

Values given are for averages of 36 samples from four strips of the check and for 9 samples from one strip for each of the strains. The analysis of variance was applied only to the data from the strains (check omitted). The F values do not indicate any significant differences among the five strains.

Fort Morgan Strips: Stands were good and variability in this test was not excessive. None of the differences in the five strains of "520" reach the level of statistical significance. However it should be noted that the trends in the performance of the selected and unselected advanced generations are similar to those shown in the other tests by these lines.

Summary: In general, with the possible exception of percentage sucrose, the differences in the data from the various "520" lines in these tests do not reach the level of statistical significance. However the trend of the data is such that the following conclusions are at least indicated. 1. It is probable that quality, as measured by sucrose percent, can be improved by selection in such a hybrid strain without sacrifice of yield as measured by the production of sugar per acre. 2. The production of an advanced generation of such a hybrid strain without selection resulted in no improvement in the general level of performance and the possibility of retrogression is at least suggested.

SPECIAL SPACING STUDY.

Three varieties of beets, thought to differ in yielding ability and growth habit, were selected for this test. These varieties were; No. 1, a Danish commercial brand said to be able to make maximum use of additional space. (The crop did not substantiate this assumption). No. 2, the selected F_2 of a sugar beet-garden beed hybrid known to give high yields of roots and to produce a moderate top growth. No. 3, an inbred line of Pioneer origin which was known to be a "runt". Root and top type of this inbred was exceedingly uniform. The spacing patterns used were; No. 1, single plants spaced 10 inches apart in 20 inch rows. No. 2, single plants spaced 20 x 20 inches. No. 3, two plant hills spaced 20 x 20 inches. No. 4, single plants spaced 40 x 40 inches. Spacings 1 and 3 provides plant populations that are approximately equal; spacing 2 provides a plant population only half as great as 1 or 3. Spacing 4 was included for a further check on the differential varietal response, if any, to greatly increased space per plant. The test consisted of six variety blocks in which the varieties were planted in randomized strips. The spacing treatments were randomized within each of the variety blocks with the restriction that all plots of any one spacing in each of the variety blocks were side by side across the variety strips.

Seed supply of the inbred was inadequate for machine planting of all plots and the plots for spacings 2, 3 and 4 were hand planted; germination

conditions were unfavorable and poor to good stands resulted for the inbred. Excellent stands of the other two varieties were obtained. The inbred proved to be very susceptible to crown gall and a majority of all roots of this variety showed slight to moderately heavy infection. At harvest it seemed that a relatively larger proportion of the plants of all varieties in the 40 x 40 spacing plots were in an unhealthy condition. It is certain that the plants in this spacing suffered severely from red spider late in the season.

At harvest all beets from the 40 x 40 spacing plots and all beets from the six inside rows of the other spacing patterns were hand dug and numbered in such a manner that their position in the plot could be recorded. All beets were topped as for mother beets. They were then washed and individually weighed; first as whole beets and then with the crown removed by cutting straight across at the point of the lowest leaf scar. Since competition is removed by 40 x 40 spacing the yields for this spacing were calculated on the basis of 1600 square inches of land for each beet harvested. Yields for the other three spacing patterns were calculated as perfect stand yields from the normally competitive beets and as actual yields for the number of feet of row harvested. In this test the weak inbred does not appear to have made quite as good use of the additional space provided in the 40 x 40 inch pattern as the other varieties did. However the application of variance analysis to the variety means for root weight indicates that a negligible proportion of the total variance can be attributed to the interaction of varieties and spacings; as shown in the following table:

<u>Variance Attributable to</u>	<u>Degrees of Freedom</u>	<u>Variance</u>
Varieties	2	.719127
Spacings	3	.385875
Varieties x Spacings	6	.008730

The variance attributable to the interaction comprises only .78 percent of the total variance and we are probably justified in concluding that it is negligible. On the basis of this and the 1938 test at Ault, Colorado (see 1938 report) it appears that selection of roots for seed production from spacings as wide as 40 x 40 inches could be made without fear of the introduction of a serious bias by reason of the abnormal spacing. It is obvious that spacings as wide as 40 x 40 inches result in yields so low that this method is of no practical value in the production of a commercial crop of beets and the data from this spacing was omitted from the statistical analysis of the test. Plot and general summaries follow:

SPACING STUDY. FORT COLLINS, COLORADO, 1939
PLOT SUMMARIES

Treatment	Competitive					Actual					
	Plot No.	Hills Harv.	T. Beets Per A.	Lbs. Suc. Per A. Gross	Ind. Av.	Ft. Row Harv.	T. Beets Per A.	\$ Sucr.	App. Coef of Pur.	Lbs. Suc. Per A. Gross	Ind. Av.
Danish Com'l 10x20 Singles	713	193	21.94	6581	5630	182	21.75	15.00	85.55	6524	5581
	718	178	19.00	6498	5812	182	18.28	17.10	89.45	6290	5591
	735	177	18.90	5784	4977	178	18.55	15.30	86.05	5678	4886
	751	166	18.86	6432	5667	181	18.10	17.05	88.10	6173	5438
	758	183	21.53	6912	6172	176	21.20	16.05	89.30	6805	6077
	774	143	15.57	4965	4612	153	15.44	15.95	92.90	4924	4574
Mean			19.30	6195	5478		18.89	16.08	88.56	6059	5358
20x20 Singles	707	90	19.27	5723	4942	172	18.83	14.85	86.35	5593	4830
	721	113	17.13	5346	4659	188	17.17	15.60	87.15	5356	4668
	741	75	16.65	5609	4939	178	15.11	16.85	88.05	5091	4483
	748	98	18.55	5601	4691	178	18.44	15.10	83.75	5570	4665
	764	100	16.87	5366	4872	182	16.45	15.90	90.80	5231	4750
	768	67	14.58	4694	4220	145	14.27	16.10	89.90	4596	4132
Mean			17.18	5390	4720		16.71	15.73	87.67	5240	4588
20x20 Doubles	710	103	19.86	5919	5182	180	19.53	14.90	87.55	5821	5096
	727	91	15.84	4688	4100	183	16.18	14.80	87.45	4789	4188
	738	100	16.08	5386	4769	178	15.93	16.75	88.55	5336	4725
	742	100	17.03	5551	4782	180	17.05	16.30	86.15	5559	4769
	755	107	17.69	5910	5357	180	17.62	16.70	90.65	5884	5334
	777	95	14.02	4583	4097	188	13.89	16.35	89.40	4542	4061
Mean			16.75	5340	4714		16.70	15.97	88.29	5322	4699
40x40 Singles	716					193	8.13	13.40	84.10	2180	1833
	724					213	7.13	12.85	84.25	1831	1543
	732					193	5.10	13.50	81.20	1377	1118
	745					213	8.25	13.45	80.75	2218	1791
	761					207	6.88	13.45	85.05	1850	1573
	771					180	5.37	13.85	85.35	1488	1270
Mean						6.81	13.42	83.45	1824	1521	

Treatment	Competitive					Actual					
	Plot No.	Hills Harv.	T. Beets Per A.	Lbs. Sug. Per A. Gross	Lbs. Sug. Per A. Ind. Av.	Pt. Row Harv.	T. Beets Per A.	% Sucr.	App. Coef of Pur.	Lbs. Sug. Per A. Gross	Lbs. Sug. Per A. Ind. Av.
Hybrid 10x20 Singles	712	181	22.21	6131	5340	179	22.13	13.80	87.10	6108	5320
	720	132	21.57	7398	6747	178	21.27	17.15	91.20	7295	6653
	734	180	20.68	6390	5716	177	20.39	15.45	89.45	6301	5636
	752	180	23.89	7615	6907	183	23.28	15.95	90.70	7425	6734
	759	135	23.11	7141	6373	177	22.61	15.45	89.25	6986	6235
	772	115	20.83	6457	5847	150	18.72	15.50	90.55	5803	5255
	Mean			22.05	6855	6155		21.40	15.55	89.71	6653
20x20 Singles	706	98	20.01	5624	4915	170	19.83	14.05	87.40	5573	4871
	723	105	20.03	6548	5847	153	19.75	16.35	89.30	6459	5768
	740	102	18.60	6176	5555	177	18.31	16.60	89.95	6080	5469
	749	104	20.94	6409	5714	180	21.05	15.30	89.45	6441	5742
	765	82	14.84	4452	3936	155	14.31	15.00	88.40	4294	3796
	766	86	22.03	6432	5644	155	21.74	14.60	87.75	6347	5569
	Mean			19.41	5940	5268		19.16	15.32	88.66	5866
20x20 Doubles	709	97	21.02	5866	5054	177	20.65	13.95	86.15	5761	4963
	729	97	18.58	6058	5410	190	18.38	16.30	89.30	5992	5351
	737	101	17.16	5630	5019	178	17.12	16.40	89.15	5616	5007
	743	109	19.82	6363	5787	188	19.88	16.05	90.95	6381	5804
	756	91	16.80	5274	4797	183	15.73	15.70	90.95	4938	4491
	775	85	16.20	4910	4444	168	15.60	15.15	90.50	4725	4276
	Mean			18.26	5684	5085		17.89	15.59	89.50	5569
40x40 Singles	715					213	11.90	12.55	82.75	2966	2471
	726					207	9.17	12.95	86.35	2376	2052
	731					200	7.04	12.35	82.80	1738	1439
	746					207	9.26	12.95	82.10	2399	1970
	762					180	7.33	13.30	86.05	1950	1678
	769					180	9.97	12.80	85.65	2553	2187
	Mean						9.11	12.82	84.28	2334	1966

Treatment	Plot No.	Hills Harv.	Competitive			Actual					
			T. Beets Per A.	Lbs. Sug. Gross	Per A. Ind. Av.	Pt. Row Harv.	T. Beets Per A.	% Sucr.	App. Cof of Pur.	Lbs. Sug. Gross	Per A. Ind. Av.
Inbred 10x20 Singles	714	83	9.53	3201	2777	176	8.57	16.80	86.75	2879	2498
	719	143	10.12	3896	3571	175	9.30	19.25	91.65	3581	3282
	733	132	9.31	3043	2579	175	8.17	16.35	84.75	2671	2264
	753	103	6.37	2349	2162	180	5.21	18.45	92.00	1921	1767
	757	133	11.55	3891	3276	174	10.54	16.85	84.20	3553	2992
	773	112	7.77	2812	2463	150	6.73	18.10	87.60	2437	2135
	Mean			9.11	3199	2804		8.09	17.63	87.82	2840
20x20 Singles	708	5	7.45	2495	2199	170	3.88	16.75	88.15	1300	1146
	722	33	7.28	2306	2045	188	5.81	15.85	88.70	1842	1634
	739	27	6.74	2197	1811	177	5.59	16.30	82.45	1823	1503
	750	29	4.56	1619	1413	178	3.01	17.75	87.30	1068	932
	763	48	7.80	2559	2146	177	6.56	16.40	83.85	2153	1805
	767	44	7.67	2670	2379	147	6.52	17.40	89.10	2269	2022
	Mean			6.92	2308	1999		5.23	16.74	86.59	1742
20x20 Doubles	711	5	5.41	1823	1597	177	4.36	16.85	87.60	1469	1287
	728	34	6.46	2351	2087	178	5.66	18.20	88.75	2061	1829
	736	23	6.79	2071	1711	178	5.58	15.25	82.60	1703	1407
	744	52	6.23	2285	2012	183	5.13	18.35	88.05	1883	1658
	754	61	9.86	3451	2887	177	8.84	17.50	83.65	3095	2589
	776	15	5.30	1795	1542	172	3.37	16.95	85.90	1143	982
	Mean			6.68	2296	1973		5.49	17.18	86.09	1892
40x40 Singles	717					133	1.90	15.35	83.05	583	484
	725					180	1.45	13.75	81.90	400	328
	730					173	1.45	13.50	80.35	391	314
	747					173	1.07	16.15	82.55	346	286
	760					167	1.76	15.25	81.30	537	437
	770					160	1.61	16.40	83.15	529	440
	Mean						1.54	15.07	82.05	464	382

SPACING TEST, FORT COLLINS, COLORADO, 1939

GENERAL SUMMARIES
(40x40 Singles Omitted)

Spacings	Competitive			Actual				
	T.Beets Per A.	Lbs. Suc. Per A. Gross Ind. Av.		T.Beets Per A.	% Sucr.	App. Coef of Pur.	Lbs. Suc. Per A. Gross Ind. Av.	
10x20 Singles	16.82	5416 4813		16.12	16.42	88.70	5184 4606	
20x20 Singles	14.50	4546 3996		13.70	15.93	87.64	4282 3766	
20x20 Doubles	13.90	4440 3924		13.36	16.25	87.96	4261 3769	
Mean	15.07	4801 4244		14.40	16.20	88.10	4576 4047	
F	14.46**	13.43** 13.45**		10.67	1.33	1.99	12.05** 12.84**	
S.E. of Mean	.406	146.2 134.6		.461	.215	.384	151.7 135.2	
S.E. of Mean in % of the Mean	2.69	3.05 3.17		3.20	1.33	.44	3.32 3.34	
2.228 times the S.E. of a Dif.	1.28	461 424		1.45	.68	1.21	478 426	
Varieties								
Danish Com'l	17.74	6160 4971		17.43	15.92	88.17	5540 4881	
Hybrid	19.91	5641 5503		19.49	15.49	89.29	6029 5386	
Inbred	7.57	2601 2259		6.27	17.19	86.84	2158 1874	
Mean	15.07	4801 4244		14.40	16.20	88.10	4576 4047	
F	112.59**	94.97** 102.51**		114.86**	10.88**	2.05	102.56** 109.23**	
S.E. of Mean	.621	197.3 171.9		.664	.268	1.903	208.1 181.7	
S.E. of Mean in % of Mean	4.12	4.11 4.05		4.61	1.65	1.71	4.55 4.49	
2.228 times the S.E. of Diff.	1.96	662 541		2.09	.84	4.74	656 572	
Spacings and Varieties								
Danish Com'l								
10x20 Singles	19.30	6195 5478		18.89	16.08	88.56	6059 5358	
20x20 Singles	17.18	5390 4720		16.71	15.73	87.67	5240 4585	
20x20 Doubles	16.75	5340 4714		16.70	15.97	88.29	5322 4699	
Hybrid								
10x20 Singles	22.05	6855 6155		21.40	15.55	89.71	6653 5972	
20x20 Singles	19.41	5940 5268		19.16	15.32	88.66	5866 5202	
20x20 Doubles	18.26	5684 5085		17.89	15.59	89.67	5569 4982	
Inbred								
10x20 Singles	9.11	3199 2804		8.09	17.63	87.82	2840 2490	
20x20 Singles	6.92	2308 1999		5.23	16.74	86.59	1742 1507	
20x20 Doubles	6.68	2296 1973		5.49	17.18	86.09	1892 1625	
Mean	15.07	4801 4244		14.40	16.20	88.10	4576 4047	
F	†	†	†	1.06	†	†	1.01	†

† Variance for treatment exceeds variance for error.

** F exceeds 1% point.

Discussion:

Stands: As previously stated the stands of the inbred were variable and probably should be omitted in the comparison of the stands of this test with the stands of the 1938 test. In harvesting this test blanks at the end of the plots, obviously due to the change of seed in the drill, were omitted in the total feet of row harvested per plot; resulting in slightly different values from plot to plot; as is shown in the plot summaries. The actual number of beets harvested per plot for spacings 1, 2 and 3 have been recalculated to a common basis of 180 feet of row per plot and are shown in the following summary table: Marketable beets are beets whose topped weight is 0.40 pound or more and approximate beets one inch in diameter at the lowest leaf scar.

<u>Variety</u>	<u>Spacing</u>	<u>Roots Harvested per Plot</u>	
		<u>Total</u>	<u>Marketable</u>
Hybrid	10 x 20 inch singles	200	191
Commercial	10 x 20 inch singles	206	195
Inbred	10 x 20 inch singles	184	153
Hybrid	20 x 20 inch doubles	206	177
Commercial	20 x 20 inch doubles	207	177
Inbred	20 x 20 inch doubles	146	106
Hybrid	20 x 20 inch singles	106	106
Commercial	20 x 20 inch singles	104	103
Inbred	20 x 20 inch singles	51	74

Since perfect stands for 10 x 20 inch singles and 20 x 20 inch doubles would have been 216 beets and for 20 x 20 inch singles 108 beets it is evident that the stands of the commercial and the hybrid were very good and are comparable to the stands of the 1938 test. It is very evident that the crowding of two plants in one hill increased the proportion of small; so called unmarketable; beets. It is possible that this condition had an adverse effect on the yield from this spacing pattern in comparison with the equal population of single plants spaced 10 inches in the row.

Yield of the Varieties: The inbred, as expected proved to be a very low yielding strain and appears to be capable of producing less than half the yield of an average commercial variety under comparable conditions. The commercial brand used in this test does not appear to be particularly capable of utilizing additional space, as was expected, and it is thought that further test would show it to be of only fair yielding ability in Northern Colorado. The actual yield of roots of the hybrid, calculated as the average for spacings 1, 2 and 3, exceeded that of the commercial by 2.06 tons per acre with a difference of 2.09 tons per acre required for statistical significance. Since the commercial exceeded the hybrid in percent sucrose in the beet by .43% the difference in yield of sugar per acre is less than the amount, needed for statistical significance.

Yield of the Spacings: As previously stated yields from the 40 x 40 inch spacings were very low (see plot summaries) and were omitted from the analysis of the data. It is possible that yields calculated to a perfect stand basis from the normally competitive beets should be a more precise measure of the effect of the spacing patterns on yield. However in this test, with generally good stands, there appears to be little difference in the relative yields as calculated from normally competitive beets or as actual yields of the area harvested. The trend is the same in either case. Since the trend in yield of the inbred for all three spacings so closely paralleled that of the two normal varieties its inclusion in the averages for spacings appeared to be justified. In yield of tons of roots and pounds of sugar per acre the yield of 10 x 20 inch spaced beets exceeded that of two plant hills spaced 20 x 20 inches; the difference being considerably in excess of that required for statistical significance; although total plant populations for the two spacing patterns were approximately equal. In this test the yields from two plant hills and from single beets, each spaced 20 x 20 inches, were approximately equal.

Percent Sucrose and Spacings: As normally expected percent sucrose was considerably depressed by the excessively wide 40 x 40 inch spacing. This trend was also apparent in the case of the single plants spaced 20 x 20 inches, particularly in comparison with the beets from the 10 x 20 inch single plant spacing pattern. However the differences between 10 x 20 singles, 20 x 20 inch doubles and 20 x 20 singles are not statistically significant.

Summary:

On the basis of the 1938 and 1939 tests it appears that from equal plant populations, one spaced 10 x 20 inch as single plants and the other spaced as two plant hills at 20 x 20 inches, the larger yield will be obtained from the former. Percent sucrose in the beet from these spacing patterns will be approximately equal. The relatively larger proportion of very small beets from the two plant hills may bear some relation to the relative yields. Differential varietal response to the increased space provided by 40 x 40 inch spacing is probably negligible.