

SPACING TEST
FORT COLLINS, COLORADO
1938

Location:

Three miles south east of Ault Colorado, approximately twenty miles east of Fort Collins, on the Harry Clark Farm. The land was spring plowed potato ground of high fertility.

Plan of Test:

Eight varieties selected to include strains of known high and low yielding ability were planted as a Latin Square. Each of these variety plots was eight rows wide and ninety feet long. At thinning each of these plots was split into three plots eight rows wide and thirty feet long by spacing treatments as follows: (a) Normal spacing, twenty inch rows with single plants at ten inch intervals, (b) twenty inch rows with doubles at twenty inch intervals, (c) forty inch rows with single plants at forty inch intervals. Spacings (a) and (b) had approximately the same plant population, but arranged differently. Spacing (c) had one eighth of the plant population of the other two spacings. Each row of the variety Latin Square thus consisted of one row each of the spacing subplots. The spacing treatments were randomized in each of the eight variety Latin Square rows, making a split plot test of spacings imposed on a Latin Square of varieties.

Culture:

The test was planted in late April. Successive hard rains and hail soon after planting resulted in a crust condition that required treatment, but quite good germination stands were finally secured. The spacings were thinned to a measured tape and mostly good to very good thinned stands were finally secured. Cultivation, hoeing and irrigation conformed to accepted good practice.

Harvest:

This test was harvested in late October. Half the test was harvested in one day and the remaining half harvested the following week on two successive days. Laboratory work on these samples was unexpectedly slow and some samples from the first half harvested had as much as seven days elapse between the date of harvest and the laboratory analysis. A few of the most delayed samples while not distinctly wilted were beginning to wilt by the time they went through the laboratory. None of the second half samples were delayed as much and the weather had turned cooler with the result that these samples reached the laboratory in good condition.

Spacings were harvested as follows: (a) All normally competitive beets were first dug by hand and topped as for mother beets; these were divided into approximately equal portions and labelled samples 1 and 2. All remaining beets were then dug and topped in the usual way and then labeled sample 4. Samples 1 and 2 were washed and weighed; then topped at the bottom leaf scar with a band saw and then reweighed, split and rasped for analysis. Sample 4 was washed, weighed and then discarded. (b) All normally competitive pairs were dug and topped as for mother beets; then numbered in the field in such a way that their approximate position in the plot would be told from the number. The Sacks were then marked with the plot number only. All remaining pairs and all single beets were then dug and topped as sample 4 as was done in the case of spacing (a). Sample 4 was washed, weighed and discarded. The numbered beets were washed and then each beet weighed on the Toledo scales; the crown was then cut off with a butcher knife at the bottom leaf scar and the beet reweighed. As these beets were weighed they were divided into two samples by throwing all odd numbered beets into one box and all even numbered beets into another box. These two lots became samples 1 and 2 and were split, rasped and sent to the laboratory for analysis. (c) All normally competitive beets were dug and topped as for mother beets then divided in the field into Samples 1 and 2. All remaining beets were then dug and topped in the same way and called Sample 4. All three samples were washed, weighed, topped with the band saw, reweighed, split, rasped and sent to the laboratory for analysis.

While two or three different men topped with the band saw at one time or another and still another man topped all the spacing (b) beets with a knife it appeared that a quite uniform job of topping was done. While it was not apparent at the time it is possible that the topping by the band saw was slightly lower than that done by the one man with a knife on the spacing (b) beets. If this was the case the lower percent crown obtained from the spacing (b) beets might not be a real difference. It is not believed that this is the case, but the possibility should not be overlooked.

Discussion of harvest and data:

Use of all the normally competitive beets for the laboratory samples was a mistake and will not be repeated when so large a number of beets per plot are available. Two twenty beet samples appears to be adequate to give reliable percent sucrose and purity values. Certainly any added accuracy from the larger samples is more than offset by the increased cost and the greater chance for error in handling when a single sample consists of two or more bags of beets.

Examination of the data from individual plots shows considerable non-uniformity in this field. The rise in quality from east to west (lengthwise of the rows) is particularly striking. Variations in yield, while considerable, did not exhibit any such uniform trend; although there appeared to be a tendency for a low yield streak to run through the center of the test from east to west.

The individual weighing of the roots from spacing (b) resulted in a mass of data only part of which has been used in the present analysis.

An average of three more beets per plot were harvested from the (b) spacing than from the (a) spacing. This difference is not significant. Due to the method of harvesting the (b) spacing it is thought that practically all beets of non commercial size from this spacing are accounted for. It is possible that a few of these small beets from the (a) spacing were lost and not accounted for. It does not seem probable that this error, even if it did occur, is of sufficient magnitude to affect the conclusions..

After examination of beets returned with the dirt tare to farmers' trucks and considering what would be a simple measurement for such beets it was decided that all beets which weighed less than .40 pounds after the crown was cut off were of non commercial size. This test was individually applied to all normally competitive beets from the (b) spacing. While this measurement was not individually applied to the (a) spacing beets and the remainder beets from the (b) spacing a comparison of the non commercial beets from these with those of known size indicated that the classification was satisfactory.

When the data was assembled from this test it was found that there was a question as to the actual number of beets which had been harvested from many of the (c) spacing plots due to the failure of the counts by the harvest and washhouse crews to check. Since one beet more or less was equivalent to a three to five percent error in the case of these big beets it was decided to eliminate this spacing from the final analysis of the test.

Spacing (c); 40 x 40 Inches.

Whole beet, variety, mean weights were obtained from the unquestioned samples from this spacing. A comparison of these means from normally competitive beets and from beets adjacent to one or more blanks by Student's Paired Comparisons indicated that this spacing had eliminated competition. A similar comparison of the same classes of beets from individual plots lead to the same conclusion. Variety means were then computed using all beets from unquestioned samples. The smallest number of beets for any one variety was 172 and the greatest number 249. These appear to be adequate numbers on which to base a mean value.

This test was planned to show varietal reaction to different spacings, if any. This is particularly important in the case of the (c) spacing. Since much of the data from this spacing was questioned some short cut that would indicate the presence or lack of varietal reaction to space was desired. If varietal reaction to space was indicated correction and adjustment of errors would be needed to put the (c) spacing data in such shape that it could be used in a general analysis of the test. To test the relative importance of the interaction, varieties times spacings, the following analysis was used:

Mean whole beet weights were calculated for the normally competitive beets from spacing (a). The same calculations were made for normally competitive hills of spacing (b). The above mean weights for spacing (c) were used. These means were then reduced to a mean root weight per 200 square inches of area; the divisors used being 1, 2 and 3 respectively.

The following table was then made up and an analysis of variance calculated.

Mean Weights of Whole Beets per 200 Square Inches of Area.

Var. No's.	59	60	61	62	63	64	65	66
Spacing (a)	1.712	1.516	1.440	1.504	1.371	1.659	1.439	1.235
Spacing (b)	1.530	1.393	1.352	1.467	1.297	1.509	1.398	1.115
Spacing (c)	1.161	1.077	.988	.990	.827	.939	.998	.707

<u>Variance due to</u>	<u>Degrees of Freedom</u>	<u>Mean Square</u>
Varieties	7	.055319
Spacings	2	.627109
Varieties x Spacing	14	.002683

It is evident that that part of the total variance attributable to the interaction is proportionally very small.

It appears that we may safely conclude that 40 x 40 inch spacing did eliminate competition and that differential varietal response to these three spacings was so small as to be negligible in any effect it would have in the selection of breeding material from such spacings.

The data obtained from the (a) and (b) spacings was unusually free of obvious errors and these two spacings were combined for the analysis of a number of different values.

Plot and general summaries follow for these two spacings only.

SPACING TEST AULT, COLORADO, 1938
PLOT SUMMARIES

10 x 20 Singles (a) Phase

Var. No.	Plot No.	No. Beet Harv	Competitive Beet Data					Ann. Coef. of Pur	Lbs. Sug. Per A.	
			Av. Wt. Whole C. Beet	T. per A Whole Beets	% Crown	T. per A Topped Beets	% Sugar		Gross	Ind Av.
59	550	167	1.577	24.73	20.92	19.56	11.80	87.65	4616	4046
	565	133	1.832	28.72	17.12	23.81	11.60	87.90	5523	4855
	591	113	1.688	26.46	14.79	22.55	12.75	89.65	5790	5155
	611	173	1.510	23.55	20.71	18.67	11.90	85.20	4444	3786
	650	122	1.944	30.49	19.48	24.55	12.95	85.95	6359	5466
	680	138	1.864	29.24	14.69	24.94	14.75	90.25	7358	6641
	692	95	1.827	28.66	17.51	23.64	14.15	91.30	6689	6107
	729	65	1.486	23.31	11.39	20.65	15.70	93.90	6485	6089
Mean			1.716	26.90	17.68	22.30	13.20	88.98	5903	5268
60	554	168	1.712	26.85	22.25	20.88	9.75	85.00	4072	3461
	564	157	1.542	24.03	18.29	19.64	11.40	87.80	4477	3931
	590	143	1.415	22.03	15.18	18.69	11.85	90.45	4429	4006
	615	168	1.343	21.06	18.62	17.14	10.20	88.10	3496	3080
	648	171	1.432	22.45	16.34	18.78	12.90	87.60	4846	4245
	675	174	1.613	25.30	19.95	20.25	14.55	88.20	5893	5198
	697	128	1.665	26.11	15.72	22.00	14.80	90.95	6513	5924
	725	171	1.509	23.66	14.88	20.14	14.80	92.90	5961	5538
Mean			1.529	23.94	17.65	19.69	12.53	88.88	4961	4423
61	552	184	1.403	22.00	16.70	18.32	12.75	89.75	4672	4193
	569	183	1.499	23.51	15.34	19.91	14.00	89.30	5574	4978
	587	181	1.457	22.86	16.38	19.11	11.50	88.30	4396	3882
	618	165	1.555	24.39	13.76	21.03	12.80	87.85	5384	4730
	644	161	1.471	23.07	15.87	19.41	14.55	91.10	5649	5146
	678	157	1.482	23.24	16.16	19.49	15.65	88.55	6099	5401
	693	79	1.372	21.52	13.47	18.62	15.60	90.60	5809	5263
	727	160	1.240	19.45	11.14	17.28	16.05	92.45	5547	5128
Mean			1.435	22.50	14.85	19.15	14.11	89.74	5391	4840
62	551	160	1.428	22.40	14.57	19.13	13.10	92.10	5012	4616
	568	185	1.579	24.76	15.58	20.90	13.60	89.20	5686	5072
	589	172	1.581	24.64	14.65	21.03	13.40	91.60	5637	5163
	617	176	1.498	23.49	15.71	19.80	14.70	88.85	5821	5172
	646	194	1.303	20.43	10.17	18.36	14.40	89.85	5287	4790
	676	155	1.630	25.57	12.62	22.34	14.90	88.55	6657	5895
	698	190	1.612	25.28	12.50	22.12	14.90	90.90	6591	5991
	723	176	1.423	22.31	13.58	19.28	15.65	93.35	6035	5634
Mean			1.507	23.61	13.67	20.37	14.33	90.55	5841	5287

Competitive Beet Data

<u>Var. No.</u>	<u>Plot No.</u>	<u>No. Beet</u> <u>Nary</u>	<u>Av. Wt. Whole</u> <u>G Beet*</u>	<u>T. Per A Whole</u> <u>Beets</u>	<u>% Crown</u>	<u>T. Per A Topped</u> <u>Beets</u>	<u>% Sacr.</u>	<u>App. Coef. of Pur.</u>	<u>Lbs. Sug. Per A. Gross</u>	<u>Ind Av.</u>
63	553	183	1.347	21.00	15.79	17.69	13.30	89.10	4705	4192
	567	170	1.334	20.91	13.81	16.02	14.40	92.05	5191	4778
	592	170	1.466	22.99	12.44	20.13	15.30	91.55	6159	5639
	612	196	1.310	20.55	15.93	17.27	13.65	88.20	4716	4160
	643	179	1.417	22.23	11.04	19.77	15.60	91.90	6169	5669
	677	154	1.498	23.49	12.70	20.51	15.70	90.15	6440	5806
	694	154	1.370	21.49	10.38	19.26	17.05	91.90	6566	6034
	730	121	1.035	16.23	8.53	15.01	17.70	93.75	5313	4981
Mean			1.347	21.11	12.58	18.46	15.34	91.08	5657	5157
64	547	148	1.533	23.55	16.78	19.60	12.70	88.05	4979	4384
	570	121	1.801	28.24	14.32	24.20	13.55	87.85	6557	5760
	588	132	1.888	29.60	15.25	25.09	13.60	89.35	6825	6098
	616	153	1.564	24.53	12.62	21.43	13.60	90.30	5829	5264
	645	133	1.719	26.95	12.60	23.56	14.80	90.65	6973	6321
	681	132	1.854	29.07	11.69	25.67	16.00	90.50	8215	7435
	695	111	1.676	26.28	10.91	23.41	16.25	90.55	7608	6889
	726	111	1.244	19.51	10.07	17.55	16.25	93.25	5703	5318
Mean			1.660	25.97	13.03	22.56	14.59	90.06	6386	5934
65	548	177	1.611	24.98	16.25	20.92	13.10	89.35	5480	4896
	566	132	1.446	22.50	11.93	19.82	12.95	90.90	5132	4665
	594	149	1.600	25.09	13.84	21.62	14.75	89.70	6377	5720
	613	167	1.308	20.39	15.75	17.17	12.30	89.35	4225	3775
	649	167	1.499	23.51	14.38	20.13	15.50	91.50	6241	5711
	679	130	1.567	24.57	10.36	22.03	16.30	90.70	7181	6513
	691	162	1.644	25.78	16.79	21.45	15.40	90.65	6607	5989
	728	121	1.209	18.96	10.12	17.04	16.00	92.50	5454	5045
Mean			1.486	23.22	13.68	20.02	14.54	90.58	5837	5289
66	549	153	1.174	18.30	18.94	14.83	14.25	88.75	4227	3752
	563	164	1.204	18.88	17.67	15.55	14.50	89.00	4509	4013
	593	142	1.283	20.12	16.68	16.76	15.70	91.55	5264	4819
	614	151	1.102	16.94	17.04	14.05	13.70	89.90	3850	3461
	647	153	1.158	18.16	15.46	15.35	16.55	88.75	3082	4510
	682	132	1.564	24.52	12.84	21.37	16.05	89.05	6860	6109
	696	97	1.357	21.28	12.23	18.67	17.20	90.75	6423	5829
	724	152	1.155	18.11	11.57	16.01	17.00	91.95	5444	5006
Mean			1.250	19.54	15.30	16.57	15.62	89.96	5207	4687

* Marketable beets approximately one inch in diameter at base of crown.

10 x 20 Singles (a) Phase

Actual Yield Data

Yar. No.	Plot No.	Actual Yield Data		Tons per A Topped Beet	Lbs. Sug. per A	
		Total Beets Harvested	Total "C" Beets Harvested		Gross	Ind. Av
59	550	195	195	19.17	4525	3966
	555	188	188	21.23	4925	4329
	591	178	178	20.15	5137	4605
	611	201	200	18.56	4418	3764
	650	180	180	22.53	5835	5015
	680	168	168	19.33	5703	5147
	692	190	190	22.78	6447	5886
	729	179	179	19.57	6146	5771
Mean		185	185	20.42	5392	4810
60	554	199	199	20.54	4005	3404
	564	207	202	19.19	4375	3801
	590	195	192	19.08	4522	4090
	615	208	208	17.21	3512	3094
	648	202	202	18.80	4851	4249
	675	200	200	20.10	5848	5158
	697	193	193	21.87	6475	5889
	725	207	207	19.95	5905	5486
Mean		201	200	19.99	4937	4401
61	552	210	210	19.04	4856	4358
	569	207	207	19.88	5566	4970
	587	205	205	20.69	4759	4202
	618	205	203	20.81	5327	4680
	644	197	197	19.13	5567	5072
	678	182	182	17.39	5445	4822
	693	204	204	19.65	6132	5556
	727	200	200	16.73	5372	4966
Mean		201	201	19.16	5378	4828
62	551	203	203	20.43	5353	4930
	568	197	197	19.08	5190	4629
	589	207	203	22.22	5954	5454
	617	209	207	19.99	5878	5223
	646	215	215	19.11	5503	4944
	676	193	193	22.01	6560	5809
	698	210	210	22.75	6778	6161
	723	206	206	19.54	6117	5710
Mean		205	204	20.64	5917	5358

10 x 20 Singles (a) Phase

Actual Yield Data

Var. No.	Plot No.	Total Beets	Total "C" Beets	Tons Per A	Lbs. Suc. Per A.	
		Harvested	Harvested	Topped Beets	Gross	Ind. Av.
63	553	206	205	18.18	4836	4309
	567	212	212	18.54	5340	4915
	592	204	201	20.20	6183	5661
	612	215	212	17.58	4800	4234
	643	210	210	19.73	6154	5656
	677	194	194	20.23	6351	5725
	694	199	199	18.47	6298	5788
	730	197	197	15.74	5572	5224
Mean		205	204	18.58	5692	5189
64	547	199	196	20.23	5139	4525
	570	179	177	20.99	5688	4997
	588	179	176	22.37	6084	5436
	616	204	202	20.97	5705	5152
	645	187	187	22.59	6688	6063
	681	179	179	24.36	7797	7056
	695	180	180	21.02	6833	6187
	726	187	187	16.03	5210	4858
Mean		187	186	21.07	6143	5534
65	548	199	197	20.41	5347	4778
	566	194	193	18.69	4840	4400
	594	201	197	22.27	6571	5894
	613	204	202	17.47	4297	3839
	649	205	205	20.34	6304	5768
	679	180	180	21.69	7072	6414
	691	199	196	20.31	6254	5669
	728	200	200	16.84	5387	4983
Mean		198	196	19.75	5759	5218
66	549	196	195	15.04	4287	3805
	563	200	200	15.47	4487	3993
	593	195	195	16.90	5307	4859
	614	203	196	14.11	3865	3475
	647	195	195	15.19	5027	4461
	682	178	178	19.61	6295	5606
	696	182	182	16.52	5684	5158
	724	204	204	15.83	5384	4951
Mean		194	193	16.08	5042	4538

SPACING TEST AULT, COLORADO, 1938
PLOT SUMMARIES

20 x 20 Doubles (b) Phase

Var. No.	Plot No.	Competitive Beet Data								
		No. Hill Hary.	Av. Wt Whole C Beet*	T. per A Whole Beet	% Crown	T. per A Topped Beets	% Sucr.	App. Coef. of Pur	Lbs. Sucr. per A Gross	Ind Av
39	558	60	1.560	21.81	15.53	18.43	12.05	88.15	4441	3915
	573	75	1.703	23.50	16.59	19.60	13.90	89.85	5449	4896
	607	75	1.577	21.77	14.04	18.71	13.15	88.55	4922	4358
	619	75	1.656	22.50	18.10	18.43	11.75	84.10	4331	3642
	642	47	2.063	27.19	18.48	22.17	12.10	83.60	5365	4485
	664	67	1.767	25.02	15.73	21.09	13.90	87.75	5862	5144
	700	86	1.692	23.60	14.77	20.13	14.60	89.60	5637	5051
	721	52	1.708	23.69	10.87	21.11	14.90	91.00	6291	5725
Mean			1.716	23.64	15.51	19.96	13.22	87.82	5287	4652
60	562	79	1.737	23.96	20.29	19.10	11.35	85.40	4335	3702
	572	90	1.660	22.27	19.89	17.84	11.90	87.95	4246	3734
	606	95	1.269	16.55	14.75	14.11	12.65	90.65	3569	3235
	623	96	1.509	20.21	16.81	16.82	11.40	87.45	3834	3353
	640	86	1.546	20.72	17.97	17.01	11.95	84.30	4066	3428
	659	85	1.565	21.50	18.15	17.60	13.85	87.25	4875	4253
	705	83	1.669	24.76	13.29	21.46	15.05	88.70	6460	5730
	717	85	1.491	21.18	12.81	18.47	14.40	92.80	5319	4936
Mean			1.556	21.39	16.74	17.80	12.82	88.06	4588	4046
61	560	100	1.492	20.47	14.55	17.49	14.20	91.10	4968	4526
	577	92	1.497	20.93	15.50	17.68	14.80	88.70	5235	4643
	603	91	1.510	20.56	16.48	17.17	12.40	86.45	4259	3682
	626	87	1.542	20.71	16.77	17.24	12.50	87.45	4310	3769
	636	96	1.492	21.57	14.38	18.47	13.35	88.25	4931	4352
	662	88	1.521	21.01	12.18	18.45	15.25	89.25	5628	5023
	701	86	1.536	21.57	12.23	18.94	15.80	92.05	5984	5508
	719	93	1.363	18.73	10.02	16.85	15.70	92.35	5292	4887
Mean			1.494	20.69	14.01	17.79	14.25	89.45	5076	4549
62	559	96	1.467	20.26	13.53	17.51	13.95	90.25	4886	4410
	576	82	1.639	23.03	12.78	20.09	14.50	91.10	5826	5307
	605	98	1.551	20.59	12.22	18.08	12.75	91.50	4611	4219
	625	95	1.717	22.96	13.49	19.87	13.85	86.85	5503	4779
	638	91	1.646	21.28	12.45	18.63	14.00	88.40	5216	4611
	660	87	1.820	24.94	12.44	21.84	15.15	88.80	6617	5876
	706	89	1.749	24.35	10.67	21.75	15.05	90.70	6547	5938
	715	91	1.596	22.69	9.97	20.43	14.85	92.95	6067	5639
Mean			1.648	22.51	12.19	19.78	14.26	90.07	5659	5097

Var. No.	Plot No.	No. Hill Hary	Ay. Wt. Whole C Beet	T. per A Whole Beet	% Crown	T. per A Topped Beets	% Sugar	App. Coef. of Pur	Lbs. Suc. per A Gross	Ind. Ay.
63	561	102	1.394	19.62	12.59	17.14	15.90	91.65	5314	4870
	575	90	1.386	19.67	10.83	17.55	15.55	91.95	5457	5018
	608	95	1.422	20.19	10.23	18.12	15.85	90.30	5743	5186
	620	99	1.316	18.98	11.21	16.85	13.90	89.30	4685	4184
	635	90	1.460	19.59	12.44	17.15	13.85	88.10	4752	4187
	661	89	1.592	22.44	10.30	20.13	15.75	87.60	6341	5555
	702	99	1.368	19.40	8.49	17.75	16.45	90.00	5839	5255
	722	83	1.392	19.46	7.13	18.07	16.25	94.10	5873	5526
Mean			1.420	19.92	10.40	17.84	15.39	90.38	5500	4973
64	555	59	1.604	22.17	13.38	19.20	13.40	87.30	5146	4492
	578	32	1.577	22.42	12.98	19.50	15.45	89.70	6027	5406
	604	83	1.543	22.45	11.41	19.89	13.45	88.45	5352	4734
	624	82	1.626	21.92	12.06	19.28	13.40	86.15	5166	4451
	637	68	1.685	23.71	10.71	21.17	14.60	89.60	6182	5539
	665	59	1.821	26.13	11.04	23.24	15.60	88.75	7252	6436
	703	53	1.642	24.05	8.14	22.10	16.30	91.05	7205	6560
	718	37	1.667	24.01	8.74	21.91	16.20	92.85	7099	6591
Mean			1.646	23.36	11.06	20.79	14.80	89.23	6179	5526
65	556	88	1.454	20.07	14.25	17.21	13.15	89.30	4527	4043
	574	78	1.536	21.00	11.51	18.59	12.79	87.45	4721	4129
	610	67	1.768	24.83	12.74	21.67	14.45	90.30	6264	5656
	621	88	1.543	20.48	12.90	17.84	12.70	86.60	4531	3924
	641	95	1.611	21.94	11.57	19.40	14.95	89.05	5799	5164
	663	81	1.547	20.82	10.62	18.60	15.50	89.85	5768	5183
	699	84	1.573	22.91	9.73	20.68	15.30	89.30	6327	5650
	720	76	1.413	20.12	8.09	18.49	16.10	92.55	5953	5510
Mean	557	93	1.556	21.52	11.43	19.06	14.36	89.30	5486	4907
66	557	93	1.204	15.83	14.08	13.60	14.60	92.00	3971	3653
	571	84	1.389	17.51	16.94	14.54	15.80	90.45	4596	4157
	609	78	1.361	18.05	14.64	15.41	16.60	90.25	5116	4617
	622	84	1.167	14.37	14.21	12.33	14.20	90.00	3502	3152
	639	99	1.329	16.73	14.23	14.35	15.10	88.65	4334	3842
	666	55	1.507	20.41	13.98	17.56	16.30	88.55	5726	5070
	704	60	1.299	17.65	11.70	15.59	16.80	91.30	5238	4782
	716	94	1.172	15.26	9.80	13.75	16.40	92.85	4512	4189
Mean			1.304	16.98	13.70	14.64	15.72	90.51	4624	4183

* Marketable Beets Weight, topped, .4 lb. and over.

20 x 20 Doubles (b) Phase

Var. No.	Plot No.	Actual Yield Data				
		Total Beets Harvested	Total "C" Beets Harvested	Tons Per A. Toned Beet	Lbs. Suc. Per A. Gross	Lbs. Suc. Per A. Ind. Av.
59	558	184	171	18.53	4467	3938
	573	193	172	20.16	5605	5036
	607	196	174	19.93	5241	4641
	619	189	167	18.52	4352	3660
	642	166	151	22.10	5348	4471
	664	197	184	22.35	6212	5451
	700	196	177	19.53	5468	4899
	721	171	199	18.90	5632	5125
Mean		186	169	20.00	5291	4653
60	562	198	176	18.52	4204	3990
	572	202	175	17.64	4199	3693
	606	207	175	14.69	3716	3369
	623	208	180	17.89	4079	3967
	640	204	179	18.03	4310	3633
	659	208	187	18.98	5257	4587
	705	202	193	21.37	6431	5704
	717	199	183	18.44	5311	4929
Mean		204	181	18.20	4688	4134
61	560	208	183	17.57	4990	4546
	577	209	186	18.12	5364	4758
	603	208	183	17.55	4352	3762
	626	209	180	17.99	4498	3934
	636	211	196	19.14	5110	4510
	662	206	185	19.10	5826	5200
	701	201	183	18.42	5820	5357
	719	208	185	17.37	5453	5036
Mean		208	183	18.16	5177	4638
62	559	210	185	17.53	4892	4415
	576	200	183	20.24	5870	5348
	605	213	180	18.69	4767	4362
	625	211	182	20.10	5566	4834
	638	210	178	19.37	5424	4795
	660	209	187	22.75	6894	6122
	706	203	183	21.74	6545	5936
	715	204	187	20.37	6050	5623
Mean		208	183	20.10	5751	5179

20 x 20 Doubles (b) Phase

Actual Yield Data

Var. No.	Plot No.	Actual Yield Data		Lbs. Sugar per A.		
		Total Beets Harvested	Total "C" Beets Harvested	Tons Per A. Topped Beets	Gross Ind. Av.	
63	551	211	190	17.04	5282	4841
	575	208	188	17.49	5139	5001
	608	208	190	18.53	5873	5303
	620	214	193	17.55	4878	4356
	635	207	181	17.74	4915	4330
	661	210	192	20.81	6557	5744
	702	214	195	18.41	6057	5451
	722	201	183	17.18	5583	5254
	Mean		209	189	18.09	5573	5035
64	555	183	162	18.16	4866	4248
	578	165	155	21.11	6524	5852
	604	201	186	20.30	5460	4829
	624	201	175	20.20	5415	4665
	637	197	183	21.28	6213	5567
	665	180	170	22.77	7106	6307
	703	192	185	20.06	6539	5954
	718	158	150	19.09	6186	5744
	Mean		183	171	20.37	6039	5396
65	556	202	180	17.24	4533	4048
	574	197	175	18.62	4730	4136
	610	197	177	21.83	6309	5697
	621	204	173	18.53	4708	4077
	641	212	187	20.18	6035	5374
	663	205	182	19.70	6108	5488
	699	201	189	20.12	6156	5497
	720	193	179	17.77	5723	5297
	Mean		201	180	19.25	5538	4952
66	557	210	174	13.88	4053	3729
	571	201	164	14.90	4708	4258
	609	191	166	15.62	5185	4679
	622	203	167	13.19	3746	3371
	639	211	172	14.97	4521	4008
	666	184	169	17.37	5661	5013
	704	189	173	15.42	5181	4730
	716	208	176	13.93	4570	4243
	Mean		200	170	14.91	4703	4254

SPACING TEST AULT, COLORADO, 1938
GENERAL SUMMARY - VARIETIES

Variety No. Name	Whole Beet		Competitive Beets					
	Av. Wt. (1)	T. Per A. (2)	% Gross (1)	Topped Beets Tons Per A. (2)	% Suor. (1)	Ann. Conf. of Fur. (1)	Lbs. Suc. Per A. Gross	Ind. Av. (2)
59 6 - 199 - 0	1.716	25.26	16.30	21.13	13.21	88.40	5595	4960
60 Synthetic Check	1.542	22.66	17.20	18.75	12.68	88.47	4774	4235
61 U. S. 217 (1937)	1.464	21.60	14.43	18.47	14.18	89.59	5234	4694
62 U. S. 215	1.577	23.06	12.93	20.07	14.30	90.31	5750	5192
63 U. S. 200	1.384	20.52	11.49	18.15	15.36	90.72	5579	5065
64 7 - 1322 - 02	1.653	24.66	12.04	21.68	14.70	89.66	6382	5730
65 7 - 1323 - 0	1.521	22.37	12.55	19.54	14.45	89.94	5662	5098
66 5 - 580 - 0	1.277	18.26	14.50	15.61	15.67	90.23	4916	4435
Mean	1.517	22.30	13.93	19.17	14.32	89.66	5486	4926
Z	1.8799	1.8481	1.8273	1.8932	1.7525	.8014	1.6301	1.5956
5% Point	•	•	•	•	•	•	•	•
1% Point	•	•	•	•	•	•	•	•
S.E. of Mean of 16 determinations	.0217	.353	.329	.2872	.1737	.3711	99.88	95.1
S.E. of Mean in % of mean	1.43%	1.58%	2.36%	1.50%	1.21%	.41%	1.82%	1.93%
Diff. nec. of Sig.	.061 lb	1.00 T	.93%	.81 T	.49%	1.05%	282 lb	269 lb.

* 2 exceed 5 and 1 percent respectively.

(1) Beets of Non-marketable size ignored

(2) Based on total competitive beets harvested: Marketable plus non-marketable

SPACING TEST AULT, COLORADO, 1938
GENERAL SUMMARY - VARIETIES

Varieties		Actual Yields				
		Beets Harvested		Tons Beets	Lbs. Sug. Per A.	
No.	Name	Total	M'k'ible	Per Acre	Gross	Ind. Av.
59	6 - 199 - 0	186	177	20.21	5341	4732
60	Synthetic check	202	191	18.89	4812	4268
61	U. S. 217	204	193	18.66	5277	4733
62	U. S. 215	206	194	20.37	5834	5268
63	U. S. 200	207	196	18.34	5632	5112
64	7 - 1322 - 02	186	178	20.72	6091	5465
65	7 - 1323 - 0	200	188	19.50	5648	5085
66	5 - 580-0	197	182	15.50	4873	4396
Mean		198	187	19.02	5439	4882
z		1.5621	1.5948	1.8403	1.5136	1.4891
5% Point		.	.	.	.	.
1% Point		.	.	.	.	.
S.E. of Mean of 16 determinations		1.794	1.514	.2642	98.8	95.0
S.E. of Mean in % of the mean.		.91%	.81%	1.39%	1.82%	1.95%
Dif. nec. for Significance		5 beets	4 beets	.75 T	279 lb.	269 lbs

* z exceeds the 5% point and 1% points respectively.

SPACING TEST AULT, COLORADO, 1938
GENERAL SUMMARY - SPACINGS

Spacing	Competitive Beets							
	Whole Beets		T. Beet		App. Coef of Pur.	Lbs. Sug. Per A. (2)		
	Av. Wt (1)	T. Per A (2)	Gross (1)	Per A. (2)		Gross	Ind. Av.	
a. 10x20" Singles	1.491	23.35	14.73	19.89	14.28	89.98	5673	5111
b. 20x20" Doubles	1.542	21.25	13.13	18.46	14.35	89.35	5300	4742
Mean	1.517	22.30	13.93	19.17	14.32	89.66	5486	4926
z	.6198	1.5973	1.6258	1.3463	†	.6697	1.1388	1.1239
5% Point		•	•	•			•	•
1% Point		•	•	•				
S.E. of Mean of 64 determinations	.0195	.30	.2225	.2637	.1727	.2262	64.45	64.80
S.E. of Mean in % of Mean	1.29%	1.35%	1.60%	1.38%	1.21%	.25%	1.54%	1.72%
Dif. nec. for sig. (3)	.065 lb	1.00	.74 %	.887	.56%	.76%	282 lb.	284 lb.

Spacing	Actual Yields						
	Beets Harvested		Tons Beets		Lbs. Sug. Per A.		
	Total	M'k'ible	Per	Acres	Gross	Ind. Av.	
a. 10x20" Singles	197	196	19.41		5532	4985	
b. 20x20" Doubles	200	179	18.63		5345	4780	
Mean	198	187	19.02		5439	4882	
z	.2814	1.8033		.9706		.7739	.8244
5% Point		•		•			
1% Point		•					
S.E. of Mean of 64 determinations	1.598	2.04	2.2085		61.145	63.14	
S.E. of Mean in % of the mean	.81%	1.09%	1.10%		1.12%	1.30%	
Dif. nec for sig. (3)	5 beets	7 beets	.70 %		205 lb.	212 lb.	

* z exceeds 5 and 1 percent points respectively

† z is a minus value.

(1) Beets of non marketable size ignored.

(2) Based on total competitive beets harvested; Marketable plus nonmarketable.

(3) S.E. of a difference times 2.363; corresponding to exact odds of 19:1.

SPACING TEST AULT, COLORADO, 1938
GENERAL SUMMARY - SPACING AND VARIETIES

(3) Spacing Variety			Competitive Beets							
			(1) Whole Beets	(1) %	(2) Tons	(1) %	(2) App. Coef	(2) Lbs. Sur.	Per A.	
Sp.	No.	Name	Av. Wt.	T. Per A.	Crown	Per A.	Sucr.	of Pur.	Gross	Ind. Av.
a.	59.	6-199-0	1.716	26.90	17.08	22.30	13.20	88.98	5903	5268
b.			1.716	23.64	15.51	19.96	13.22	87.82	5287	4652
a.	60	Synthetic ck	1.529	23.94	17.65	19.69	12.53	88.88	4961	4423
b.			1.556	21.39	16.74	17.80	12.82	88.06	4588	4046
a.	61	U. S. 217	1.435	22.90	14.85	19.15	14.11	89.74	5391	4840
b.			1.494	20.69	14.01	17.79	14.25	89.45	5076	4549
a.	62	U. S. 215	1.507	23.61	13.67	20.37	14.33	90.55	5841	5287
b.			1.648	22.51	12.19	19.78	14.26	90.07	5659	5097
a.	63	U. S. 200	1.347	21.11	12.58	18.46	15.34	91.08	5657	5157
b.			1.420	19.92	10.40	17.84	15.39	90.38	5500	4973
a.	64	7-1322-02	1.660	25.97	13.03	22.56	14.59	90.06	6586	5934
b.			1.646	23.36	11.06	20.79	14.80	89.23	6179	5526
a.	65	7-1323-0	1.486	23.22	13.68	20.02	14.54	90.58	5837	5289
b.			1.556	21.52	11.43	19.06	14.36	89.30	5486	4907
a.	66	5-580-0	1.290	19.54	15.30	16.57	15.62	89.96	5207	4687
b.			1.304	16.98	13.70	14.64	15.72	90.51	4624	4183
Mean			1.517	22.30	13.93	19.17	14.32	89.66	5486	4926
Z			.1736	.2659	†	.2232	†	.1636	†	†
5/8 Point										
1/8 Point										

(1) Beets of nonmarketable size ignored.

(2) Based on total competitive beets harvested; marketable plus nonmarketable.

(3) "a" is 10 x 20 inch single beets; "b" is 20 x 20 inch double beet hills.

† Z is a minus gma value.

SPACING TEST AULT, COLORADO, 1938
GENERAL SUMMARY - SPACING AND VARIETIES

Spacing	Variety		Actual Yields				
	No.	Name	Total Beets	Harv. Mkt'ble	Tons Beets Per A.	Lbs. Sug. per A. Gross	Ind. Av.
a.	59	6 - 199 - 0	185	185	20.42	5392	4810
b.			186	169	20.00	5291	4653
a.	60	Synthetic check	201	200	19.59	4937	4401
b.			204	181	18.20	4688	4134
a.	61	U. S. 217	201	201	19.16	5378	4828
b.			208	185	18.16	5177	4638
a.	62	U. S. 215	205	204	20.64	5917	5358
b.			208	183	20.10	5751	5179
a.	63	U. S. 200	205	204	18.58	5692	5189
b.			209	189	18.09	5573	5035
a.	64	7 - 1322 - 02	187	186	21.07	6143	5534
b.			185	171	20.37	6039	5396
a.	65	7 - 1323 - 0	198	196	19.75	5759	5218
b.			201	180	19.25	5538	4952
a.	66	5 - 580 - 0	194	193	16.08	5042	4538
b.			200	170	14.91	4703	4254
Mean			198	187	19.02	5439	4882
‡			‡	‡	‡	‡	‡
5½ Point							
1½ Point							

‡ is a minus quantity.

DISCUSSION AND CONCLUSIONS

Varieties:

The varieties varied considerably in stand, yield, quality and percent crown. Many of these differences are significant. This is as expected since the varieties for this test were chosen to show such differences.

Spacings:

Tons competitive whole beets, tons competitive commercially topped beets and actual tons commercially topped beets are all in favor of spacing (a). The differences though small all reach the level of probable significance. The mean weight of the whole beets of commercial size from spacing (b) ^{was} slightly, but not significantly greater than the same mean for beets from spacing (a). The total beets harvested from each of these spacings was also greater from spacing (b), but the difference was not significant. However the number of beets of commercial size from spacing (b) was significantly less than that for spacing (a). Therefore the greater yield from spacing (a) appears to be attributable to proportionably greater number of roots which grew to commercial size in this spacing.

Pounds sugar per acre, competitive beet basis, are significantly greater from spacing (a). Pounds sugar, actual yields, are also greater from spacing (a), but in this case the differences do not quite reach the level of probable significance.

The means for percent sucrose for the two spacings are almost the same; that for spacing (b) being only .07 higher than for spacing (a). An examination of the plot summaries shows that percent sucrose was somewhat erratic, being in general much lower at one end of the test than at the other. There also appears to be a pronounced tendency for the percent sucrose for spacing (b) to be relatively higher on the "low sugar" end of the field. This was the end of the test first harvested and as previously mentioned there was delay in the analysis of some of these samples. Since the spacing (b) samples were probably slightly more delayed than the spacing (a) samples this may account for part of these differences. However it is doubtful if this explains the general trend of this half of the test. This (the "low sugar" end of the test did not appear quite as "ripe" when dug. This observation leads to speculation on the effect of crowding in the two beet hills on "ripening".

General Conclusions:

40 x 40 inch spacing eliminates plant competition.

Differential varietal response to these spacings was negligible.

Normal 10 x 20 inch spacing outyielded two beet hills spaced 20 x 20 inches because relatively more of the beets reached marketable size.