IDAHO AGRICULTURAL EXPERIMENT STATION

BULLETIN 533
DECEMBER 1973

STORAGE STUDIES ON SUGAR BEETS IN SOUTHEASTERN IDAHO

J. Augustin
D. O. Everson
A. C. Wiese
J. P. Chandler

TEACHING RESEARCH SERVICE

UNIVERSITY OF IDAHO
College of Agriculture

CONCLUSIONS

1. Sugar beets lose substantial amounts of both weight and sucrose during storage.
2. The actual weight losses of whole and undamaged beets during storage amounted to 5.396 percent. Since a significant number of beets entering storage are cut and bruised, this figure is considered somewhat less than realistic. Using study data adjusted for additional losses to cut and bruised beets, and disregarding losses due to rot, the daily weight losses amounted to more than 0.069 percent or 1.38 pounds per day per ton, but no more than 0.157 percent or 3.14 pounds per day per ton.
3. Based on study data adjusted for cut and bruised beets, sucrose losses, corrected for weight losses, amounted to more than 0.0203 percent or 0.406 pounds per day per ton but no more than 0.0345 percent or 0.691 pounds per day per ton. Losses of 0.691 pounds per day per ton are probably more realistic when taking into account storage losses due to freezing and rot.
4. There is little difference in changes occurring in beets as a result of location in the beet pile. In general, the variability of changes is greater in beets located in the peripheral parts of the pile than in those in the central part of the pile. On a wet basis, sucrose losses are higher in the peripheral parts. This is not true on a dry basis.

The authors express their appreciation to the Eastern Idaho Sugar Beet Growers for their financial assistance, to the Utah-Idaho Sugar Company for allowing use of its facilities and to their representative, Neal Vance, for his continued assistance.

AGRICULTURAL EXPERIMENT STATION

University of Idaho
Moscow, Idaho

College of Agriculture
1.5 M 12-73

Storage Studies on Sugar Beets In Southeastern Idaho

J. Augustin, D. O. Everson,
A. C. Wiese, J. P. Chandler*

In the spring of 1969, the Eastern Idaho Sugar Beet Growers Association requested the University of Idaho to investigate the sugar content in beets at time of harvest and to measure subsequent changes in weight and sugar (sucrose) contents in beets during storage.

EXPERIMENTAL PROCEDURES

An experimental beet pile was put up outside the processing plant of the Utah-Idaho Sugar Company in Idaho Falls. Two sets of experiments were conducted with beets in this pile.

Experiment No. 1

Sugar beets were placed into wire baskets and 15 sets of 30 baskets each were placed into the pile as shown in Figs. 1a and 1b. The distance between sets of baskets was approximately 15 feet.

The sugar beets were cleaned with wire brushes before they were placed in the baskets and excessive amounts of leaf material were cut off. The beets in each basket were weighed. The tops of the baskets were sealed with chicken wire before they were positioned in the pile.

Beet samples for these baskets were taken from one or two truckloads of beets per day.

---

* J. Augustin is associate research professor of food science and biochemistry, headquartered at the University of Idaho Research and Extension Center, Aberdeen. D. O. Everson is statistician for the Agricultural Experiment Station and A. C. Wiese is professor of biochemistry. J. P. Chandler is technical aid working with Dr. Augustin at the Aberdeen Research and Extension Center.

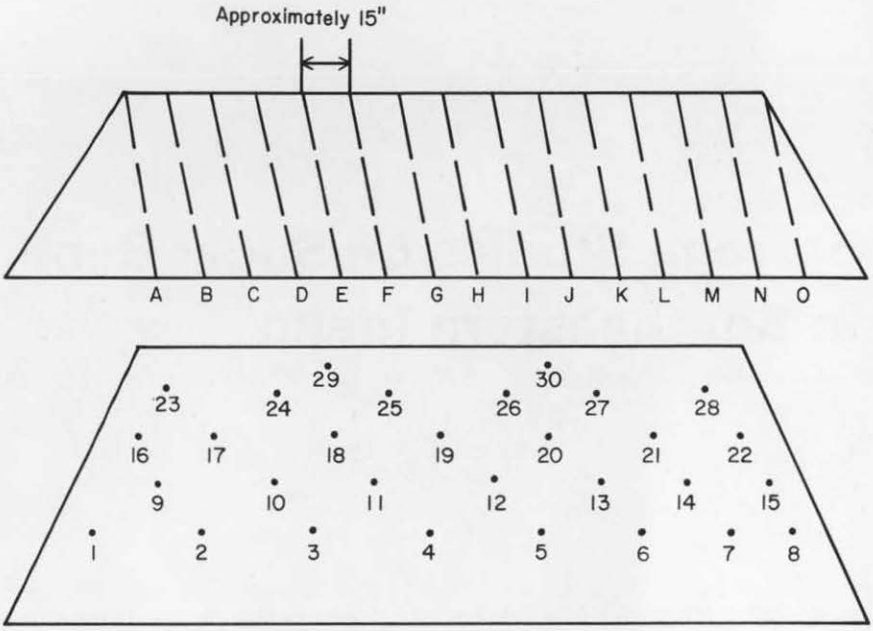

Fig. 1. Arrangement of basket samples in the sugar beet pile. Top is longitudinal view of the pile; bottom, cross-section view.

To determine initial sugar and dry matter content, 10 to 30 samples of approximately 20 pounds each were removed from each truckload. These samples were washed, drained for one minute and ground in a Spreckle saw. Each ground sample was placed in a double polyethylene bag, identified and frozen for later analysis.

Starting November 17, baskets were removed from the pile at weekly intervals. The beets were weighed, then washed, ground and frozen until they could be analyzed.

Experiment No. 2

One sample weighing approximately 20 pounds was taken from every sixth incoming truckload of beets. Each sample was washed, ground, wrapped and frozen.

During the winter as the pile was removed, samples were taken at the same rate as above and treated as outlined in Experiment 1.

Analytical

Dry matter: Samples were dried in duplicate in an air oven at 100° C.

Sugar contents: The official A.O.A.C. * hot extraction polarimetric method was used.

---

* Association of Official Analytical Chemistry, 10th Edition, p. 513

RESULTS

In Experiment 1 (Table 1 to 5 and Figs. 2 to 5), overall weight loss was statistically significant at the 5 percent level with the mean loss amounting to 5.396 percent over a mean storage period of 77.96 days. Computed on a daily basis, this loss amounted to 0.069 percent or 1.38 pounds per day per ton of beets. Changes in sucrose content on wet and dry matter bases and changes in dry matter content were not statistically significant, although the data indicated a trend toward more loss in sugar content with increased storage time.

A comparative statistical analysis of sample baskets situated in the peripheral part (outside baskets), i.e., baskets 1, 8, 9, 15, 16, 22, 23, 28, 29, and 30, and those in the central part of the storage pile (inside baskets), revealed highly significant weight losses over time only with the inside baskets (Tables 6 to 10 and Figs. 1, 6, 7, 8). The lack of significant weight losses in the outside baskets over time would seem to be due to the high variability found among these baskets.

An F test of the data (Table 6) revealed no difference between outside and inside baskets except with the sucrose content on a wet basis. Changes in sucrose content among beets in the outside baskets were significantly higher (0.472%) than that of the inside baskets, (0.366%) at the per cent level. However, taking into consideration the values on dry matter and sucrose content on a dry weight basis, it appears that this difference is merely due to a difference in the dry matter content of the beets.

In Experiment 2 (Tables 11 to 14 and Figs. 9 to 11), average sucrose content declined 1.082 units over an average storage period of 91.96 days. This was a loss of 6.934 percent or 138.68 pounds sucrose per ton of beets. Computed on a daily basis, the losses were 0.075 percent or 1.51 pounds sucrose per day per ton of beets. This loss as well as the loss in sucrose content, computed on a dry matter basis, is statistically significant at the 1 percent level. The change in dry matter content is not statistically significant.

The above data on loss in sucrose content do not take into consideration weight losses which occurred during storage. These losses are corrected through the following equation:

$$CSL = (W_I \times S_A) - (W_O \times S_B)$$

Where CSL = corrected sucrose loss
W_I = initial weight
W_O = final weight
S_A = initial sugar content
S_B = final sugar content

The sucrose losses corrected for weight losses in Experiment 1 amounted to 1.22 percent or 24.34 pounds per ton respectively over an average storage period of 77.96 days or 0.0156 percent and .312 pounds per ton per day. In Experiment 2, assuming losses identical to those in Experiment 1, the corrected sucrose losses amounted to 37.34 pounds per ton or 1.84 percent over an average storage period of 91.96 days; on a daily basis, 0.406 pounds and 0.020 percent.

If the ratio of weight loss to sucrose loss remained constant for both experiments, it would be possible to calculate the weight loss for Experiment 2 from the following equation:

$$L_B = \frac{L_A \times S_B}{S_A} = \frac{0.069 \times 0.075}{0.033} = 0.157$$

Where L_B = daily weight loss in Experiment 2, %

L_A = daily weight loss in Experiment 1, %

S_B = daily sucrose loss in Experiment 2, %

S_A = daily sucrose loss in Experiment 1, %

Using this formula, the corrected total sucrose loss in Experiment 2 would amount to 3.17 percent per 63.45 pounds per ton; 0.0345 percent or 0.691 pounds per ton per day of storage.

DISCUSSION

A comparison of data from the two experiments reveals some striking differences in sucrose losses. However, these differences are explainable on the basis of differences in beet selection. In general for Experiment 1, whole and undamaged beets were used. In Experiment 2, the selection included cut and otherwise damaged beets as well. Since the data show that dehydration can be ruled out as a cause for these differences, it is safe to attribute the higher sucrose losses in Experiment 2 to increased respiration rates. These in turn are speculated to have been due to the occurrence of cuts and bruises on the beets and possibly to infection by rot organisms. Undoubtedly the beet selection made in Experiment 2 represents more realistically the situation which prevails in an average beet pile. Therefore, the sucrose losses in this experiment can be considered more realistic than those found in Experiment 1.

Considering the corrected sucrose losses, the figures for Experiment 1 undoubtedly are below the actual losses because of the mode of beet selection for this experiment. The corrected losses for Experiment 2 also appear somewhat unrealistic since the weight losses were calculated on the basis of actual weight losses obtained with whole and undamaged beets in Experiment 1.

To assume ratio constancy with sucrose and weight losses is not valid because of the differences in beet selection. In Experiment 2, sucrose is not always completely metabolized to carbon dioxide and water. In part, it is transformed to compounds which are used as building blocks in the wound periderm formation on cut and bruised beets. In this case, the weight loss might not be as high as calculated.

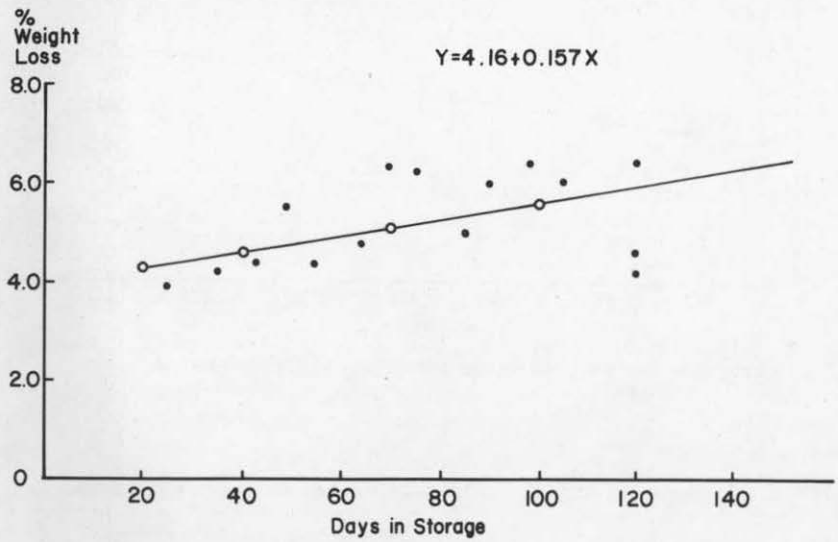

Fig. 2. Percentage weight loss in storage, Experiment 1.

Table 1. Sugar beet weight loss during storage, Experiment 1.

Area in pile	Number of baskets	Days stored	Weight Loss (%)
A	25	27	4.14
B	27	35	4.49
C	29	42	4.88
D	29	49	5.09
E	28	56	5.29
F	28	63	5.45
G	29	70	5.58
H	28	77	5.70
I	28	84	5.79
J	24	91	5.79
K	30	98	5.74
L	27	105	6.55
M	28	121	4.49
N	26	121	4.89
O	27	121	6.47
	Mean weight loss, all baskets		5.396

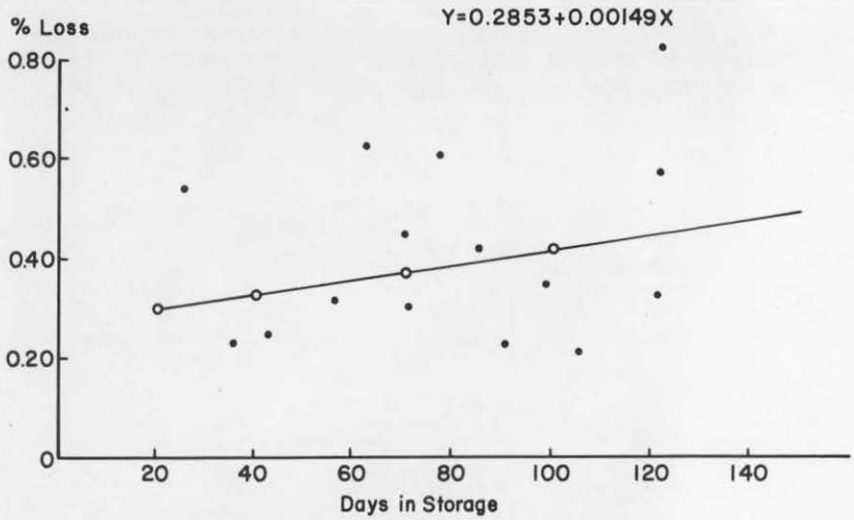

Fig. 3. Changes in sucrose percentage during storage, Experiment 1.

Table 2. Changes in sucrose percentage during storage, Experiment 1.

Area in pile	No. samples	Days stored	Sucrose percentage Initial Range	Initial Mean	Final Range	Final Mean	Mean difference
A	25	27	13.7-16.0	15.10	13.4-15.9	14.56	0.54
B	27	35	13.7-16.0	15.10	14.0-15.6	14.87	0.23
C	29	42	13.2-16.1	15.40	14.1-15.9	15.16	0.24
D	29	49	13.2-16.1	15.40	14.0-16.3	15.35	0.05
E	28	56	13.2-16.1	15.40	14.0-16.1	15.08	0.32
F	28	63	14.5-16.5	15.49	13.2-16.2	14.85	0.64
G	29	70	14.5-16.5	15.49	13.1-16.3	15.02	0.47
H	28	77	14.5-16.5	15.49	13.4-16.0	14.88	0.61
I	28	84	15.0-16.5	15.31	13.7-15.7	14.88	0.43
J	29	91	15.5-16.5	15.81	13.9-16.4	15.58	0.23
K	30	98	15.5-16.5	15.81	14.9-16.4	15.46	0.35
L	27	105	15.5-16.5	15.81	14.3-16.7	15.59	0.22
M	28	121	15.1-16.4	15.80	11.0-16.1	15.22	0.58
N	26	121	15.1-16.4	15.80	11.5-16.6	15.46	0.34
O	27	121	14.5-17.4	15.91	8.8-16.4	15.09	0.82
			Mean all samples:		Samples in	15.543	
					out	15.143	
				Mean difference		.400	

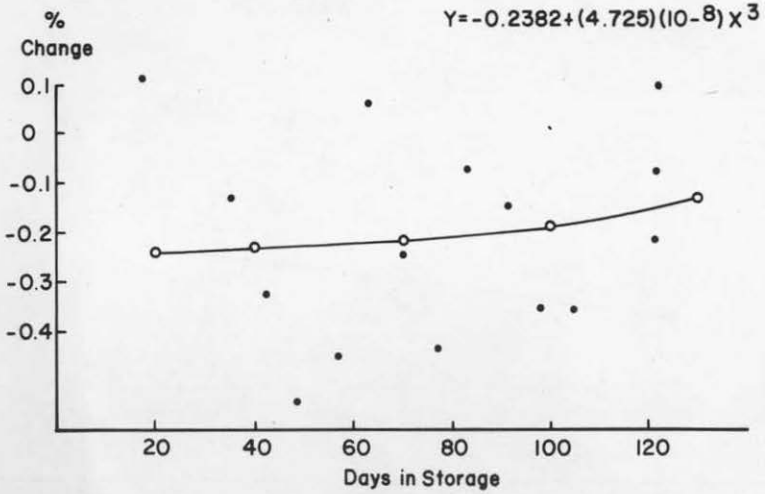

Fig. 4. Change in dry matter percentage during storage, Experiment 1.

Table 3. Changes in dry matter during storage, Experiment 1.

Area in pile	No. samples	Days stored	Dry matter percentage				Mean difference
			Initial		Final		
			Range	Mean	Range	Mean	
A	25	27	19.7-22.0	21.15	19.5-22.3	21.03	0.12
B	27	35	19.7-22.0	21.15	20.0-22.1	21.28	-0.13*
C	29	42	18.1-22.1	21.28	20.9-22.1	21.60	-0.32
D	29	49	18.1-22.1	21.28	20.4-22.8	21.83	-0.55
E	28	56	18.1-22.1	21.28	20.5-22.9	21.75	-0.47
F	28	63	20.2-22.3	21.39	20.2-22.8	21.33	0.06
G	29	70	20.2-22.3	21.39	20.3-22.3	21.63	-0.24
H	28	77	20.2-22.3	21.39	21.1-22.6	21.84	-0.44
I	21	84	21.1-22.2	21.33	20.2-22.6	21.41	-0.07
J	29	91	20.7-22.7	22.00	21.4-23.1	22.15	-0.15
K	30	98	20.7-22.7	22.00	21.4-23.1	22.36	-0.36
L	27	105	20.7-22.7	22.00	20.8-24.3	22.35	-0.35
M	28	121	20.7-22.6	22.05	20.0-23.3	21.95	0.10
N	26	121	20.6-22.6	22.05	20.1-23.3	22.15	0.17
O	27	121	21.3-23.1	21.92	20.0-23.4	22.14	-0.22
						Samples in	21.578
						out	21.790
				Mean difference			-.212

*Negative indicates gain in percentage dry matter during storage.

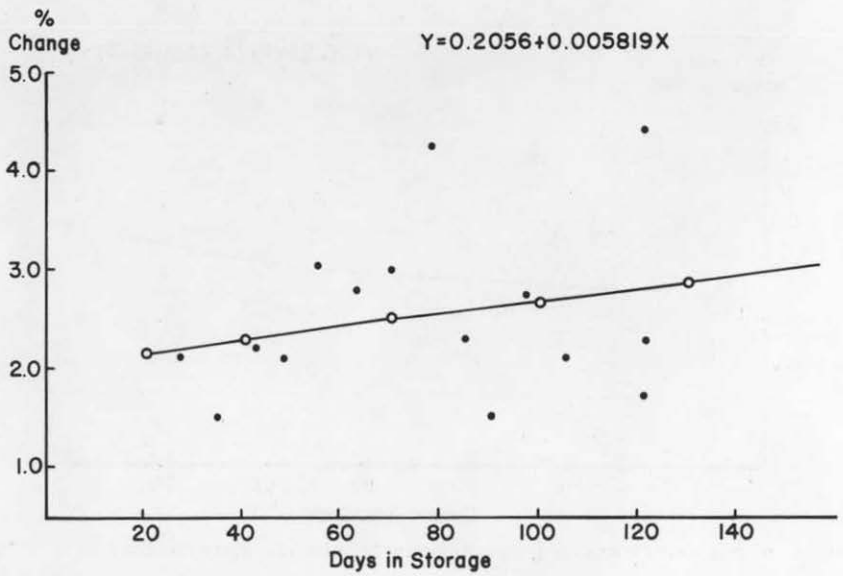

Fig. 5. Change in sucrose percentage, dry-matter basis, during storage, Experiment 1.

Table 4. Changes in sucrose during storage on a dry matter basis, Experiment 1.

Area in pile	No. samples	Days stored	Sucrose %/Dry Matter % Initial mean	Final mean	Mean difference
A	25	27	71.39	69.23	2.16
B	27	35	71.39	69.88	1.51
C	29	42	72.37	70.19	2.18
D	29	49	72.37	70.32	2.05
E	28	56	72.37	69.33	3.04
F	28	63	72.42	69.62	2.80
G	29	70	72.42	69.44	2.98
H	28	77	72.42	68.13	4.29
I	28	84	71.78	69.50	2.28
J	29	91	71.86	70.34	1.52
K	30	98	71.86	69.14	2.72
L	27	105	71.86	69.75	2.11
M	28	121	71.66	69.34	2.32
N	26	121	71.66	69.89	1.77
O	27	121	72.58	68.16	4.42
			Samples in	72.036	
			out	69.489	
		Mean difference		2.547	

Table 5. Statistical constants, Experiment 1.

	Weight loss	Change sucrose	Change dry matter	Change, sucrose (dry matter basis)
Number of samples	418	412	418	418
Mean change	5.96	0.400	-0.212**	2.547
Standard error of the estimate	0.738	0.209	0.217	0.899
Correlation coefficient	0.540	0.211	0.118	0.204
T-value	2.313*	0.788	0.430	0.75

*Significant at the 5% level

**Negative sign indicates gain

Table 6. Statistical constants, outside vs. inside baskets, Experiment 1.

	Outside baskets			Inside baskets		
	Weight	Sucrose	Dry matter	Weight	Sucrose	Dry matter
Number of baskets	136	136	136	282	282	282
Mean change	5.370	0.472	0.041	5.372	0.364	-0.294
Standard error of the estimate	3.614	0.945	0.655	2.014	0.564	0.563
Correlation coefficient	0.081	0.148	0.091	0.293	0.037	0.066
T-value	0.935	0.666	-1.063	5.124*	0.618	1.108
F-value***	1.103	3.697**	0.908			

*Significant at the 1% level

**Significant at the 5% level

***F-values include both inside and outside baskets

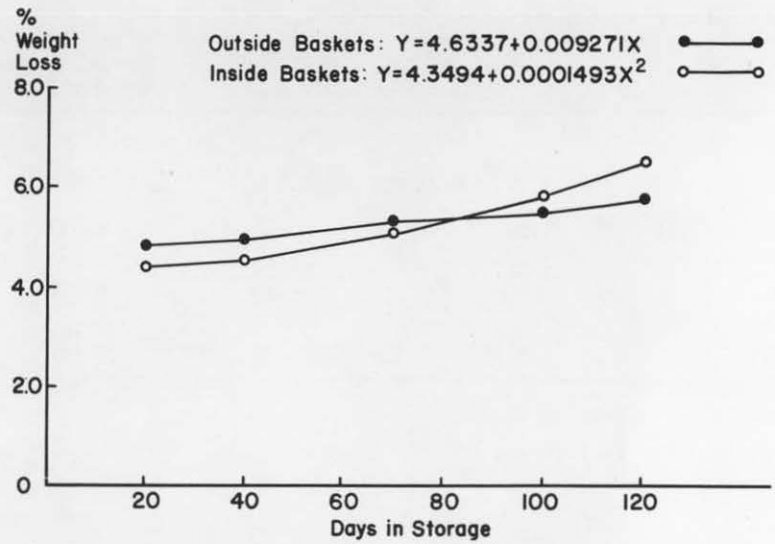

Fig. 6. Comparative weight losses of outside and inside baskets during storage, Experiment 1.

Table 7. Comparative weight changes outside vs. inside baskets during storage, Experiment 1.

Area in pile	Days stored	Outside baskets			Inside baskets		
			Weight loss (%)			Weight loss (%)	
		No.	Mean	Range	No.	Mean	Range
A	28	10	4.82	2.15-10.47	15	3.80	2.94- 7.38
B	35	9	4.71	3.61- 8.64	19	4.29	3.09- 6.65
C	42	10	4.37	3.50- 5.80	20	4.65	3.16- 6.13
D	49	10	5.18	3.46- 7.57	19	5.91	4.20- 8.53
E	56	10	4.20	2.95- 5.68	19	4.83	1.98- 7.84
F	63	10	5.75	2.21-15.00	18	4.68	3.11- 5.79
G	70	9	7.57	4.13-20.71	20	5.98	3.34- 9.11
H	77	8	6.15	4.06- 9.89	20	5.99	0 - 7.92
I	84	8	5.61	2.61-11.27	20	5.04	2.96- 9.85
J	91	9	5.61	0.80- 9.09	19	6.25	3.36-14.35
K	98	10	5.37	2.84- 9.69	20	7.02	4.03-10.60
L	105	8	6.66	0.49-21.43	19	6.21	3.60-10.38
M	121	10	5.58	0 -12.50	19	3.86	1.46- 7.69
N	121	8	4.30	0 - 8.23	19	5.48	0 - 9.25
O	121	9	7.33	1.35-14.82	19	6.42	0 -10.15

Outside baskets: 5.518
Inside baskets: 5.392

Table 8. Comparative changes in sucrose content of outside vs. inside baskets during storage, Experiment 1.

Area in pile	Initial sucrose %	Days stored	Outside Baskets				Inside Baskets			
			No.	Sucrose Content % Mean	Sucrose Content % Range	Mean loss	No.	Sucrose Content % Mean	Sucrose Content % Range	Mean loss
A	15.10	28	10	14.70	13.9-15.9	0.40	19	14.46	13.3-15.5	0.64
B	15.10	35	8	14.79	14.5-15.0	0.31	20	14.92	14.0-15.6	0.18
C	15.40	42	10	15.34	14.8-15.9	0.06	20	15.13	14.1-16.2	0.27
D	15.40	49	10	15.22	14.0-15.9	0.18	20	15.40	14.1-16.4	0.00
E	15.40	56	10	14.92	14.4-15.8	0.48	19	15.16	14.0-16.1	0.24
F	15.49	63	10	14.90	13.8-16.2	0.59	20	14.84	14.2-16.1	0.65
G	15.49	70	10	14.94	13.1-15.8	0.55	20	14.97	14.0-16.3	0.52
H	15.49	77	9	14.99	14.4-16.0	0.50	20	14.82	13.4-15.7	0.67
I	15.31	84	10	14.78	13.7-15.3	0.53	20	14.96	14.0-15.7	0.35
J	15.81	91	10	15.64	14.9-16.4	0.17	20	15.56	13.9-16.3	0.25
K	15.81	98	10	15.69	15.2-16.4	0.12	20	15.35	14.0-16.4	0.46
L	15.81	105	8	15.70	14.3-16.7	0.11	19	15.54	14.9-16.0	0.27
M	15.80	121	10	14.72	11.0-15.9	1.08	20	15.52	15.0-16.1	0.28
N	15.80	121	9	15.17	11.5-16.7	0.63	19	15.61	14.0-16.6	0.19
O	15.91	121	8	14.43	8.8-15.8	1.48	20	15.39	13.8-16.4	0.52

Mean sucrose loss (as % units): Outside baskets 0.472
Inside baskets 0.366

Table 9. Comparative changes in dry matter content of outside vs. inside baskets during storage, Experiment 1.

Area in pile	Initial % dry matter	Days stored	Outside baskets				Inside baskets			
			No.	Final dry matter % Mean	Final dry matter % Range	Mean* change	No.	Final dry matter % Mean	Final dry matter % Range	Mean* change
A	21.15	28	10	20.95	20.40-20.46	-0.20	19	20.91	19.52-21.79	-0.24
B	21.15	35	8	20.87	20.07-21.34	-0.28	20	21.45	20.72-22.14	+0.30
C	21.28	42	10	21.53	20.95-21.94	+0.25	19	21.64	21.00-22.12	+0.36
D	21.28	49	10	21.58	20.38-22.29	+0.30	20	21.96	21.02-22.82	+0.68
E	21.28	56	9	21.33	20.45-22.37	+0.05	19	21.95	20.95-22.91	+0.67
F	21.39	63	10	21.39	20.57-22.78	0	20	21.34	20.22-22.67	-0.05
G	21.39	70	10	21.36	20.29-22.02	-0.03	20	21.69	20.90-22.90	+0.30
H	21.39	77	9	21.81	21.08-22.74	+0.42	20	21.89	21.08-22.59	+0.50
I	21.33	84	10	21.09	20.17-21.59	-0.24	20	21.55	20.55-22.64	+0.22
J	22.00	91	10	22.21	21.37-22.99	+0.21	20	22.12	20.33-23.05	+0.12
K	22.00	98	10	22.48	21.87-23.07	+0.38	20	22.30	21.38-23.01	+0.30
L	22.00	105	8	22.19	20.78-23.24	+0.19	19	22.42	21.69-23.24	+0.42
M	22.05	121	10	21.72	19.97-23.30	-0.33	19	22.08	21.33-22.66	+0.03
N	22.05	121	9	21.90	20.71-23.15	-0.15	20	22.11	20.08-23.29	+0.06
O	21.92	121	9	21.61	20.04-22.83	-0.31	20	22.32	21.09-23.41	+0.40

Mean change in percent dry matter: Outside baskets -0.031*
Inside baskets +0.378*

*Negative prefix signifies gain in dry matter during storage; positive prefix signifies loss.

Table 10. Comparative changes in sucrose content on a dry matter basis of ourside vs. inside baskets during storage, Experiment 1.

Area in pile	Initial sucrose %	Days stored	Outside baskets			Inside baskets		
			No.	Mean final sucrose content	Sucrose loss %	No.	Mean final sucrose content	Sucrose loss %
A	71.39	28	10	70.17	1.22	19	69.15	2.24
B	71.39	35	8	70.87	0.52	20	69.56	1.83
C	72.37	42	10	71.25	1.12	20	69.92	2.45
D	72.37	49	10	70.53	1.84	20	70.13	2.24
E	72.37	56	10	69.95	2.42	19	69.07	3.30
F	72.42	63	10	69.66	2.76	20	69.54	2.88
G	72.42	70	10	69.94	2.48	20	69.02	3.40
H	72.42	77	9	68.73	3.69	20	67.70	4.72
I	71.78	84	10	70.08	1.70	20	69.42	2.36
J	71.86	91	10	70.42	1.44	20	70.34	1.52
K	71.86	98	10	69.80	2.06	20	68.83	3.03
L	71.86	105	8	70.75	1.11	19	69.31	2.55
M	71.66	121	10	67.77	3.89	20	70.29	1.37
N	71.66	121	9	69.27	2.39	20	70.60	1.06
O	72.58	121	9	66.77	5.81	20	68.95	3.63

Loss in percent sucrose on dry matter basis: Outside baskets 2.304
Inside baskets 2.571

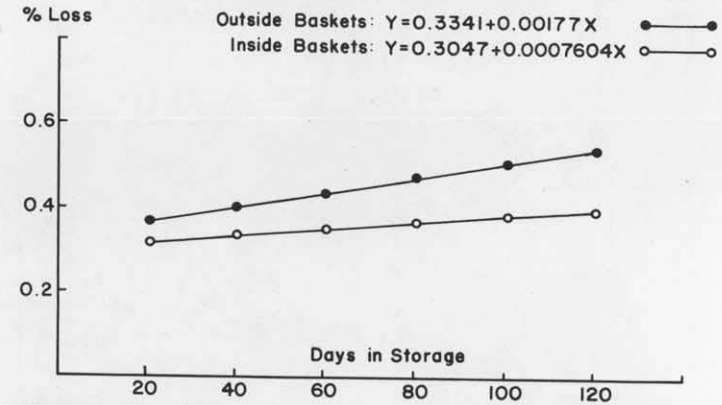

Fig. 7. Comparative changes in sucrose content of outside and inside baskets during storage, Experiment 1.

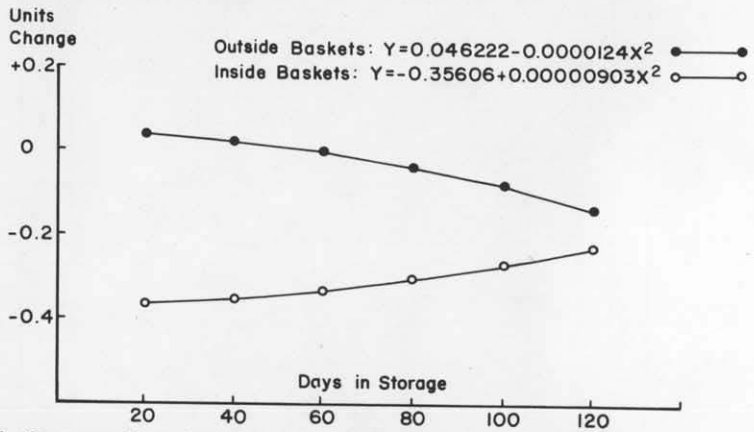

Fig. 8. Comparative changes in dry matter content of outside and inside baskets during storage, Experiment 1.

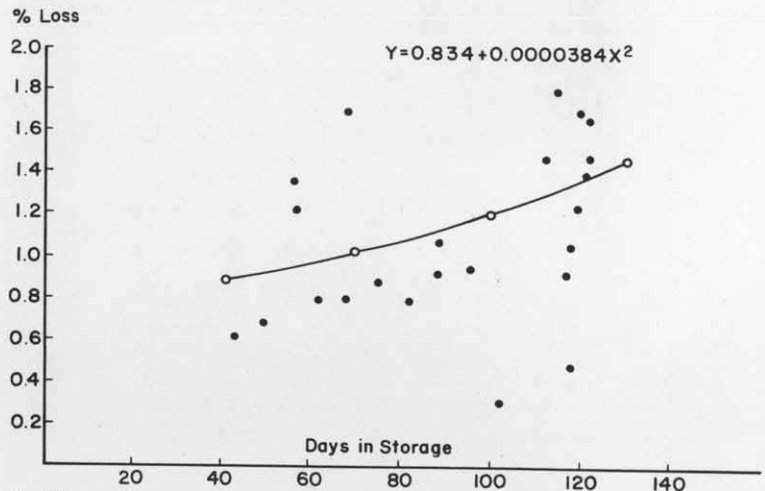

Fig. 9. Change in sucrose percentage during storage, Experiment 2.

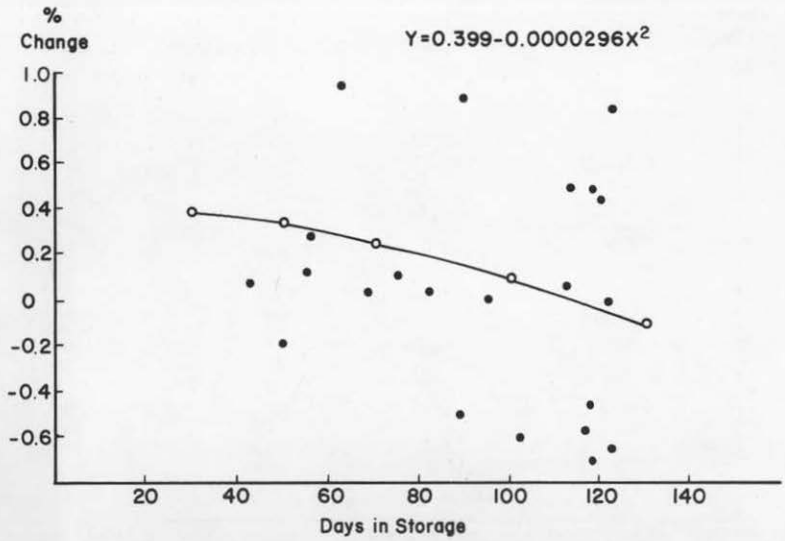

Fig. 10. Change in dry matter percentage during storage, Experiment 2.

Table 11. Changes in dry matter during storage, Experiment 2.

No. samples	Days stored	Dry matter % Initial Range	Initial Mean	Final Range	Final Mean	Mean difference
17	42	20.34-22.57	21.43	19.31-22.61	21.36	0.07
30	49	20.10-22.36	21.28	20.16-23.72	21.48	-0.20*
18	56	20.59-23.03	21.76	19.76-23.03	21.41	0.35
12	55	20.93-23.06	21.34	20.20-22.36	21.22	0.12
27	62	19.62-23.41	21.50	18.42-22.08	20.55	0.95
20	69	19.64-22.82	21.64	19.64-22.82	21.62	0.02
2	68	22.82-23.84	23.23	20.87-22.55	21.71	1.62
23	75	18.14-22.90	21.30	19.44-22.23	21.19	0.11
25	82	20.55-23.12	21.55	20.12-22.85	21.51	0.04
13	89	20.95-22.80	21.72	19.49-22.34	20.84	0.88
9	88	18.98-21.56	20.48	19.46-22.18	20.99	-0.51
23	95	18.46-22.71	21.04	20.00-22.30	21.04	0
23	102	15.83-22.76	20.54	20.04-22.12	21.13	-0.59
10	118	19.27-22.60	20.99	20.38-22.39	21.69	-0.70
30	116	19.00-22.81	20.79	20.14-23.24	21.35	-0.56
30	122	17.41-22.52	20.09	19.24-22.57	20.72	-0.63
20	117	19.53-21.79	20.58	19.10-22.81	21.04	-0.46
32	123	18.85-22.41	21.21	18.4 -22.40	20.36	0.86
3	114	20.58-22.68	21.51	20.19-21.76	21.01	0.50
34	121	18.27-22.68	20.71	18.99-22.20	20.70	0.01
19	120	18.38-22.42	20.75	19.03-21.94	20.28	0.47
21	113	19.31-22.96	20.93	19.33-22.51	20.86	0.07
32	119	18.94-22.20	21.02	18.94-22.26	20.52	0.50

	Samples in	21.069
	out	21.000
Mean difference		.069

*Negative prefix indicates gain in dry matter

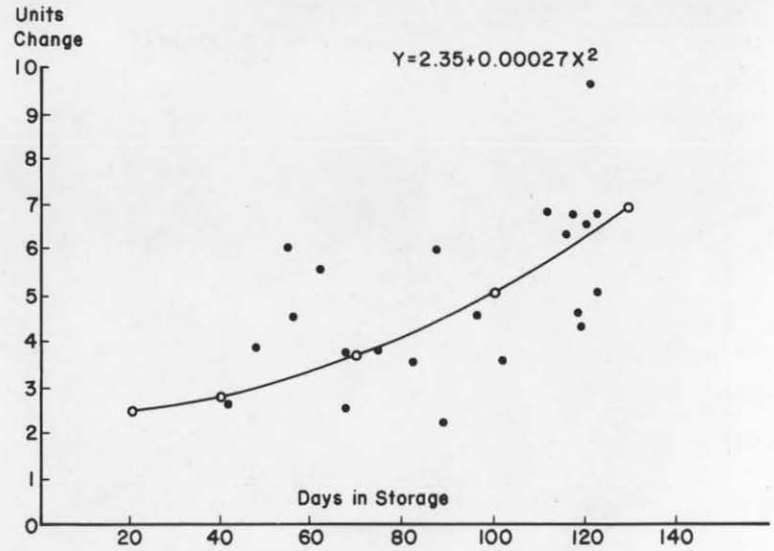

Fig. 11. Change in sugar content, dry matter basis, during storage, Experiment 2.

Table 12. Changes in sucrose content on a dry matter basis during storage, Experiment 2.

No. samples	Days stored	% Sucrose/% Dry Matter Initial mean	Final mean	Mean difference
17	42	72.56	69.94	2.62
30	49	73.21	69.32	3.89
18	56	73.48	68.94	4.54
12	55	73.85	67.81	6.04
27	62	73.02	72.46	0.56
20	69	73.29	69.61	3.68
2	68	72.65	70.24	2.41
23	75	71.88	68.18	3.73
25	82	71.88	68.34	3.54
13	89	72.97	70.87	2.10
9	88	76.32	70.37	5.95
23	95	73.91	69.39	4.52
23	102	73.42	69.90	3.52
10	118	73.32	68.74	4.58
30	116	74.46	68.85	6.31
30	122	77.55	68.00	9.55
20	117	75.46	68.73	6.73
32	123	73.79	68.71	5.08
3	114	73.59	66.78	6.81
34	121	76.34	69.61	6.73
19	120	75.90	69.28	6.62
21	113	74.47	67.59	6.88
32	119	73.17	68.86	4.31

Mean of all samples:	In	74.045
	Out	69.129
Mean difference		4.916

Table 13. Changes in sucrose content during storage, Experiment 2.

No. samples	Days stored	Sucrose content % Initial Range	Initial Mean	Final Range	Final Mean	Mean difference
17	42	14.3-16.5	15.55	13.6-15.6	14.94	0.61
30	49	14.4-16.8	15.58	14.0-16.0	14.89	0.69
18	56	15.1-17.0	15.99	13.5-16.2	14.76	1.23
12	55	14.9-16.9	15.76	13.4-15.6	14.39	1.36
27	62	14.8-16.9	15.70	13.8-15.8	14.89	0.81
20	69	15.0-16.8	15.86	13.9-15.8	15.05	0.81
2	68	16.4-17.5	16.95	14.7-15.8	15.25	1.70
23	75	12.8-17.1	15.31	13.1-15.8	14.44	0.87
25	82	14.1-16.6	15.49	13.1-15.5	14.70	0.79
13	89	14.7-17.5	15.85	13.9-15.8	14.77	1.07
9	88	14.2-16.3	16.63	13.9-15.8	14.70	0.93
23	95	14.1-16.9	15.55	13.3-16.0	14.60	0.95
23	102	12.3-16.1	15.08	13.1-15.7	14.77	0.31
10	118	14.2-16.8	15.39	14.2-15.7	14.91	0.48
30	116	14.4-16.7	15.48	13.0-16.1	14.55	0.93
30	122	13.2-17.2	15.58	13.0-15.4	14.09	1.49
20	117	14.4-16.8	15.53	12.0-16.0	14.46	1.07
32	123	13.6-17.3	15.65	12.5-15.0	13.99	1.66
3	114	15.3-16.9	15.83	12.8-14.8	14.03	1.80
34	121	14.6-17.7	15.81	12.8-15.8	14.41	1.40
19	120	14.5-16.8	15.75	13.4-15.7	14.05	1.70
21	113	14.4-17.2	15.59	12.7-15.2	14.10	1.49
32	119	13.9-18.1	15.38	12.1-15.7	14.13	1.25
		Mean difference:		Samples in	15.592	
				out	14.510	
					1.082	

Table 14. Summary of statistical constants, Experiment 2.

	Change, sucrose percentage	Change, dry matter percentage	Change, sucrose percentage (dry matter basis)
Number of samples	473	473	473
Mean change	1.082	0.069	4.916
Standard error of the estimate	0.329	0.583	1.590
Correlation coefficient	0.497	0.242	0.041
T-value	2.628*	-1.144**	3.822*

*Significant at the 1% level

**Negative sign indicates gain