both the whole and segmented seeds. In the whole seed the number of sprouts remained about the same for the entire period of the test. In the segmented seed the number of sprouts followed a pattern similar to that observed for its germination percentages. At the end of the 17 years storage period it had dropped from 106 to 92 or a decrease of 13 percent. The correlation coefficient between germination percent and number of sprouts was 0.74, which is significant at the 0.01 percent point.

In examining Table 7, it will be seen that as the seeds became older the percentage of weak sprouts decreased in both whole and

Table 6.—Number of sprouts per 100 seed balls.

Year	Designation	Age in years															18	19	20		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15				16	17
		Whole seed																			
1943	GW 59L-43 N.M.	112	116		101	128	147	113	111	127	126	118	107	119	123	124	99	96	130	102	110
1944	GW 92	161		169	192	166	200	199	167	197	196	201	210	189	202	206	204	196	208	200	
1944	GW 59 N.M.	128		128	144	124	142	116	125	128	121	117	116	109	150	102	102	132	118	102	
1945	GW 95-43 N.M.	126	125	152	153	141	139	124	147	140	142	146	147	142	128	144	144	137	160		
1946	CW 72-46 O.W.	154	235	174	187	192	156	180	189	142	136	169	176	175	178	186	199	209			
	Average:	136	159	156	155	150	157	146	148	145	144	150	151	147	156	152	150	154	154	135	110
		Segmented seed																			
1943	GW 59-L43 N.M.	112	121		102	116	107	110	96	91	93	98	100	122	92	97	82	85	104	95	102
1944	GW 92	134		136	152	138	157	129	132	139	157	158	165	151	135	122	136	136	144	138	
1944	GW 59 N.M.	97		100	110	107	89	83	92	88	104	79	99	78	76	84	84	80	80	64	
1945	GW 95-43 N.M.	91	84	122	88	90	76	79	84	97	86	100	81	90	87	80	86	84	86		
1946	GW 72-46 O.W.	96	133	99	119	108	83	101	123	85	107	96	102	82	87	90	104	76			
	Average:	106	113	114	114	112	102	100	105	100	109	106	110	105	95	95	98	92	104	99	

Table 7.—Percent of weak sprouts per one hundred seed balls.

Year	Designation	Age in years																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Whole seed																					
1943	GW 59L-43 N.M.				2.5	3.0	4.4	2.0	1.0	0.9	3.5	2.5	3.0	3.0	1.5	1.5	1.0	1.0	0.0	1.0	1.5
1944	GW 92			3.8	2.5	4.4	1.3	1.0	5.2	3.9	0.5	1.0	0.0	1.5	0.0	1.0	0.0	0.5	0.0	0.5	
1944	GW 59 N.M.			2.2	0.5	1.2	0.6	1.5	2.9	2.6	1.4	1.0	2.0	1.0	1.5	3.0	0.0	0.5	0.0	1.0	
1945	GW 95-43 N.M.		5.0	3.0	5.1	0.6	0.9	4.6	3.0	1.0	2.0	1.0	2.0	1.0	3.5	1.5	4.0	2.5	1.0		
1946	GW 72-46 O.W.	2.0	0.5	4.0	0.0	1.5	9.0	3.7	6.1	1.0	2.5	3.0	1.5	3.0	1.0	5.0	4.0	5.0			
Average:					2.12	2.14	3.22	2.56	3.64	1.88	1.98	1.7	1.7	1.9	1.5	2.4	1.8	1.9			
Segmented seed																					
1943	GW 59L-43 N.M.				3.0	5.5	2.4	1.6	3.4	5.8	2.0	3.0	5.5	5.0	2.0	2.0	2.0	1.0	2.5	1.5	1.5
1944	GW 92			6.0	2.0	3.3	0.6	1.0	3.9	2.4	0.5	4.0	1.0	1.0	2.5	3.0	1.0	3.0	0.0	0.5	
1944	GW 59 N.M.			3.2	2.5	3.2	0.6	2.0	4.2	1.4	2.3	4.0	4.5	3.2	3.0	2.0	0.5	3.0	0.5	0.0	
1945	GW 95-43 N.M.		3.2	2.0	8.8	1.3	3.0	6.3	3.9	4.0	3.1	1.0	2.6	3.5	5.0	1.5	4.0	1.0	1.5		
1946	GW 72-46 O.W.	9.2	3.2	6.0	5.3	3.4	7.5	2.3	4.1	5.8	3.5	4.2	7.5	4.0	1.0	2.0	0.0	0.0			
Average:					4.32	3.34	2.82	2.64	3.9	3.88	2.28	3.24	4.22	3.34	2.7	2.1	1.5	1.6			

segmented seed. In the early years of storage the segmented seeds had a higher percentage of weak sprouts than did the whole seed.

### Summary and Conclusions

Whole sugar beet seed and segmented seed from each of five lots were stored in cotton sacks in a dry, unheated room at the Colorado Agricultural Experiment Station at Fort Collins from 1943 to 1963. After 17 years of storage, the average germination of the whole seed was 79 percent as compared with 78 percent for the original germination. The segmented seed dropped from 73 percent original germination to 67 percent germination after storage for 17 years, a decrease of 8 percent.

With the whole seed the number of sprouts per 100 balls varied from 136 to 159, but remained about the same for the 17-year period. The number of sprouts per 100 balls was lower for the segmented seed, varying from 95 to 114, and dropping off slightly in the last four years of storage. The percentage of weak sprouts decreased in the last four years of storage in both whole and segmented seed. The percentage of weak sprouts was higher in the segmented seed than in the whole seed.

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