1-1919

Yields From Two Systems of Corn Breeding

A.N. Hume

BULLETIN No. 184 **January, 1919.**

AGRICULTURAL EXPERIMENT STATION

SOUTH DAKOTA

STATE COLLEGE OF AGRICULTURE AND MECHANIC ARTS

AGRONOMY DEPARTMENT

A. N. Hume,
Head of Department

Yields From Two Systems of Corn Breeding

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TWO SYSTEMS OF CORN BREEDING

by A. N. Hume
Agronomist and Supt. Substations.

Beginning with 1911, and continuing throughout the even cropping seasons following, South Dakota Experiment Station, Agronomy Department has conducted two systems of corn breeding by ear-to-row selection. During the seasons wherein these breeding-plots have been conducted, the actual carrying out of field work and of seed selection has been participated in by all members of Agronomy Department Crops Division. These systems of corn breeding were installed partly with the idea that they might produce comparative results in the form of ear-row-yields which would be helpful in defining a practical corn breeding system, which could be recommended to farmers as superior to other systems.

One of the corn breeding-plots here reviewed is patterned after the plan devised by Hopkins and described in Illinois Experiment Station Bulletin No. 100.

Through the seasons of 1912 and 1918 inclusive, this ear-to-row breeding plot has been conducted at South Dakota Experiment Station Brookings field. According to this system, it should be remembered that in whatever year of the breeding plot, the separate rows are planted with seed from separate mother ears. Also this system calls for detasseling all stalks of the even-numbered rows in all quarters of the breeding plot every year, and seed ears for succeeding years are always selected from the six highest-yielding, even-numbered rows of each of the four quarters of the plot. This latter rule has been adhered to in connection with the breeding plot under discussion except in cases where rows yielding the highest weight of ear corn were found to be very inferior in other respects.

In the following table the actual yields of the several rows for the several separate years are put down in a manner to show the relative position of the rows in the breeding plot itself; as well as the actual yield of the given row, in bushels per acre, figured on the basis of pounds of field-dried ear corn per acre.

TABLE I.

Yields (Actual) of Breeding plot Rows, in Bushels of Field-dry Corn per Acre.

	1912	1913		1914		1915-1916			1917		1918	
Row No.	Bu. per acre	Dam	Bu. per acre	Dam	Bu. per acre	Dam	Bu. per acre	Bu. per acre	Dam	Bu. per acre	Dam	Bu. per acre
1	55.7	180	39.4	282	42.1	380		25.0	476	24.2	586	27.9
2	65.7	104	51.7	206	47.1	302	12.3	35.0	406	11.7	510	41.6
3	57.1	186	44.7	292	43.4	394	15.0	38.9	482	11.7	592	36.7
4	70.0	110	43.7	210	36.4	306	11.6	35.6	412	14.1	514	40.9
5	58.5	198	44.7	296	44.0	398	16.4	40.0	486	22.2	598	39.0
6	68.6	122	51.6	214	37.6	318	13.0	39.0	418	16.2	520	55.3
7	48.6	176	52.6	286	47.7	378	11.6	40.0	478	21.1	582	49.0
8	71.4	106	51.2	208	35.6	304	13.7	39.4	408	11.7	512	49.1
9	60.0	184	55.1	294	37.7	386	16.4	50.9	484	26.4	588	46.9
10	68.6	112	52.0	212	33.3	314	17.9	32.0	414	21.6	518	52.4
11	74.3	188	48.6	298	44.0	396	15.0	32.0	488	22.2	596	53.4
12	61.4	124	49.2	222	37.7	320	13.0	39.7	420	26.9	522	46.3
13	62.8	176	53.8	286	42.7	378	21.3	43.4	478	51.9	582	52.4
14	70.0	104	57.3	206	38.1	302	16.4	41.3	406	25.9	510	60.4
15	54.3	184	48.6	294	42.7	386	17.1	44.0	484	15.9	588	52.4
16	68.6	110	53.0	210	36.7	306	14.4	38.9	412	16.2	514	53.6
17	61.4	188	51.7	298	32.6	396	15.7	41.7	488	24.2	596	53.4
18	62.8	122	53.1	214	42.0	318	16.4	37.1	418	26.4	520	51.3
19	48.5	180	43.4	282	45.3	380	17.9	40.6	476	32.9	586	53.0
20	57.1	106	48.1	208	42.3	304	16.4	48.1	408	24.2	512	30.9
21	44.3	186	43.4	292	40.9	394	14.4	33.1	482	31.7	592	51.3
22	51.4	112	57.3	212	35.4	314	15.7	31.9	414	25.9	518	46.3
23	50.0	198	61.7	296	52.4	398	16.4	42.9	486	30.7	598	58.0
24	47.1	124	48.6	222	30.9	320	17.9	36.0	420	18.4	522	53.9
25	57.1	158	50.0	256	36.4	358	19.9	45.7	458	37.0	558	54.6
26	47.1	132	49.6	228	35.1	332	13.7	44.1	426	13.7	530	60.7
27	62.8	168	47.4	262	34.8	362	21.3	39.4	464	23.3	564	50.1
28	60.0	136	61.3	232	42.0	336	20.6	41.0	430	15.9	534	59.3
29	70.0	174	50.0	268	49.6	374	16.7	45.1	468	26.4	572	58.0
30	67.1	144	46.8	242	41.3	346	19.1	43.0	446	27.6	540	60.4
31	67.1	154	50.0	258	49.0	356	15.0	41.7	460	24.2	554	60.1
32	57.1	134	50.6	230	41.3	334	15.7	29.7	428	18.0	532	55.4
33	65.7	164	38.1	266	46.6	360	17.1	41.1	466	18.0	560	57.4
34	62.8	140	42.6	240	45.9	338	17.1	42.0	434	33.2	538	54.9
35	64.3	172	59.1	270	45.3	370	15.7	38.9	470	31.7	568	61.3
36	67.1	148	45.4	244	45.6	348	15.7	36.6	448	14.9	544	61.7
37	61.4	154	50.0	258	46.6	356	18.2	37.1	460	28.6	554	68.0
38	67.1	132	46.7	228	45.7	332	18.4	38.4	426	22.7	530	61.9
39	70.0	164	48.6	266	45.3	360	16.4	29.7	466	25.4	560	62.4
40	71.4	136	52.8	232	39.7	336	17.9	33.7	430	19.4	534	72.3
41	61.4	172	43.4	270	47.1	370	15.0	32.0	470	22.2	568	37.3
42	70.0	144	47.6	242	43.3	346	18.4	35.7	446	14.1	540	60.9
43	62.8	158	44.7	256	47.1	358	18.4	44.6	458	24.2	558	65.7
44	67.1	134	51.6	250	38.3	334	15.0	29.1	428	23.7	532	62.0
45	74.3	168	53.8	262	44.6	362	15.7	34.9	464	24.2	564	53.4
46	50.0	140	43.8	240	40.3	338	18.4	42.9	434	7.7	538	59.6
47	50.1	174	42.0	268	52.9	347	15.0	36.0	468	17.0	572	58.0
48	60.0	148	42.8	244	48.0	348	15.7	28.9	448	13.7	544	64.0

	1912	1913		1914		1915-1916			1917		1918	
Row No.	Bu. per acre	Dam	Bu. per acre	Dam	Bu. per acre	Dam	Bu. per acre	Bu. per acre	Dam	Bu. per acre	Dam	Bu. per acre
51	51.4	106	26.3	206	39.6	304	10.2		406	22.2	512	42.3
52	64.3	154	52.8	256	28.7	356	9.5	26.7	458	17.4	554	45.4
53	60.0	112	47.3	210	42.7	314	8.8	22.9	412	37.0	518	50.7
54	62.8	164	43.8	262	38.3	316	13.0	28.0	464	38.1	560	38.7
55	55.7	124	34.1	214	44.0	320	6.9	33.1	418	29.6	522	52 .4
56	41.4	172	56.1	268	42.3	370	6.9	40.7	468	28.6	568	43.7
57	54.3	104	50.0	208	40.3	302	9.6	28.9	408	21.1	510	42.3
58	65.7	158	64.7	258	47.7	358	14.4	51.4	460	28.0	558	45.1
59	72 .8	110	50.0	212	40.3	306	12.3	41.1	414	15.3	517	45.7
60	58.6	168	45.6	260	40.1	362	11.0	42.9	466	37.0	564	49.0
61	74.3	122	51.3	222	44.0	318	9.6	42.9	420	30.7	520	47.9
62	62.8	174	59.8	270	41.3	374	13.0	37.9	470	29.0	572	37.9
63	62.8	104	50.0	208	38.9	302	12.3	42.9	408	19.4	510	42.3
64	64.3	154	52.0	256	33.0	356	15.0	41.1	458	38.1	554	51.4
65	67.1	110	51.3	212	35.0	306	13.0	39.4	414	43.4	514	50.1
66	61.5	164	60.1	262	35.6	360	13.7	43.0	464	23.3	560	44.4
67	67.1	122	56.3	222	43.6	318	12.3	32.0	420	44.4	520	53.4
68	70.0	172	71.1	268	34.0	370	13.7	44.0	468	48.0	568	41.3
69	64.3	106	42.0	206	44.6	304	17.1	30.9	406	21.1	512	53.4
70	48.6	158	57.1	258	40.4	358	15.0	54.1	460	25.9	558	45.9
71	58.6	112	55.1	210	36.3	314	8.8	38.9	412	28.6	518	41.9
72	77.1	168	51.8	266	34.9	362	12.3	34.4	466	37.0	564	39.3
73	62.8	124	52.6	214	35.7	320	9.6	47.4	418	24.2	522	47.9
74	68.6	174	54.6	270	40.6	374	11.5	42.4	470	25.4	572	47.6
75	70.0	134	55.1	228	47.1	334	15.7	44.0	426	28.6	532	42.9
76	71.4	176	49.3	282	36.6	378	11.0	39.0	476	25.9	582	43.7
77	74.3	140	46.0	232	47.3	338	11.5	46.3	430	20.6	538	46.9
78	60.0	184	46.7	292	43.4	386	11.0	46.6	482	27.6	588	46.4
79	67.1	148	60.4	242	45.4	348	13.0	41.1	446	24.2	544	45.7
80	67.1	188	40.4	296	42.6	396	12.3	35.0	486	27.6	596	42.3
81	64.3	132	44.7	230	44.1	332	6.9	43.4	428	36.0	530	51.3
82	55.7	180	56.8	286	43.6	380	8.9	44.9	478	30.7	586	39.3
83	64.3	136	50.0	240	52.6	336	12.3	48.6	434	41.2	534	50.7
84	74.3	186	53.8	294	35.6	394	11.6	38.4	484	20.6	592	57.3
85	51.4	144	40.7	244	51.3	346	10.3	40.0	448	28.6	540	47.4
86	70.0	198	61.4	298	56.6	398	11.6	42.4	488	41.7	598	41.7
87	68.6	132	43.4	230	50.0	332	13.0	37.7	428	18.0	530	41.9
88	67.1	176	54.8	282	38.7	378	15.7	40.1	476	39.6	582	45.0
89	60.0	136	44.7	240	52.6	336	11.0	38.9.	434	41.7	534	52.4
90	61.4	184	43.7	292	42.0	386	13.7	40.9	482	28.0	588	46.1
91	60.5	144	52 .6	244	46.0	346	13.0	40.0	448	30.7	540	47.4
92	58.5	188	56.1	296	42.6	396	15.7	36.9	486	37.0	596	41.6
93	61.4	134	59.1	228	40.3	334	14.4	40.0	426	22.2	532	45.7
94	62.8	180	56.1	286	48.1	380	11.0	37.1	478	28.6	586	40.3
95	61.4	190	51.3	232	43.4	338	15.7	45.1	430	41.2	538	36.7
96	54.3	186	50.8	294	47.1	394	14.4	37.9	484	41.2	592	43.4
97	55.7	148	50.0	242	46.0	348	11.6	41.7	446	44.4	544	43.4
98	71.4	198	61.6	298	50.0	398	13.0	35.1	488	36.0	598	44.3

The ear-row yields of the preceeding Table I have been employed in computing Table 2 which follows:

TABLE II.

Comparison of Average Yields per Acre of (1) All Ear-Row Yields in the Breeding Plot with (2) Highest Yielding and (3) Lowest Yielding Rows for Years Indicated.

	1912	1913	1914	1915	1916	1917	1918	Average
Highest average yield of rows....	75.0	63.9	52.4	18.8	49.8	45.3	60.8	52.2
Average Yield of all Rows........	62.3	50.2	42.2	13.9	38.6	26.6	49.5	40.5
Lowest Average Yield of Rows....	46.0	36.0	32.5	9.7	27.9	13.2	34.9	28.6
Number of Bu. which highest rows exceed lowest	29.0	27.9	19.9	9.1	21.9	32.1	25.9	23.6
Number of Bu. which highest rows exceed average	12.7	13.7	10.2	4.9	11.2	18.7	11.3	11.8

With reference to Table 2, above, it should be stated that, the "highest average yields" in each instance, are computed with the use of one row-yield from each of the four quarters of the breeding plot. For instance, to find the "highest average yield of rows" for 1912, the highest yield from the first quarter of the breeding plot was put down, namely 74.3; likewise the highest yield of the second, third, and fourth quarters are put down, respectively 74.3, 77.1, and 74.3. The average of these highest yields from the four quarters is 75.0, as put down in Table 2. The "lowest average yields" were computed in a similar manner.

It is believed such a method of computation may help to equalize discrepencies due to any unevenness of soil in the several quarters of the plot.

From Table II, on the preceeding page it may be observed in the next to lowest horizontal line that the highest average yield exceeds the lowest average yield by 23.6 bushels per acre. This average difference is made up of separate differences for the several years amounting to from 9.1 bushels in 1915 to 32.1 bushels in 1917. Similarly the highest average yield exceeds the general average yield by 11.8 bushels.

These differences serve to reaffirm a fact generally recognized that different "mother-ears" of corn vary widely in productive capacity. Judging from the foregoing figures, the best ears may outyield the poorest under the conditions of this experiment, by about 24 bushels per acre and the average by about 12 bushels per acre. The inference would be that a corn breeder could expect to make large gains in yield of ear corn, by conducting an ear-row breeding plot, thus making it possible to eliminate the poor-yielding strains and select seed for following years only from the high-yielding strains. It is evident that if such a process of elimination would lead to a general improvement in yield of 12 bushels per acre, the process of ear-row breeding of corn would be highly profitable. There is much observational information to indicate that such gains in yield have been brought about, over large corn areas of South Dakota, through selection work carried out by corn breeders in our state.

AN EAR-ROW SYSTEM OF CORN BREEDING NOT ACCOMPANIED BY DETASSELING.

It will be recalled that in the system of corn breeding previously referred to in this bulletin, it is an essential part of that system that the alternate, even-numbered rows from some of which, seed is taken for the succeeding years, are detasseled, every year. Consequently the seed ears with which the breeding plot is planted are bound to be "cross-bred" or heterozygous.

A corn breeding plot has been conducted at Brookings field, parallel in time with the one previously described. This latter consists essentially of a simple ear-row system of selection, without the detasseling of any rows in the plot.

The following Table III gives the ear-row-yields from the rows of this breeding-plot, for the seasons 1912-1918 inclusive. The rows marked CHK are check rows, planted not from single-ears but from "bulk" seed.

TABLE III.

Yields (Actual) in Bushels per acre from ear-rows of a continuous ear-row breeding plot—Wherein no rows are detasseled.

	1912	1913		1914		1915-1916			1917		1918	
Row No.	Yield	Dam	Yield	Dam	Yield	Dam	Yield	Yield	Dam	Yield	Dam	Yield
1	45.7	105	54.6	209	49.7	303	8.6	19.4	408	27.1	540	52.3
2	48.5	165	55.4	235	46.6	376	9.1	28.9	414	33.3	522	59.6
3	48.5	168	62.0	211	46.0	301	7.2	39.9	418	14.4	507	56.3
4	44.3	185	44.7	226	39.1	350	10.4	37.9	422	30.4	536	54.6
5	74.3	172	59.1	217	42.6	354	9.9	50.0	430	35.0	535	64.1
6	50.0	169	59.1	224	44.1	367	7.9	44.0	409	24.9	515	57.6
7	54.3	175	50.6	218	44.0	354	9.1	43.6	415	43.4	534	56.9
8	47.8	181	58.1	222	43.0	381	9.9	43.6	421	46.9	536	54.1
chk	32.8	chk	57.8	chk	39.6	chk	11.1	35.4	chk	38.4	chk	49.0
9	54.3	186	62.4	219	50.7	362	9.9	51.0	425	28.1	535	55.9
10	54.3	176	58.7	221	47.7	316	9.1	36.3	442	26.6	508	63.9
11	48.5	105	51.3	209	43.7	303	11.9	43.1	408	39.0	515	52.7
12	50.0	165	52.6	235	48.7	376	9.1	42.7	414	32.7	535	59.7
13	45.7	168	60.4	211	44.6	301	11.9	32.3	418	29.3	524	57.0
14	48.5	185	56.8	226	46.1	350	9.9	49.9	422	31.6	540	58.6
15	50.0	172	61.7	217	47.7	354	11.1	48.0	430	38.4	508	64.1
16	45.7	169	66.4	224	47.9	367	10.4	34.3	409	37.9	524	57.1
17	44.3	175	59.1	218	40.1	318	11.1	41.7	415	13.6	522	60.4
chk	44.3	chk	48.6	chk	48.4	chk	11.9	31.4	chk	28.7	chk	50.7
18	40.0	181	59.8	222	53.7	381	9.1	43.1	421	31.6	540	55.6
19	48.5	186	58.7	219	44.7	362	10.4	40.0	425	31.6	508	62.7
20	45.7	176	53.0	221	49.0	316	11.1	48.1	442	26.6	534	56.1
21	40.0	105	60.4	209	45.0	303	9.1	49.9	408	15.9	536	53.4
22	45.7	165	50.7	235	49.6	376	11.9	48.4	414	39.0	507	67.4
23	47.1	168	63.3	211	44.1	301	12.4	37.7	418	25.4	534	57.3
24	50.0	185	42.0	226	46.0	350	11.1	41.7	422	38.4	515	60.4
25	50.0	172	44.1	217	41.4	354	10.4	48.1	430	28.7	522	47.3
26	41.4	169	59.8	224	45.0	367	8.6	38.6	409	27.7	534	52.6
chk	45.7	chk	46.0	chk	42.1	chk	11.1	49.1	chk	32.7	chk	56.3
27	50.0	175	51.7	218	42.6	296	8.6	43.6	415	18.0	535	58.9
28	37.1	181	56.7	222	39.4	381	9.9	35.6	421	29.9	515	57.3
29	45.7	186	53.8	219	42.7	362	9.9	40.6	425	30.4	516	54.4
30	37.1	176	51.3	221	41.3	316	9.1	54.9	442	27.7	507	57.6
31	40.0	105	63.7	209	37.0	303	11.9	51.1	408	23.1	522	60.1
32	48.5	165	57.8	235	43.9	376	11.1	38.9	414	35.0	524	65.3
33	32.8	168	47.3	211	33.9	301	9.9	29.7	418	22.0	516	53.4
34	52.8	185	52.0	226	39.4	350	7.1	23.3	422	39.4	535	63.7
35	38.5	172	48.1	217	42.1	354	11.9	30.9	430	33.9	508	60.4
chk	37.1	chk	51.3	chk	40.9	chk	9.9	22.9	chk	33.3	chk	51.3
36	47.1	169	50.8	224	43.3	367	9.1	25.3	409	44.0	536	55.7
37	34.3	175	52.8	218	46.0	362	7.9	24.6	415	37.3	516	54.4
38	45.7	181	51.6	222	44.4	381	8.6	38.4	421	38.4	524	61.4
39	42.8	186	45.1	219	34.0	362	9.9	34.4	425	31.0	507	49.1
40	45.7	176	60.8	221	48.3	316	8.6	32.0	442	39.4	508	61.1
41	50.0	105	53.3	209	43.6	350	9.9	39.9	408	29.3	536	58.0
42	47.1	165	52.1	235	45.7	303	11.1	57.3	409	22.0	516	55.7
43	57.1	168	48.8	211	39.9	362	11.9	44.3	415	31.0	540	62.3
44	45.7	185	41.8	226	41.7	354	8.6	41.3	425	32.1	507	63.4
chk	58.6	chk	51.3	chk	34.4	chk	9.9	18.3	chk	33.9	chk	55.7
45	58.6	172	48.4	217	42.6	303	8.6	16.0	408	19.1	540	47.0

	1912	1913		1914		1915-1916			1917		1918	
Row No.	Yield	Dam	Yield	Dam	Yield	Dam	Yield	Yield	Dam	Yield	Dam	Yield
46	50.0	169	36.7	224	41.4	376	8.6	21.9	414	33.3	522	66.3
47	51.4	175	43.0	218	40.9	301	7.9	16.3	418	11.9	507	56.3
48	61.4	181	43.1	222	39.7	350	9.1	29.4	42.2	29.3	536	51.9
49	48.5	186	49.6	219	42.0	354	8.6	31.0	430	24.9	535	57.1
50	51.4	176	46.1	221	55.3	367	5.9	16.1	409	24.9	515	60.1
51	52.8	105	47.4	209	43.1	354	5.1	23.0	415	37.9	534	58.4
52	55.7	165	52.6	235	40.3	381	8.6	37.9	421	42.3	536	56.3
53	58.6	168	46.3	211	47.3		9.9					
chk	42.8	chk	42.0	chk	44.6	chk	11.9	25.1	chk	28.1	chk	52.4
54	54.3	185	38.8	226	47.6	362	8.6	43.7	425	29.9	535	53.7
55	57.1	172	45.4	217	48.9	316	11.9	29.3	442	29.9	508	62.9
56	35.7	169	41.7	224	46.7	303	9.9	28.3	408	31.6	515	55.1
57	57.1	175	43.8	218	40.4	376	9.9	24.1	414	38.4	535	60.1
58	54.3	181	40.1	222	46.7	301	11.1	32.6	418	31.0	524	54.6
59	48.5	186	43.0	219	45.6	350	9.9	36.0	422	31.0	540	59.6
60	57.1	176	44.3	221	47.6	354	10.4	37.6	430	35.0	508	64.3
61	58.6	105	44.4	209	42.3	367	11.9	37.6	409	36.1	524	59.7
62	67.1	165	49.3	235	48.3	318	11.9	39.4	415	10.1	522	63.0
chk	52.8	chk	39.4	chk	48.4	chk	12.4	23.1	chk	24.3	chk	55.7
63	44.3	168	46.0	211	41.9	381	8.6	48.0	421	28.7	540	60.6
64	45.7	185	36.1	226	43.1	362	13.1	42.3	425	28.7	508	57.0
65	64.3	172	40.4	217	44.4	316	9.1	41.3	442	32.7	534	52.3
66	47.1	169	47.3	224	43.6	303	12.4	42.1	408	20.3	536	48.1
67	48.5	175	35.8	218	49.6	376	12.4	50.0	414	35.1	507	69.0
68	55.7	181	35.6	222	40.9	301	9.9	45.4	418	18.0	534	56.0
69	52.8	186	36.8	219	41.0	350	10.4	48.1	422	42.9	515	54.0
70	54.3	176	34.4	221	47.9	354	8.5	51.0	430	23.7	522	46.7
71	41.4	105	36.6	208	44.6	367	10.4	33.7	409	26.6	534	46.9
chk	57.1	chk	43.4	chk	45.9	chk	13.1	34.3	chk		chk	46.9
72	57.1	165	32.6	235	49.9	376	11.9	42.3	415	36.7	535	52.4
73	52.8	168	39.0	211	44.6	381	11.1	31.7	421	26.0	515	55.0
74	44.3	185	34.8	226	47.7	362	11.9	39.6	425	33.9	516	46.1
75	60.0	172	34.4	217	43.9	316	13.1	43.1	442	26.6	507	52.4
76	58.6	169	34.4	224	50.6	303	13.7	40.9	408	32.7	522	55.0
77	58.6	175	33.1	218	44.6	376	13.1	38.3	414	28.1	524	54.9
78	52.8	181	34.6	222	35.6	301	9.9	27.6	418	29.9	516	52.0
79	55.4	186	36.1	219	44.3	350	15.7	32.9	422	39.4	535	55.4
80	54.3	176	36.8	221	40.6	354	14.4	34.6	430	35.6	508	53.6
chk	52.8	chk	34.1	chk	47.1	chk	13.7	28.0	chk	22.6	chk	50.7
81	58.6	105	33.6	209	55.7	367	14.4	23.3	409	35.0	536	51.7
82	52.8	165	45.8	235	42.3	362	12.4	36.6	415	36.7	516	51.3
83	55.7	168	43.7	211	44.9	381	13.7	32.1	421	37.3	524	62.7
84	43.3	185	31.6	226	46.4	362	11.1	39.4	425	26.0	507	49.4
85	63.4	172	34.7	217	38.6	316	13.7	50.0	442	37.3	508	55.1
86	55.7	169	32.8	224	45.3	350	14.4	34.3	408	24.9	536	51.1
87	57.1	175	32.4	218	36.6	303	16.4	27.4	409	22.0	516	53.0
chk	48.5	196	47.6	211	44.9	362	12.4	34.9	415	20.9	540	59.0
		176	38.7	217	44.3	354	13.1	27.9	425	24.3	507	57.7
		chk	25.0	chk	37.0	chk	11.1	33.7	chk	26.0	chk	45.7

The yields from ear-rows, put down in Table III are summarized in the following Table IV.

TABLE IV.

Averages of Yields of Corn from Ear-Rows Put Down in Previous Table, from a System of Ear-Row Breeding Without Detasseling Alternate Rows.

	1912	1913	1914	1915	1916	1917	1918	Ave.
Highest average yield of Rows........	67.3	65.4	53.8	15.2	53.6	44.3	67.0	52.4
Average Yield of All Rows............	50.3	47.9	44.4	10.5	37.6	30.3	56.7	39.7
Average Yield of Check Rows.........	47.3	44.0	42.8	11.6	31.1	33.1	51.4	37.3
Lowest Average Yield of Rows........	35.0	32.3	35.8	6.3	16.7	12.5	46.7	26.5
Number of Bushels Highest Exceeds Average	17.0	17.5	9.4	4.7	16.0	14.0	10.3	12.7
Number of Bushels which Highest Exceeds Lowest	32.3	33.1	18.0	8.9	36.9	31.8	20.3	25.9
Number of Bushels Average of All Rows Exceeds Checks	3.0	3.9	1.6	-1.1	6.5	-2.8	5.3	2.4

From the above table it may be observed in the last column that as an average of seven years, the highest yielding rows in the breeding plot exceeded the lowest yielding rows 25.9 bushels per acre, and the average of all rows 12.7 bushels per acre. It is also to observe in the lowest horizontal line, that the average yield of all rows in the breeding plot for each of the seven years with exceptions of 1915 and 1917 are higher than that of the "Check" rows. The average of all rows exceeds the "check" rows 2.4 bushels per acre. The check rows were planted not with seed from single ears but from "bulk" seed of the same variety as the single ears used in planting the remainder of the field. The highest rows in the breeding plot as an average out-yielded the check rows 15.1 bushels per acre.

The yields of Table III, and their averages in Table IV furnish additional illustration of the differences in yielding power of different ears of corn. The fact that the average yield of ear-rows in the breeding plot, themselves selected from presumably high-yielding strains was 2.4 bushels higher than the yield from the check rows indicates that such an ear-row system is of practical value from the standpoint of securing increased yields.

Which Is the Best Practical System of Corn Breeding?

As already suggested, the foregoing portion of the present bulletin summarizes results (Table 2 and Table 4) from two separate systems of corn breeding. Both of these are ear-row systems, carried out continuously, the former system however differing from the latter, in the respect that in it the alternate, even-numbered rows from some of which seed is always selected, are detasseled, while the latter is the simplest system of ear-row breeding by selection. It is evident that the essential difference between these two systems is this detasseling of alternate rows in the first system, and consequent greater theoretical degree of hybridity of the progeny of those rows. The practical corn breeder desires to know whether the labor of detasseling alternate rows of corn in the breeding plot has yielded commensurate returns. Scientifically he desires to know the same thing in asking whether the supposed greater degree of hybridity of seed from detasseled rows becomes evident in greater yields.

It is important to consider as part of the conditions of this experiment that these two systems of corn breedings have been carried out through the several years in close proximity to each other. Accordingly it must have been possible for the wind to carry pollen from one breeding plot to the other also it is probable that both plots received some pollen from other corn of the same variety (Minnesota 13) in the same vicinity.

A comparison of the average yields produced in the several successive seasons resulting from the use of seed from each of the systems of breeding, indicates no great difference in effectiveness in increasing yield. Following are put down the average yields of all rows in each breeding plot for direct comparison:

Average yields from All Rows— Bu. Ear Corn per acre	1912	1913	1914	1915	1916	1917	1918	Avr.
System with Alternate Rows Detasseled.	62.3	50.2	42.2	13.9	38.6	26.6	49.5	40.5
Simple Ear-Row Selection System Without Detasseling Alternate rows	50.3	47.9	44.4	10.5	37.6	30.3	56.7	39.7

It may be observed by looking at the figures of the foregoing table that the average yields secured from the two plots vary from each other chiefly within what appears to be a limit of error. In the 1918 season after seven years of selection the average yield from the simple ear-row system was higher than that from the system with alternate rows detasseled. The same was true in the previous year. Further comparison of the average yields from the two systems in the several years, reveals no decided advantage for either system over the other. This is apparently true even though the average yield from the system with alternate rows detasseled exceeds the average yield from the system having no detasseled rows, by 0.8 bushels per acre, largely due to the difference in the first year, 1912.

Evidently the detasseling of alternate rows in the breeding plot where that is practically carried out requires much labor. Whatever theoretical advantage there may be in following a corn breeding system requiring the labor of detasseling alternate rows should appear practically in the form of increased bushels per acre over a term of years. Otherwise practical corn breeders, desiring especially to secure higher yielding strains through ear-row selection will employ the simplest system without detasseling.

Comparative Yields From Similar Seed of Three Strains.

The practical purpose which corn breeders have in mind, in conducting any system of ear-row selections, is to secure strains of corn that produce yields of sound corn higher than those already produced. Seed ears enough must be selected from the ear-row breeding plot in any given year to plant the plot again in the following year. **The breeding plot however, exists chiefly for the purpose of securing seed therefrom for planting larger areas** and the test of any corn-breeding system depends upon whether the strains produced from it and planted first perhaps in an increase plot, and then in the larger area of the general field yield higher than the corn from which these selections were originally made.

Beginning with 1913 comparative tests were made with selected seed from three systems of corn breeding, or rather from two systems in comparison with bulk seed of the same kind. The seed of the first kind consisted of ears selected by mass selection from the highest yielding rows of the breeding plot, wherein the alternate rows are always detasseled. Accordingly the ears used in this instance were certainly cross-bred ears, or heterozygons. The seed of the second kind consisted of remnants of the highest yielding ears, chosen upon the basis of their production in the ear-row breeding plot wherein no rows are detasseled. The third kind of bulk seed, consisted of choice ears selected by mass selection from similar corn grown each year on land in the vicinity of the breeding plots. The following Table 5, gives the summary of comparative yields from these three selections of seed, for the three years 1913, 1914 and 1915.

TABLE V.

Actual and Computed Yields of Air Dry Ear Corn From Selected Seed From Three Sources.

	Yields in Bushels Ear Corn Acre							
	1913		1914		1915		Average	
	Actual yield	Computed to 100% stand	Actual yield	Computed to 100% stand	Actual yield	Computed to 100% stand	Actual yield	Computed to 100% stand
Seed Selected From Breeding Plot, having Alternate Rows Detasseled........	42.1	44.5	53.6	56.1	26.3	32.1	40.7	44.2
Seed From Remnants of High Yielding Rows in Ear-row plot, no Rows Detasseled	44.3	45.9	52.9	55.7	27.6	36.7	41.6	46.1
Choice Ears, Mass Selected From Adjoining Plots	44.0	45.5	51.3	53.6	27.5	35.0	40.9	44.7

The results put down in Table 5 make it appear that the actual yields of grain secured from planting the three kinds of seed comparatively are almost equal, making due allowance for such limit of error as will always appear among yields from several plots of land. It is true that the columns showing average yield, both actual and computed indicate a small possible superiority amounting to 0.7 to 0.9 bushels per acre for the seed from remnants of high yielding ears.

It may be recalled again that the "Seed from Remnants" is tested for yielding power before being put into the comparative trial. In each year of the simplest ear-row test plot, the rows are planted with part of the kernels from given mother ears and the remnants of the mother ears preserved until after husking and weighing time. At that time it is determined which mother ears have yielded highest. Then the remnants of these latter are shelled together and used for planting in comparison with other seed.

The seed selected from the breeding plot having alternate rows detasseled, consists not of remnants of high yielding ears but of progeny ears selected from the highest yielding rows. The "choice ears, mass selected from adjoining plots," hardly need further description except to say that these ears are picked from corn grown on any and all of a considerable number of experiment plots. There is furthermore a possibility that some of these ears may have either been progeny from ear-rows in some one of the corn breeding plots that were cast into the bulk seed after the ear selections for the following year's breeding plot had been made. Moreover in this connection it is also especially important to recall the probability that more or less cross pollenation is almost certain to take place throughout all corn planted on experiment plots at Brookings field. There is not only much likelihood that the ears in ear-row plots become pollenated to some extent from corn outside said plots but the reverse must often be the case, namely, that corn on outside plots must oftimes be cross pollenated from corn growing within the breeding plots. It is conceivable that under these circumstances such a process after several generations of corn breeding would cause all strains of corn involved to assume a "level."

It might therefore be expected that even the "bulk seed" would indirectly be benefited by the process of selection carried out in the breeding plots. If such be the case it is not difficult to understand that seed from high-yielding tested ear-remnants might yield only appreciably higher than progeny ears taken directly from the breeding plot and the latter yield no higher than "bulk" seed.

The situation of the corn breeding plots at Brookings field, exposed to considerable extent as they are to pollenation from corn outside the plots presents a very real difficulty, in attempting either to uncover the principles of corn breeding, or to establish quantatively the practical gain of conducting a corn-breeding plot on any farm. In actual practice nearly every corn breeding plot is exposed to outside pollen, not only those corn breeding plots situated no experiment station farms but those on farms in general.

In attempting therefore to decide what form of corn breeding plot to recommend for practical use, it is to remember that a considerable amount of "crossing" is the normal condition of corn. In a system of corn-breeding wherein alternate rows are annually detasseled, the detasseling apparently only accentuates or hastens a process that inevitably goes on even without it. Placing an ear-row corn-breeding plot in rather close proximity to a multiplying plot or general field has some of the same effect as detasseling alternate rows; inasmuch as it practically insures an amount of cross pollenation. Such cross pollenation will not be so objectionable as it otherwise would be if care is taken that the general field be planted with high yielding seed either directly from the breeding plot or multiplying plot.

Corn breeding under practical conditions is apparently a process of (1) seeking out the highest yielding "mother" ears, usually by planting the same in ear rows, and (2) of later planting the remnants of these ears and the progeny thereof under such conditions that they will dominate production. In order to accomplish these purposes the following steps are suggested for South Dakota corn growers. It is believed that they may serve as a means for a general increase of corn yield and quality with a minimum of labor.

Suggested Steps For Conducting A Corn Breeding Plot.

In order to be of any actual service in increasing the yield of corn over any considerable area a corn-breeding plot must accomplish two general processes: (1) It must furnish a means for accurately finding "mother ears" of highest yielding power (2) It must furnish a means for propagating the strains represented by these mother ears over a corn area much larger than the breeding plot.

It is indirectly but absolutely important also that during the process of finding and disseminating these strains they shall not become isolated; because too great a degree of isolation must result in a great degree of close breeding and in-breeding.

The actual steps for accomplishing these purposes may be put down as follows: and it may well be kept in mind that the steps will often be modified in single instances.

(1) Select no fewer than twenty-five ears of seed corn, and as much larger number as practicable. These ears may be secured from whatever source or sources may be expected to furnish corn having the characteristics and yielding power desired, whether purchased from recognized corn breeders, or selected from the general field or other sources. Start with the best ears obtainable, so far as it is possible to judge them from appearances.

(2) Give each of these seed ears a number which shall also correspond with the number of the ear-to-row breeding plot to be planted with seed from the given ear. Thus, Row No. 1, will be planted with seed from No. 1 and so on.

In connection with keeping these ear numbers, the corn breeder may make record of as many ear characteristics as desired e. g. length, circumference, number of rows of kernels ,roughnes, smoothness, etc. Any records made and put down should be retained with some clear idea of using them in later computations, otherwise time is wasted in taking them. It is suggested that each corn breeder make and keep only as many records as he actually needs. Keep a few records and those accurately.

(3) Plant the rows of an ear-to-row breeding plot with the seed ears selected using seed from each individual ear for the corresponding single row. Plant a "check" row, with seed of uniform quality as often as every tenth row. When the breeding plot is thus planted with ears and rows numbered successively, and with "check" rows systematically interspersed, duplicate the entire plot, either on adjoining ground, or in another field, in case it can be made practicable to do so.

The breeding plot should be planted on as uniform ground as possible. The rows planted from each ear may contain 25 hills or less. Every precaution should be taken to secure a uniform stand in the several rows. The breeding plot should be cultivated as ordinarily. It is necessary that weeds be not permitted to disturb the uniformity of the plot.

(3-A) Carefully preserve the remnants of the seed ears used in planting the several separate rows.

(4) Harvest the ears from each row separately, weigh the corn from each row separately and record the weights in connection with the ear-row number.

> The matter of taking accurate weights is important. Every corn breeder knows that some ears of corn may be more mature at early harvest time than other ears; consequently bear a higher content of water. It may be desirable to weigh corn from breeding-plot rows immediately after husking; but it should be weighed again after it has become at least air-dry. Still more accurate weights are secured for comparative purposes by shelling the corn harvested after it becomes air-dry and weighing the shelled corn.

(5) Determine the numbers of the seed ears that have produced the highest yields. Retain not over one-half the total original number. Pick out the remnants of seed ears that have proved to be low yielders and discard them for all seed purposes.

(6) Select seed ears for planting next year's ear-to-row breeding-plot, as always from all sources where high yielding ears are likely to be found, namely, (a) the highest yielding ear remnants tested in this year's ear-to-row breeding plot (b) the general field of the same kind of corn (c) seed ears from outside sources, especially from breeding plots of recognized breeders of the same kind of corn.

> However close selection is made of seed ears from the home stock, several unrelated ears should be secured from neighbors or distant corn breeders.

(7) After taking out any highest yielding ear remnants as under 6, retain all remaining ear remnants that produced high yields and shell them together the following year for planting a multiplying plot.

(8) Always plant the general field with seed selected from (a) the multiplying plot and (b) the highest yielding rows of the ear-row breeding plot.

(9) Preserve and sell as much seed corn as practicable, not needed for home planting from (a) the high yielding rows of the ear-row breeding plot (b) the multiplying plot (c) the general field.

(10) Repeat the process of selection annually, introducing improvements of detail with experience.

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RAINFALL AT THE SEVERAL STATIONS

	BROOKINGS						COTTONWOOD					
	1913	1914	1915	1916	1917	1918	1913	1914	1915	1916	1917	1918
January	.02	.22	.18	1.47	1.54	.19	.16	.30	.39	.04	.45	.32
February	.09	.40	1.12	.32	.47	.14	.10	1.18	1.57	.02	1.5	1.5
March	.45	.42	.18	.50	1.09	.44	.43	.35	.64	.04	.31	.34
April	2.24	1.64	2.03	2.95	3.09	1.28	1.15	2.26	2.80	.81	.80	2.27
May	3.60	4.16	2.12	3.72	3.03	3.40	2.95	2.35	6.51	3.87	3.30	2.78
June	1.96	6.67	3.28	4.27	3.49	1.85	.59	1.64	4.79	1.83	.62	1.37
July	2.99	1.62	3.04	.40	2.03	3.95	.81	1.04	4.85	1.80	.90	2.29
August	1.33	3.16	3.52	2.03	1.20	4.19	1.84	1.88	2.51	2.22	2.00	3.43
September	1.55	3.32	2.63	.84	2.89	.72	1.15	1.19	2.42	.18	1.17	1.43
October	1.18	2.21	1.37	.45	.12	1.56	.76	2.23	.90	.57	.14	.28
November	.81	T	.28	.03	.04	1.61	.38	.02	T	.15	.39	.11
December	.09	.33	.62	.36	.31	1.09	.38	.84	.10	.14	.50	.25
Total	16.31	24.15	20.42	17.34	19.35	20.42	10.46	15.28	27.31	11.67	12.08	16.37

	EUREKA						HIGHMORE						VIVIAN			
	1913	1914	1915	1916	1917	1918	1913	1914	1915	1916	1917	1918	1915	1916	1917	1918
January	.10	.22	.90	.79	.49	.14	.05	.13	.43	1.40	1.12	.60	.50	1.00	1.35	1.10
February	.03	.05	1.08	.13	.20	.5	.3	.62	1.23	.27	.52	.25	1.77	.04	.18	.50
March	.09	.13	.23	1.78	1.46	.58	.87	.45	.37	.74	1.27	.45	1.19	.29	1.00	.50
April	.63	2.07	1.83	.88	2.18	1.98	1.27	3.65	2.50	.89	2.79	2.57	2.62	1.08	2.38	3.92
May	1.97	2.20	2.58	3.57	1.30	1.97	4.56	2.23	3.48	4.15	2.04	3.57	3.02	3.46	5.20	3.33
June	2.91	4.28	4.66	4.16	[illegible]	.93	.97	4.09	4.87	4.54	2.04	1.59	4.31	4.49	1.18	1.70
July	2.16	1.25	3.38	.00	1.04	1.03	1.79	2.01	5.55	2.10	1.91	5.26	6.76	3.53	1.02	2.07
August	1.53	2.11	2.47	4.62	.93	1.77	1.20	1.16	.78	4.10	.68	1.88	1.12	3.52	2.01	3.32
September	.54	.70	3.74	1.05	.67	.33	.53	1.01	2.36	2.75	2.03	.62	3.16	.90	2.64	.75
October	1.52	.87	3.19	.29	.06	.55	.61	1.92	1.15	.58	.03	.49	1.12	.57	.00	.82
November	.06	T	.56	.14	2.00	.53	.03	.00	.32	.13	.07	1.10	.38	.12	.00	.22
December	.52	.53	.36	.06	.75	.20	.28	.25	.20	.47	.27	.86	.03	.04	.32	.90
Total	12.11	14.41	24.89	17.47	12.60	10.54	12.46	17.52	23.29	22.12	14.80	29.24	25.98	19.04	17.28	19.13

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148. Corn Silage and Mill products for Steers.

149. Some Varieties and Strains of Oats and their yields in So. Dakota.

151. Trials with Sweet Clover as a field Crop in South Dakota.

152. Testing and Handling Dairy Products.

153. Selecting and Breeding Corn for protein and oil in So. Dak.

154. The Pit Silo.

155. Selection and Preparation of Seed Potatoes.

156. Kaoliang, A New Dry Land Crop.

157. Rape Pasture for pigs in Corn field.

158. Proso and Kaoliang for table use.

159. Progress in Plant Breeding.

160. Silage and Grains for Steers.

161. Winter Grain in So. Dak.

162. First Annual Report of Vivain Experiment and Demonstration Farm.

163. Comparative Yields of Hay, from Several Varieties and Strains of Alfalfa, at Brookings, Highmore, Cottonwood and Eureka.

164. Making butter and cheese on
165. Corn Silage for lambs.
the farm.

166. Important Factors affecting milking machines.

167. Transplanting alfalfa.

168. Breakfast Foods and their relative value.

169. Flax Culture.

170. Quack Grass Eradication.

171. Cream Pateurization.

172. Grasshoppers and their control.

173. Sugar Bets in So. Dak..

174. Sorghums for Forage in South Dakota.

175. The Role of Water in a Dairy Cow's Ration.

176. Potato Culture.

177. The Sheep.

178. Injurious Corn Insects.

179. Emmer in South Dakota.

180. Root Crop Culture.

181. Corn Culture.

182. Corn Silage for steers.

NOTE– We do not add the names of non-residents to the regular list.