Bulletin 326 April 1936

UNIVERSITY OF MINNESOTA
AGRICULTURAL EXPERIMENT STATION

Minnesota Corn Hybrids

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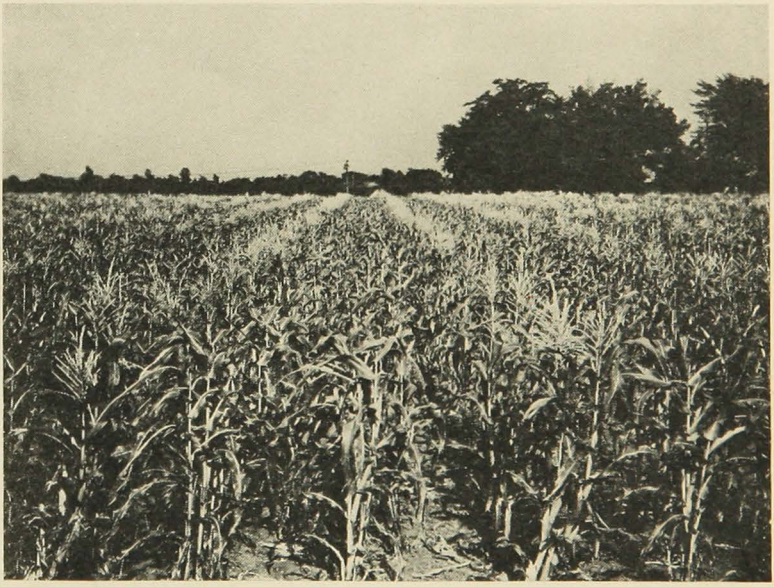


A Detasseled Isolated Plot Used to Produce Hybrid Seed Corn

UNIVERSITY FARM, ST. PAUL

MINNESOTA CORN HYBRIDS

I. J. Johnson, C. W. Doxtator, H. K. Hayes, and R. F. Crim

The hybrid method of seed corn production has been accepted widely by investigators and by many seed companies as a desirable method of obtaining hybrids that excel in yielding ability, disease resistance, ability to withstand lodging, and in other important agronomic characters. Inbreeding and selection in self-fertilized lines were first tried in Minnesota in 1914 as a means of corn improvement. Since 1925 extensive corn breeding experiments have been under way at University Farm, St. Paul, and at the Southeast Experiment Station, Waseca. This bulletin describes hybrids of commercial value produced by the Minnesota Agricultural Experiment Station.

Pollination in corn.—To form a kernel of corn, a male cell borne in the pollen grain unites with a female cell borne at the base of the silk on the ear. A pollen grain, falling on a silk, germinates and sends out a tube which grows down through the silk. This tube carries the male reproductive cell which fertilizes the female cell and leads to the production of a kernel of corn. Controlled experiments have shown that nearly 100 per cent cross-pollination by wind occurs in corn; i.e., the silks of a corn plant are pollinated by pollen from many plants. Corn pollen may be carried for a considerable distance by wind so that different varieties in nearby fields often intercross. Because corn is naturally cross-pollinated, early methods of selection were based on the appearance of the mother plant or ear only, without a knowledge of the characteristics of the male or pollen parents. In contrast, self-fertilization by controlled pollination gives an opportunity for the selection of lines in which both the male and female parentages are known.

Effects of inbreeding corn.—A large number of recessive abnormalities appear when corn is self-pollinated. These undesirable characters do not result from the effects of inbreeding itself, but become manifest. These abnormal characters are present in normal varieties, but they seldom appear because the normal or dominant characteristic covers up the abnormal. The undesirable characters are eliminated by selection in the self-fertilized lines.

In addition to the undesirable characters, inbred lines also show differences for many desirable characters. By inbreeding and selection, strains resistant to lodging and to smut and other diseases are isolated. After several years of self-pollination, lines are obtained that breed true in these important hereditary characters.

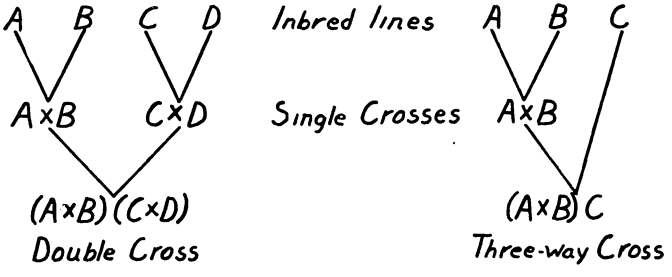
Most of the inbred lines, however, are much less productive than the normal varieties from which they were obtained. Consequently it is necessary to combine the desirable lines into hybrids. Many crosses must be made to find the specific combinations that give best results. Certain hybrid combinations commonly prove markedly superior to normal varieties.

Fig. 1. Controlled Self-Pollination
The pollen from the tassel bag is poured over the silk and the ear bag placed again over the ear shoot.

Kinds of corn hybrids.—Several kinds of crosses may be utilized in corn breeding. A single cross or first generation hybrid between two inbred strains can be used as seed for the commercial crop only when the two parental strains are relatively productive and have normal-sized seed. The progeny of a cross between uniform strains are also uniform in appearance and type. Single crosses are therefore highly desirable in

sweet corn for canning purposes, as uniformity of maturity is of outstanding importance when only one date of harvest is used. Because of the great importance of uniformity, single crosses in sweet corn may be the most economical method of hybrid seed production. The sweet corn hybrids produced by the Minnesota station are all single crosses, and it is believed that the inbred strains are sufficiently productive to make the use of first crosses economically feasible.

It is very difficult to cross two inbred lines of field corn and utilize the hybrid seed for the commercial crop because the lines are less productive and the seed usually smaller than normal corn. The cost of producing single-crossed seed in field corn is also too high for commercial utilization. Consequently, three-way or double crosses must be used. A three-way cross is made by crossing a first generation single cross with an inbred line used as the pollen parent. The hybrid seed will then be produced on the single-crossed parent, and higher yields of normal-sized seed corn will be obtained. A double cross is made by crossing a single cross with another single cross. An advanced generation of a single cross may be used with equal advantage as the pollen parent and in some cases may prove more desirable because of greater variation in time of pollen production. Such advanced generation crosses are obtained by allowing the normal single cross to pollinate itself without crossing with other corn. First generation single crosses should be used for the female parent to obtain maximum yields of uniform seed. The following diagrams illustrate the double cross and three-way cross plan.



Of the three field corn hybrids distributed by the Minnesota station, two are double crosses and one is a three-way cross. The double-crossed or three-way-crossed seed is produced by planting the two parents in an isolated seed plot and detasseling all plants of the female parent before its tassels have produced pollen. Detailed directions for producing hybrid seed corn may be obtained from the Division of Agronomy and Plant Genetics, University Farm.

Hybrid seed.—To obtain the full benefit from corn hybrids, it is essential that only first generation crossed seed should be planted. Experimental tests conducted by the United States Department of Agriculture and by the Wisconsin Agricultural Experiment Station have shown that seed corn saved from the commercial hybrid crop has yielded from 15 to 25 per cent less than that obtained by planting first generation hybrid seed. The actual yields of advanced generation double or three-way crosses would then be no better, or even less, than those obtained from standard adapted varieties.

CORN HYBRIDS DISTRIBUTED BY THE MINNESOTA EXPERIMENT STATION

Field Corn Crosses

Double crosses, Minhybrids 401 and 402.—In 1930, the Minnesota Experiment Station released for distribution two field corn double crosses. These hybrids, now called Minhybrid 401 and Minhybrid 402, are made by crossing a Minnesota 13 single cross E with single crosses K and I obtained from Rustler inbred lines. Because the two parental single crosses are yellow and white, the commercial crop obtained from the double-crossed seed is a mixed yellow and white corn.

The appearance of the ears of the inbred lines used in the single crosses K, E, and I, the ears of the three single crosses, and the ears of the commercial double crosses are shown in Figure 2.

These two double crosses have been tested extensively in replicated plot trials in comparison with standard adapted varieties in central Minnesota. The yields obtained in these trials, given in Table 1, show that the hybrids have outyielded the average of the open-pollinated varieties in all trials. In some counties the margin of superiority has been greater than in others. The average increased yield in the long-time trials with Minnesota 13 and Rustler has been 4.5 bushels greater for Minhybrid 402 and 6.0 bushels per acre for Minhybrid 401.

In the shorter period of trial, Minhybrids 401 and 402 have been compared with several other varieties. Among these varieties, White Cap and Golden King have given the highest yields. Average yields in these 29 comparable trials for Golden King and White Cap were 53.6 bushels and 55.4 bushels, while Minhybrids 401 and 402 averaged 57.9 bushels and 54.3 bushels, respectively. Thus Minhybrid 401 gave an average increase over White Cap of only 2.5 bushels per acre in these trials. The superiority of the hybrids in other characters is of value also.

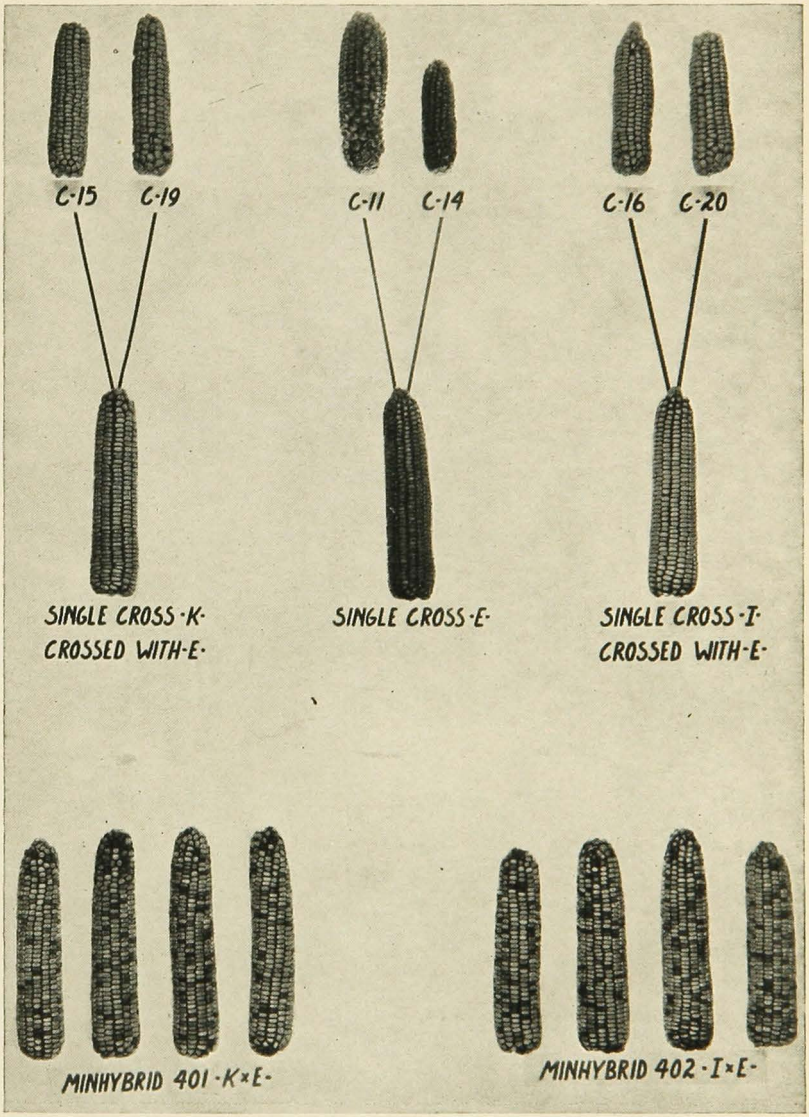


Fig. 2. Ears of Inbred Lines 15, 19, 11, 14, 16, and 20, the Single Crosses K, E, and I, and the Commercial Double Crosses Minhybrid 401 (KxE) and Minhybrid 402 (IxE)

Table 1.—Comparative Yields of Shelled Corn in Bushels per Acre of Minhybrid 401 and Minhybrid 402 with Standard Varieties in Central Minnesota

Variety or cross	Bushels of shelled corn per acre														
	University Farm		Morris		Benton County	Lac qui Parle County		Meeker County		Carver County	Renville County	Goodhue County		Lyon County	Rock County
	9 yrs.	3 yrs.	8 yrs.	3 yrs.	3 yrs.	6 yrs.	2 yrs.	8 yrs.	5 yrs.	2 yrs.	1 yr.	6 yrs.	5 yrs.	4 yrs.	2 yrs.
Minhybrid 401	51.2	64.8	49.1	42.4	65.0	45.5	32.3	55.9	60.1	65.9	58.4	58.0	63.1	56.8	53.5
Minhybrid 402	51.6	61.5	47.2	39.9	57.9	46.6	33.4	57.3	60.2	65.7	56.0	51.5	53.0	51.8	54.1
Rustler—Medium	46.8	58.5	43.5	34.4	55.4	44.6	28.1	49.2	54.2	53.9	51.4	52.0	57.3	47.2	48.6
Minn. 13—Medium	44.8*	58.9	47.0	40.4	59.6	42.2	26.7	48.1	50.8	52.0	48.4	50.6	53.5	46.0	49.1
Minn. 13—Med. late		65.6		34.7	52.9	42.2	28.5	47.8*	51.0	52.0	50.5	52.3	54.6	43.1*	41.1
Golden King		59.4		35.8	62.4		30.5		57.7	58.1	53.6		55.8	54.3	50.3
White Cap		64.1		43.4*	59.4		32.5		60.2	57.2	63.1		55.9	54.2	55.0
Farm Local		.....		39.0	55.5		23.0		54.1	59.1	52.9		.....	.....	51.1
Average of varieties		61.5		38.0	57.5		28.2		54.7	55.4	53.3		55.4	49.0	49.2

* Grown one year less than average. Data adjusted to Rustler for same period.

The data in Table 2 show that the hybrids are earlier in maturity than the commercial varieties as indicated by the lower moisture percentage at harvest time, have a lower percentage of smut infection, and produce a higher percentage of plants with good ears. The ability of the hybrids to produce a good ear on nearly every plant largely accounts for their increased yielding ability. The comparative moisture percentage between the hybrids shows that Minhybrid 402 is somewhat earlier in time of maturity than Minhybrid 401 and is consequently adapted to the northern edge of the central section while Minhybrid 401 is better adapted to the southern edge. The results from the yield trials in Goodhue and Lyon counties, in the southern part of central Minnesota, clearly indicate the advantage of Minhybrid 401 in these regions.

Table 2.—Comparative Moisture Percentage at Harvest, Shelling Percentage, Percentage of Plants Infected with Smut, Number of Good Ears Per Plant, and Ear Length of Minhybrid 401 and Minhybrid 402 and Standard Varieties When Grown in Central Minnesota

Variety or cross	Moisture percentage, 29 trials	Shelling percentage, 29 trials	Plants smutted, percentage, 5 years*	Good ears per plant, 4 years	Ear length, inches, 4 years
Minhybrid 401	25.3	84.1	33.5	0.99	6.5
Minhybrid 402	21.8	82.3	30.0	0.96	6.1
Rustler—Medium	27.5	82.9	36.0	0.88	5.9
Minn. 13—Medium	28.7	82.5	43.1	0.85	5.7
Minn. 13—Medium late	31.1	82.1	44.7	0.81	5.9
Golden King	26.8	84.5	41.0	0.89	5.8
White Cap	27.4	83.4	51.8	0.89	5.8

* In cooperation with the Division of Plant Pathology and Botany.

In addition to the replicated yield trials, Minhybrids 401 and 402 have been compared with farm varieties under actual farm conditions. These trials were made by planting a few rows of the hybrid in the farmer's field and harvesting 50 hills of the hybrid and 50 hills of the farm variety from nearby sections. A moisture sample of each was obtained, and yields were calculated on a 14 per cent moisture basis. Since 1930, when first demonstration tests were begun, 316 comparisons have been made between Minhybrid 401 and farm varieties, and 438 comparisons have been made between Minhybrid 402 and farm varieties. The majority of the comparisons with Minhybrid 401 were made in the southern half of the central section, and those with Minhybrid 402 in the northern half of the central section. A summary of the farm demonstration trials for a four-year period is given in Table 3.

The results of these comparisons demonstrate clearly that the double crosses, Minhybrid 401 and Minhybrid 402, have been superior to the farm varieties in 80 per cent of the trials and have averaged 5.5 and 5.0 more bushels per acre, respectively. When the increased yields are con-

sidered together with increased earliness in time of maturity, the value of the hybrids for central Minnesota conditions warrants their recommendation for use in this region of the state.

Table 3.—Comparative Yields of Minhybrid 401 and Minhybrid 402 with Farm Varieties in Demonstration Trials for the Period 1930-1935

	Minhybrid 401	Minhybrid 402
Number of trials	316	438
Trials cross excelled	254	349
Average yield of hybrid	50.7	45.0
Average yield of farmer's variety	45.2	40.0
Increase, bushels per acre	5.5	5.0

The principal disadvantage of the two double crosses as cash crops lies in their mixed color. At the present time breeding work is in progress by which the four Rustler inbred lines will be changed from white to yellow endosperm. When this work has been completed, Minhybrid 401 and Minhybrid 402 will become pure for yellow endosperm, which should greatly improve their value as market corn.

Three-way cross, Minhybrid 301.—In 1934 a later maturing yellow endosperm hybrid, named Minhybrid 301, was released for distribution. This hybrid was made by crossing the Minnesota 13 single cross, E, with a late-maturing inbred line, B164, obtained from the Hi-Bred Corn Co. of Grimes, Iowa. The parental inbred lines, the single cross E, and the ears of the commercial hybrid are shown in Figure 3.

Minhybrid 301 is adapted to regions in southern Minnesota where later maturing varieties are grown. It is superior in ability to withstand lodging and is as tall or taller than Silver King, Murdock, or Golden Jewel. The ears are yellow, 14- to 18-rowed, and are equal in length or slightly longer than southern Minnesota varieties. The kernels are slightly smaller than the later maturing varieties, are deep, and have a smooth dent.

Minhybrid 301 has been tested in southern and central Minnesota in replicated yield trials in comparison with standard varieties. The data on yields and moisture percentage in southern Minnesota trials are given in Table 4.

The results of these trials show that Minhybrid 301 has outyielded the average of the standard varieties in all tests by margins of 4.6 bushels at Waseca to 17.0 bushels per acre in Winona County. It has also averaged as early or earlier in time of maturity, as shown by the comparative moisture percentages of Minhybrid 301 and the varieties.

The results from the central Minnesota replicated trials in which Minhybrid 301 was compared with earlier maturing varieties adapted to this region are given in Table 5.

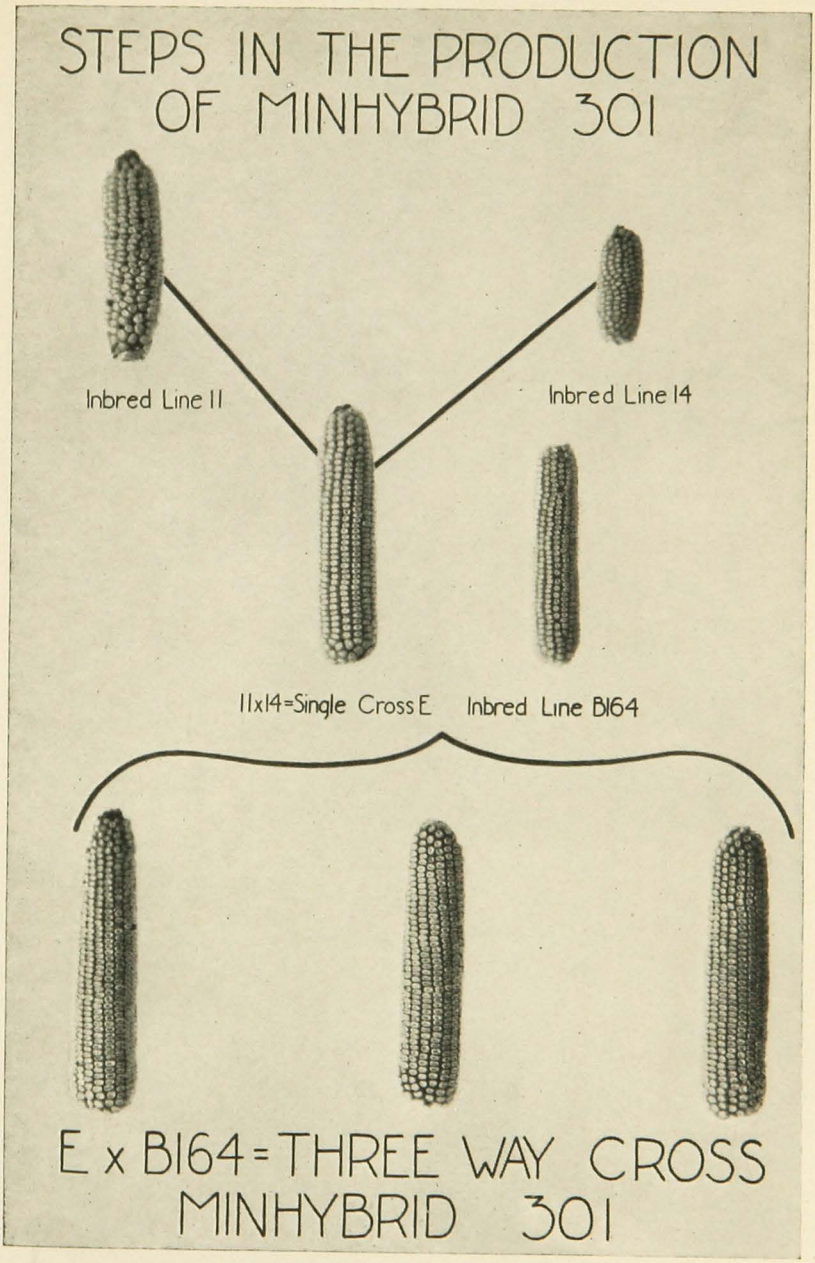


Fig. 3. Ears of the Inbred Lines 11 and 14, Single Cross E, Inbred Line B164, and the Three-way Cross Minhybrid 301 (ExB164)

Table 4.—Comparative Yields of Shelled Corn in Bushels Per Acre and Moisture Percentage at Harvest Time from Minhybrid 301 and Standard Varieties in Southern Minnesota

Variety or cross	Waseca,* 2 yrs.	Cottonwood County, 2 yrs.	Faribault County, 2 yrs.	LeSueur County, 2 yrs.	Rice County, 2 yrs.	Olmstead County, 2 yrs.	Martin County, 1 yr.	Winona County, 1 yr.
				Bushels of shelled corn per acre				
Minhybrid 301	63.5	51.4	71.0	71.8	65.8	65.9	78.6	78.7
Golden King	55.0	43.2	59.4	60.7	60.8	62.1	66.9	57.2
Golden Jewel	66.8	42.9	63.9	62.2	59.3	57.0	71.2	63.5
Silver King	59.2	46.3	66.3	57.8	57.4	55.4	70.4	61.3
Murdock	54.3	48.7	61.7	60.0	58.2	51.7	72.7	67.9
Average of varieties	58.9	45.3	62.8	60.2	59.0	56.5	70.3	61.7
				Moisture percentage at harvest				
Minhybrid 301	40.5	33.6	29.4	38.2	39.8	42.3	20.0	31.9
Golden King	35.1	30.5	26.1	32.8	34.0	39.0	19.3	29.8
Golden Jewel	42.3	35.7	32.8	40.4	40.8	45.4	23.3	35.3
Silver King	41.9	36.5	33.5	41.4	40.4	47.7	22.6	35.6
Murdock	42.5	35.0	32.1	39.2	41.1	45.4	22.0	36.9
Average of varieties	40.4	34.4	31.4	38.4	39.1	44.4	21.8	34.4

* In a five-year test at Waseca, Minhybrid 301 has outyielded Silver King by 7.6 bushels.

Table 5.—Comparative Yields of Shelled Corn in Bushels Per Acre and Moisture Percentage of Minhybrids 301, 401, and Standard Varieties in Central Minnesota

Variety or cross	University Farm, 2 yrs.	Morris, 3 yrs.	Benton County, 3 yrs.	Meeker County, 3 yrs.	Carver County, 1 yr.	Goodhue County, 3 yrs.	Lyon County, 3 yrs.	Rock County, 2 yrs.
				Yield in bushels per acre at 14 per cent moisture, shelled corn				
Minhybrid 301	65.7	37.3	57.8	68.1	79.8	66.1	64.2	62.0
Minhybrid 401	68.8	42.4	65.0	59.8	79.3	61.9	55.3	53.5
Minn. 13—Medium late	67.4	34.7	52.9	52.4	64.5	54.3	41.8	41.1
Rustler—Medium	62.1	34.4	55.4	54.6	66.5	56.5	46.1	48.6
Golden King	60.8	35.8	62.4	59.8	70.6	54.7	52.7	50.3
White Cap	62.4	43.4	59.4	60.8	65.6	55.0	52.7	55.0
Minn. 13—Medium	60.9	40.4	59.6	49.9	60.0	53.5	45.7	49.1
Average of varieties	62.7	37.7	57.9	55.5	65.4	54.8	47.8	48.8
				Moisture percentage at harvest				
Minhybrid 301	34.0	27.9	53.9	31.5	17.8	33.6	18.7	26.0
Minhybrid 401	29.2	21.2	45.7	24.5	11.9	26.7	12.1	22.7
Minn. 13—Medium late	33.9	28.3	50.5	31.0	19.8	33.4	18.3	26.6
Rustler—Medium	29.2	25.0	46.4	26.9	15.3	28.7	15.9	24.3
Golden King	31.0	22.6	46.1	26.0	13.4	28.6	13.8	23.3
White Cap	29.2	24.2	45.0	27.5	15.4	29.0	15.3	22.6
Minn. 13—Medium	32.3	24.1	48.2	29.3	19.3	32.4	16.0	24.5
Average of varieties	31.1	24.8	47.2	28.1	16.6	30.4	15.9	24.3

These trials show that Minhybrid 301 has given about the same yield as the average of the varieties in tests at University Farm, Morris, and Benton counties and that the moisture percentage at harvest has been higher in Minhybrid 301 than in adapted varieties. In the southern part of Central Minnesota, in Goodhue, Lyon, and Rock counties, Minhybrid 301 has been superior to the average of the varieties, altho somewhat later in time of maturity. In these three counties, Minhybrid 301 has also outyielded Minhybrid 401. In the tests in Meeker and Carver counties on very productive soils, Minhybrid 301 has shown marked superiority in yield. It is doubtful, however, if the cross is adapted in general to these two counties except under favorable conditions.

During the three-year period 1933-1935, several farm demonstration trials have been conducted in comparisons between Minhybrid 301 and farm varieties. The plan for these trials was the same as outlined in the discussion of the trials with the double crosses. A summary of these trials in southeastern, south central, and southwestern areas of southern Minnesota is given in Table 6.

Table 6.—Comparative Yields of Minhybrid 301 and Farm Varieties in Demonstration Trials in Southern Minnesota for 1933-1935

	S.E. Minn.	S.C. Minn.	S.W. Minn.
Number of comparisons	62	181	38
Trials cross excelled	56	164	29
Average yield of cross	58.4	61.1	46.6
Average yield of farm variety	47.7	51.6	42.2
Increase, bushels per acre	10.7	9.5	4.2

These trials confirm the results obtained in the replicated trials. Minhybrid 301 appears to be particularly well adapted to southeastern and south central Minnesota, where increased yields of 10.7 and 9.5 bushels per acre were obtained in comparison with farm varieties. The trials in southwestern Minnesota were conducted in 1933 and 1935 under somewhat adverse moisture conditions, and hence the yields were not as high. The altitude in this area is greater than in the other two areas, and the results suggest that Minhybrid 301 is not as well adapted to this area as to south central and southeastern Minnesota.

Sweet Corn Crosses

The sweet corn canning industry in Minnesota represents an important source of farm income in many counties in the central and southern sections of the state. Golden Bantam has long been recognized as one of the most desirable varieties from the standpoint of quality. Crosby and Country Gentleman, two white sweet corn varieties, are also

grown extensively, the latter principally in southern Minnesota. The lack of uniformity in ordinary sweet corn varieties results in a high percentage of ears not suitable for canning when the entire field is harvested at one time. Consequently the uniformity obtained from single crosses not only materially decreases the loss resulting from over- and undermatured ears but also reduces variation in ear size, shape, color, kernel size, etc. These factors, together with improvement in yield, flavor, and tenderness, make the use of hybrid sweet corn particularly advantageous.

In 1932, three 8-rowed Golden Bantam single crosses were released for use primarily for canning purposes. A summary of yields of cut corn in per cent of normal 8-rowed canning type Golden Bantam and other important characters of the hybrids and of normal Golden Bantam are given in Table 7.

Minhybrid 201.—This hybrid was made by crossing the inbred lines 77 and 78. The appearance of the mature ears of the inbred lines and the commercial single cross is shown in Figure 4.

Minhybrid 201 is approximately one week later in canning maturity than standard Golden Bantam. In trials at University Farm for six years and at LeSueur for four years, increased yields of 31 and 56 per cent more cut corn were obtained than from the standard type. The increased yield of the hybrid results from a larger number of canning ears per plant and greater uniformity of ears as shown by a higher percentage of ears harvested that were suitable for canning purposes. The hybrid also has a considerably higher cutting percentage; i.e., the percentage of cut corn obtained from the snapped ears. The quality of canned corn from Minhybrid 201 measured from whole kernel vacuum pack is equal to standard Golden Bantam. Minhybrid 201 produces a relatively small, short ear and is especially well adapted to canning on the ear.

Minhybrid 202.—This hybrid was made by crossing the Golden Bantam inbred lines 38 and 42. The appearance of the mature ears of the inbred lines and the commercial single cross is shown in Figure 4.

Increased yields of 25 and 50 per cent cut corn (see Table 7) have been obtained from trials at University Farm and LeSueur, respectively, together with a large number of good ears per plant, greater uniformity, and a higher cutting percentage than the normal canning type, Golden Bantam. Minhybrid 202 is somewhat earlier in time of maturity than the canning type Bantam and produces ears 6 to 8 inches long. The ears are 8-rowed, occasionally 10-rowed. This hybrid excels standard Golden Bantam in tenderness and flavor as judged from whole kernel vacuum pack. Because of its comparative earliness and high quality, Minhybrid 202 is also being favorably received for market garden and home use.

Table 7.—Comparative Yields and Other Characters of Golden Bantam Single Crosses, Minhybrids 201, 202, and 203, and Normal Canning Type Eight-row Golden Bantam in Trials at University Farm, Six-year Average, and LeSueur, Minnesota, Four-year Average

Variety or cross	Yield of cut corn in per cent		No. of good ears per plant		Per cent good ears		Cutting percentage		Ear length	
	U. Farm	LeSueur	U. Farm	LeSueur	U. Farm	LeSueur	U. Farm	LeSueur	U. Farm	LeSueur
	Per cent	Per cent	No.	No.	Per cent	Per cent	Per cent	Per cent	Inches	Inches
Minhybrid 201	131	156	1.66	1.70	92	93	34.7	34.1	6.5	6.2
Minhybrid 202	125	150	1.42	1.42	89	87	33.0	29.4	7.0	6.5
Minhybrid 203*	106	106	1.33	1.21	85	79	34.7	26.0	6.7	6.3
Golden Bantam	100	100	1.13	1.03	85	72	31.9	25.1	6.7	6.1

* Grown for two years only at LeSueur. Data adjusted to Golden Bantam.

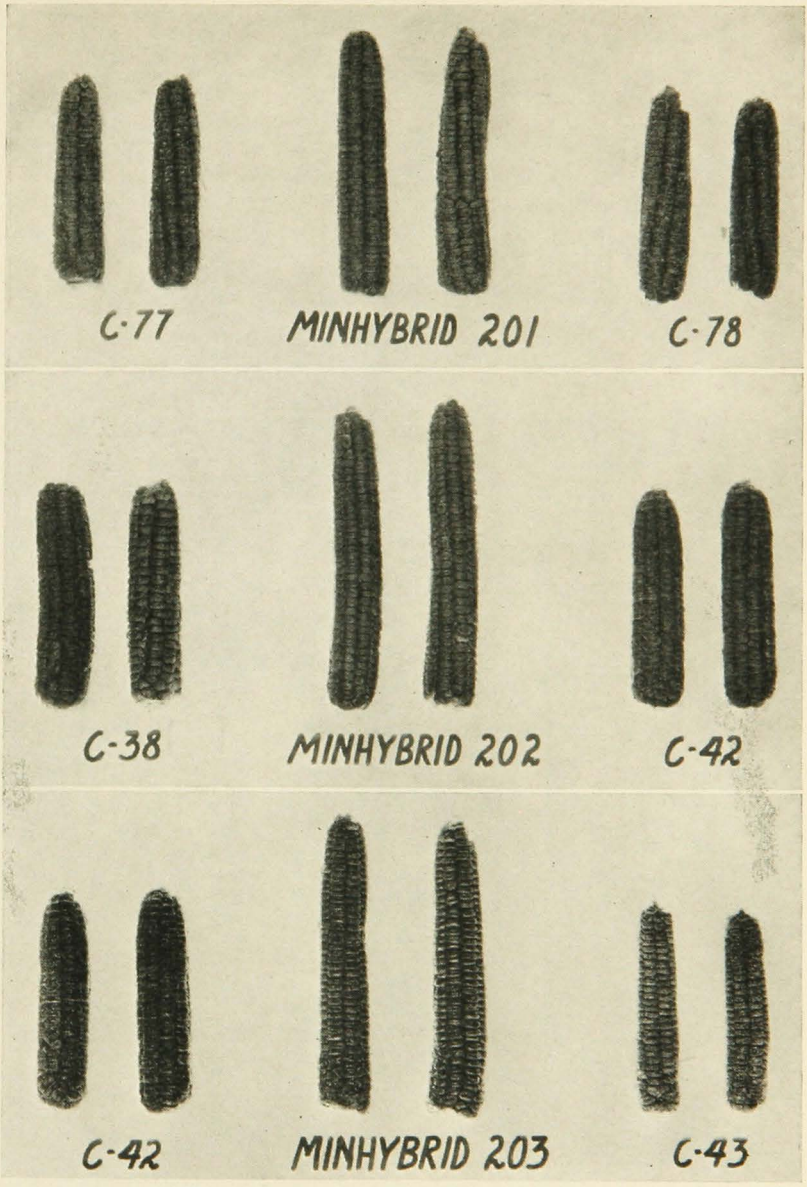


Fig. 4. Upper row: Mature Ears of the Inbred Lines 77 and 78 and the Single Cross Between Them, Minhybrid 201
Center row: Mature Ears of the Inbred Lines 38 and 42 and the Single Cross Between Them, Minhybrid 202
Lower row: Mature Ears of the Inbred Lines 42 and 43 and the Single Cross Between Them, Minhybrid 203

Minhybrid 203.—This hybrid is a single cross from the Golden Bantam inbred lines 42 and 43. The appearance of the mature ears of the inbred lines and the commercial single cross is shown in Figure 4.

Minhybrid 203 yields only slightly more than the standard canning type Golden Bantam but is superior to normal as well as Minhybrids 201 and 202 in flavor, tenderness, and sweetness. Minhybrid 203 is the earliest of the three Golden Bantam hybrids, and, because of its exceptionally fine quality, is better adapted for market garden use rather than for canning purposes.

Minhybrid 204.—A single cross between the Crosby inbred lines 1 and 5 has been approved for distribution in 1937. The appearance of the commercial hybrid ears at canning maturity is shown in Figure 5.

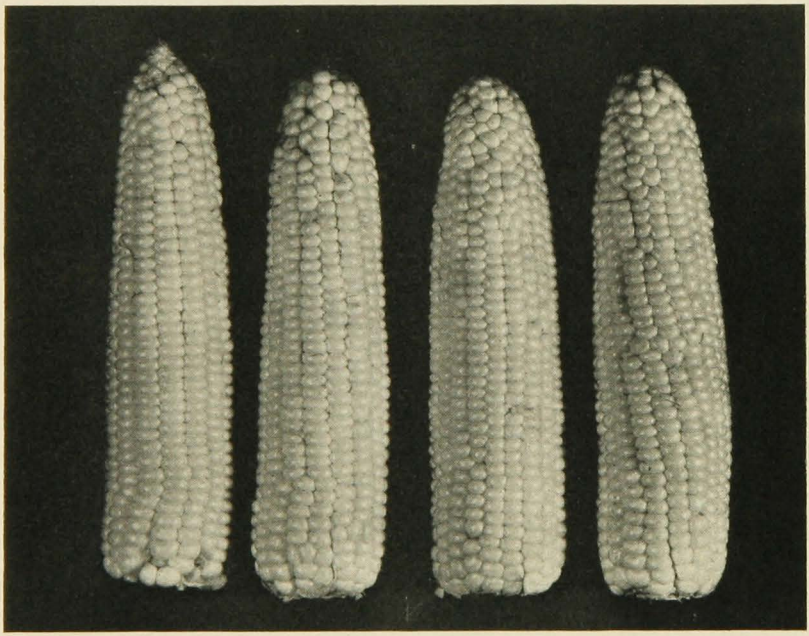


Fig. 5. Ears of the Crosby Single Cross, Minhybrid 204, at Canning Stage of Maturity

Comparative yield trials have been obtained between Minhybrid 204 and the LeSueur strain of Crosby at University Farm in 1932 and 1933, at LeSueur in 1931, and at Waseca in 1932. The average yields and other important characters of the hybrid and normal in these trials are given in Table 8.

The data given in Table 8 show that Minhybrid 204 not only outyielded normal by 35 per cent, but has produced a large number of good ears per plant, has better uniformity as indicated by a higher percentage

of good ears, gives a higher cutting percentage, and has a somewhat longer ear. In addition to the data given in Table 8, canning tests have shown that Minhybrid 204 is equal to the normal variety in tenderness and slightly superior in flavor and sweetness.

Table 8.—Yield of Cut Corn in Per Cent of Normal, Number of Good Ears Per Plant, Per Cent Good Ears, Cutting Percentage, and Ear Length of Minhybrid 204 and the LeSueur Strain of Crosby

	Minhybrid 204	Crosby
Percentage yield	135	100
Number of good ears per plant	1.12	0.99
Per cent good ears	88	78
Cutting percentage	31.2	28.3
Ear length (inches)	6.8	6.4

The seed of the parental lines will be increased in 1936, and additional single-crossed seed will be produced for general distribution in 1937. Minhybrid 204 is about the same in time of canning maturity as the LeSueur strain of Crosby and should be adapted to the regions where Crosby sweet corn is commonly grown.

Minhybrid 205.—A considerable acreage of late-maturing white sweet corn is grown in southern Minnesota. Country Gentleman has been one of the favorite varieties because of its high yields and deep kernels. The standard types, however, lack uniformity and, because of the small thin seeds, frequently give very poor stands. Breeding work has been conducted to overcome these difficulties as well as to obtain improvement in yielding ability and other characters. From the breeding work with this variety, a single cross, Minhybrid 205, made from Country Gentleman inbred lines 220 and 224, has been approved for distribution in 1937. The appearance of the commercial hybrid ears at canning stage of maturity is shown in Figure 6.

Comparative yield trials of Minhybrid 205 and the normal Country Gentleman were conducted at Waseca in 1932, University Farm in 1933, and at LeSueur in 1935. Average yields of cut corn and other important characters are given in Table 9.

Table 9.—Yield of Cut Corn in Per Cent of Normal, Number of Goods Ears Per Plant, Per Cent Good Ears, Cutting Percentage, and Ear Length of Minhybrid 205 and Normal Country Gentleman

	Minhybrid 205	Country Gentleman
Percentage yield	163	100
Number of good ears per plant	1.14	0.98
Per cent good ears	92	73
Cutting percentage	37.5	22.8
Ear length (inches)	6.5	7.3

The data given in Table 9 show that Minhybrid 205 is far superior to the normal in yield, in cutting percentage, and in uniformity. The ear length of the hybrid is less than normal. The quality of the canned corn from this cross is no better than normal.

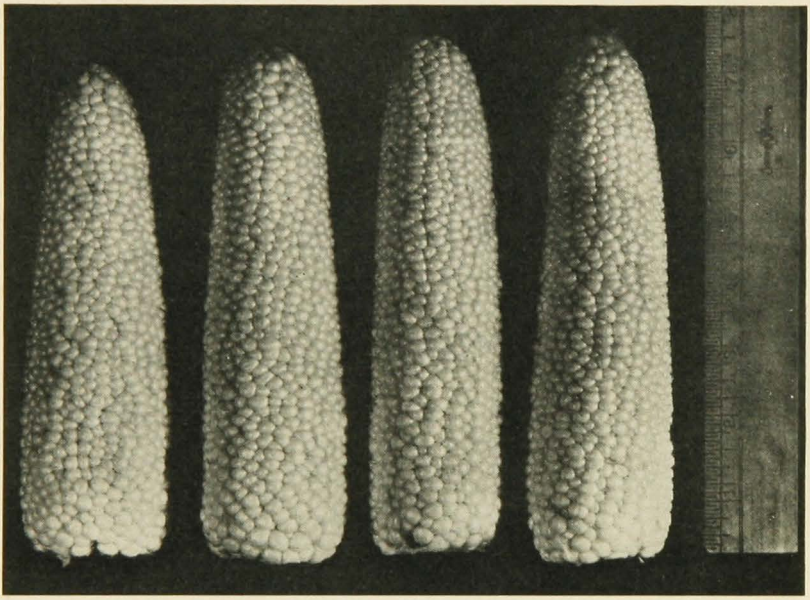


Fig. 6. Ears of the Country Gentleman Single Cross, Minhybrid 205, at Canning Stage of Maturity

Minhybrid 205 is approximately two days earlier in canning maturity than the standard, suckers somewhat less, and is far superior in standing ability. The crossed seed, when made on inbred line 224, is plump, which is an aid in obtaining satisfactory field stands. The seed of the two parental inbred lines 220 and 224 will be increased in 1936, and additional hybrid seed will also be obtained for distribution in 1937.

Pop Corn Cross

Altho the acreage of pop corn grown commercially in Minnesota is not large, many farms grow a small acreage for home use. Among the many varieties of pop corn available, Japanese Hull-less is most desirable from the standpoint of quality. In recent years, a late-maturing yellow pop corn, called South American Yellow or T.N.T., has increased in popularity because of the size of its popped kernel and because of the

creamy color of the popped corn. The popped corn from this variety is not as tender as that from Japanese Hull-less.

The first inbreeding of Japanese Hull-less was begun at University Farm in 1925, and single crosses from these inbred lines have been tested since 1930.

Minhybrid 250.—Among the hybrids tested, the single cross 1 x 6 appears most desirable from the standpoint of the vigor of the two parental lines and the yield and popping volume of the single cross. This cross has been named Minhybrid 250. The ears of the two parental lines and the ears of the commercial single cross are shown in Figure 7.

The yield and other data from trials conducted for three years at University Farm are given in Table 10.

Fig. 7. Ears of the Japanese Hull-less Inbred Lines 1 and 6 and of the Single Cross Between Them, Minhybrid 250

Table 10.—Comparative Yield of Shelled Corn, Moisture Percentage, Ear Length, Number of Good Ears Per Plant, and Popping Expansion of Minhybrid 250 and Standard Japanese Hull-less from Trials at University Farm 1931-1933

	Minhybrid 250	Japanese Hull-less
Bushels of shelled corn per acre	28.2	23.7
Moisture percentage	29.1	34.7
Ear length (inches)	3.2	3.2
Number of good ears per plant	1.45	1.16
Popping expansion	24.8	19.2

The data in Table 10 show that the hybrid has yielded 4.5 bushels per acre more than the standard variety, is earlier in maturity, produces a larger number of ears per plant, and has given a larger popping volume. The increase in popping volume of the hybrid from corn standardized at 14 per cent moisture results from a larger percentage of kernels that pop rather than an increase in kernel size. In addition to these data, the hybrid has a more desirable uniform ear shape, better standing ability, and a lower smut percentage than the standard variety.

FUTURE USE OF HYBRID CORN

From the data on the Minnesota corn hybrids given in this bulletin, and from the results of corn breeding work at other experiment stations in the United States, it is evident that the use of hybrids offers opportunity for growers to produce not only higher yielding corn, but also corn that excels in other important characters, such as standing ability, disease resistance, and adaptability to different regions in the state. In the last few years, the demand for hybrid seed corn has shown a steady, rapid increase. Demand for the parental stocks for producing the commercial hybrids has increased yearly, which indicates that farmers are anxious to produce the hybrid seed needed for their own acreage as well as for sale. In addition, the amount of hybrid seed corn produced by seed companies has greatly increased so that in recent years there has been a rapid increase in the amount of hybrid corn grown in Minnesota.

On the basis of the present-day trend of increase, it seems logical to estimate that 10 years hence 50 per cent or even more of the present corn acreage in Minnesota will be planted with hybrid seed corn. On this assumption, it is possible to calculate the acreage of crossing plots needed to produce the final hybrid seed for commercial planting. Fifty per cent of the present corn acreage in Minnesota is approximately 2,100,000 acres. Since one bushel of seed will plant seven acres, 300,000 bushels of seed corn will be needed to plant one-half of the present corn acreage in the state. On the average, 25 bushels of hybrid seed corn may be obtained per acre of detasseled crossing plots. The production of 300,000 bushels of hybrid seed corn will therefore require 12,000 acres of crossing plots.

In the past, the production of the parental stocks needed for farmers' crossing plots has been done under the supervision of the Division of Agronomy and Plant Genetics. The increased demand for this seed has made it necessary to expand the acreage of the first crosses and of parental inbred lines. Beginning with the season of 1935, the Minne-

sota Agricultural Experiment Station and the Minnesota Crop Improvement Association drew up a cooperative plan for the production of inbred lines and single crosses of field corn. This cooperative plan provides for the control of inbred lines of field corn and first crosses used in making three-way and double crosses released after 1935 by the Minnesota Agricultural Experiment Station. The production of an adequate supply of this seed is planned for through cooperation between the Minnesota Agricultural Experiment Station and the Minnesota Crop Improvement Association.