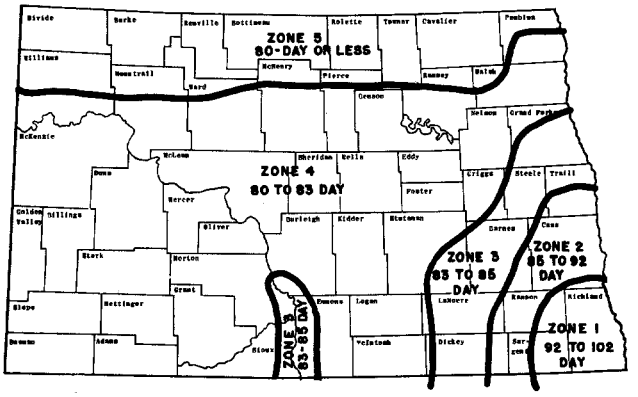
CIRCULAR A-307 MAY 1968

NORTH DAKOTA Hybrid Corn Performance



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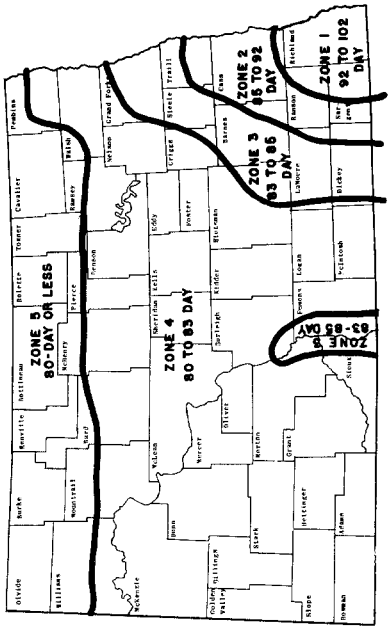

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NORTH DAKOTA CORN GRAIN PERFORMANCE

CORN ACREAGE AND YIELD TRENDS:

The Crop and Livestock Reporting Service reports that the acreage of corn grown for grain in North Dakota has decreased steadily in recent years from a 1961-65 average of 202,000 acres to 126,000 acres harvested in 1967. The average grain yield has increased during this same period from 34.2 to 39.0 bushels per acre.

The acreage of corn grown for silage has decreased also from a 1961-65 average of 660,000 acres to 446,000 in 1967. The average silage yield during the 1961-67 period was 4.8 tons per acre.

ENVIRONMENTAL CONDITIONS AND CORN GROWTH:

The length of the growing season is influenced most by the first killing frost in the fall. A killing frost rarely occurs after corn growth starts in the spring since corn requires a relatively high soil temperature to germinate. Frost kill of a plant after the kernels have reached maximum dry matter content hastens drying. However, frost before maturity slows drying and may result in low quality corn. The killing frost dates and corn grain maturity at Fargo are presented in Table 1.

Soil and air temperature during the frost-free period is the single most important environmental feature controlling plant development. The corn plant requires warmer temperatures than small grains for maximum metabolic activity. Long warm days and cool summer nights, which slow energy loss, contribute to maximum photosynthetic output and result in higher yields. The effect of temperature on corn growth is often expressed as "degree days." This concept is based on the fact that the corn plant metabolism stops when temperatures drop below 50° F. Degree days are calculated for each day by subtracting 50 degrees from the 24-hour mean temperature. Cumulative degree days have been calculated for the average corn growing season at Fargo (May 20 to Sept. 15) for the last 17 years and are presented in Table 1. Early maturing corn hybrids require fewer "degree days" than later ones to reach maturity.

Selection of the proper maturity range is very important when corn is grown for grain. The term "Relative Maturity" (R.M.) is used to designate the length of time required for a hybrid to reach maturity compared to standard hybrids which have been grown in a particular area for a long time. The differences in the length

Table 1. Degree days, killing frost date and corn grain maturity at Fargo.

Year	Degree Days Low	Degree Days High	Killing Frost Date	Maturity of corn
1950	1840		9-23	poor
1951	1657		-23	v. poor
1952		2053	-19	good
1953		2060	-21	good
1954	1963		-21	poor
1955		2272	-10	good
1956	1944		-6	poor
1957		2032	-16	fair
1958	1744		-30	fair
1959		2238	-16	good
1960		2109	-30	good
1961		2319	-27	good
1962 1/		2013	10-23	fair
1963		2227	-27	v. good
1964	1986		9-11	poor
1965	1596		-24	v. poor
1966		2029	-25	v. good
1967	1814		-26	fair

1/Very late planting date.

growing season between early and late maturing hybids is largely in the number of days from emergence silking, not in the days from silking to maturity. See ıble 2. Corn in the Fargo area reaches physiological ıturity (35% kernel moisture) 48-50 days after pollinaın. The moisture content at harvest time is dependent on the amount of water loss from the time the kernel mature until harvest. The relative maturity zones for ɔrth Dakota, based upon expected length of growing ason, are shown in Fig. 1.

Table 2. Relative maturity, ear moisture at harvest, and yield of [redacted]in of open pedigree hybrids at Fargo, North Dakota.

Hybrid variety	Maturity: Relative maturity	Maturity: Emergence to silk	Maturity: Ear moisture 1963-67	Yield at 15.5% moisture 1963-67
	R.M.	Days	%	bu/A.
Hybrid AES 101	75	58	21.0	65.2
Nodakhybrid 307	84	61	24.4	67.9
N. Dak. Exp. SX B564	85	60	27.6	79.9
Nodakhybrid 502	94	65	28.8	73.1
N. Dak. Exp. SX E399	94	65	29.8	72.3
N. Dak. Exp. DX N45	94	65	30.0	71.8
N. Dak. Exp. DX N87	95	65	30.0	73.0
N. Dak. Exp. DX N95	100	66	30.7	75.3
Minhybrid 608	100	67	30.9	75.9
N. Dak. Exp. DX N113	103	67	37.0	71.9
Minhybrid 519	105	69	37.6	68.9

Soil moisture is often the limiting corn yield factor. Although the corn crop has a high total growing season water requirement, it is one of the most efficient field crops for the production of dry matter in relation to water used. Corn uses approximately 268 pounds of water for each pound of above ground dry matter produced compared to 597 for oats, 517 for wheat, 534 for barley, 685 for rye and 905 for flax. As a general rule, 18 inches of water are needed to produce 100 bushels of corn grain. It requires approximately 5,000 gallons of water to produce one bushel of grain corn.

PRODUCTION FACTORS INFLUENCING YIELD

The three components of corn grain yield are: (1) number of ears per acre, (2) number of kernels per ear and (3) weight per kernel. Hence the performance of "Hybrid A" or "Hybrid B" cannot be predicted by any one single factor such as ear number, ear size, kernel row number, ear length, or kernel size. The highest yield per acre results from a well balanced combination of all these factors.

The lack of available soil nutrients is often the next most limiting factor for high corn grain yields. Corn requires that 13 elements be available from the soil. Nitrogen, phosphorus and potassium are required in relatively large amounts. See Table 3. Required in lesser amounts are calcium, magnesium, sulfur, copper, manganese, zinc, iron, boron, molybdenum, and chlorine.

The influence of fertilizer additions to non-fallow land on grain yields is shown in Table 4. In 1966 and 1967 the fertilized non-fallow land equaled the yields on the fallow land. Soil moisture was limiting in 1967.

Table 3. Pounds of plant nutrients required to produce 100 bushels of corn per acre.

Tissue	Nutrient: Major N	Major P_2O_5	Major K_2O	Minor Ca	Minor Mg	Minor S	Minor Cu	Minor Mn	Minor Zn
Grain	90	36	26	11	13	10	.04	.06	.10
Stover	67	24	98	18	12	7	.03	1.00	.20
Total	157	60	124	29	25	17	.07	1.06	.30

Row spacing appears to be an important consideration only when moisture and fertility are not limiting and when present cultural practices are good enough to produce the maximum yield potential. Narrower rows appear to have a yield advantage on summerfallow at Fargo, 1966 and 1967. On non-fallow land, even at high fertility levels, there was no yield advantage for narrow rows. See Table 4. Note that narrow rows did not decrease grain yield. Changing from a 40-inch row to a 30-inch or narrower row spacing is not likely to increase yields unless the maximum yield potential has been reached with present cultural methods.

Table 4. Effect of row spacing, land management, and soil fertility on corn grain yields, Fargo, N. Dak. 1960-61 (18,000 plants/acre).

Row spacing in inches	Bu./Acre at 15.5% moisture: Summerfallow 0-0-0 1966	1967	30-120-40 1/ 1966	1967	Ave.	Non-Fallow 0-0-0 1966	1967	100-60-40 1/ 1966	1967	Ave.
20	83	79	81	76	80	57	43	70	87	64
30	88	84	90	73	84	65	49	86	68	67
40	72	72	76	76	74	63	44	79	78	66
Average	81	78	83	75		62	45	78	77	
Average	80		79			54		78		
Average					79					66

1/ Lbs. of N-P_2O_5 - K_2O fertilizer applied per acre.

Plant population is easily estimated by using Table 5. When using Table 5 the number of kernels dropped should be 10 to 15 per cent higher than the desired harvest population to allow for normal stand losses.

Weed control is one of the production factors which is imperative for maximum corn grain yields. Weeds cost money through competition for water, nutrients and light. Losses due to weeds can be 10 per cent or higher. Research at Illinois and Wisconsin indicate that approximately 100 pounds of weeds equals 1 bushel of corn. Weed control must be 95 per cent effective or better for maximum realization of yield potential. Shallow cultivation plus herbicides in the row are an efficient and effective approach to weed control. Deep cultivation is not desirable since the crown roots of corn are subject to pruning. The crown roots in corn grow horizontally before turning downward and are close to the soil surface early in the plant growth period.

The importance of proper hybrid choice regarding maturity, yield, and other agronomic features cannot be

over emphasized. The corn hybrid must be adapted to the specific corn growing area in order to consistently produce high yields of well matured grain. See Table 6. The Hybrid Corn Performance trials conducted by the NDSU Agricultural Experiment Station give information on those hybrids entered for several locations in the state. Average performance from these trials is presented in Table 7 for a two year period. Note the increased response of certain hybrids to high plant population as shown in the Richland county trials. Some hybrids do not have the genetic capability to compensate for increased plant population and the resulting competition for nutrients, light, and soil moisture.

Table 5. Plant population per acre at various row widths based on kernel or plant spacings within the row.

Spacings within	Row width (inches)				
the row	20	30	36	38	40
(inches)					
5	--	41,800	34,800	33,000	31,400
6	44,800	34,800	29,000	27,500	26,100
7	--	29,900	24,900	23,600	22,400
8	39,200	26,100	21,800	20,600	19,600
9	34,800	23,200	19,400	18,300	17,400
10	31,400	20,900	17,400	16,500	15,700
11	28,500	19,000	15,800	15,000	14,300
12	26,100	17,400	14,500	13,800	13,100
13	24,100	16,000	13,400	12,700	12,000
14	22,400	14,900	12,500	11,800	11,200
15	20,900	13,900	11,600	11,000	10,500
16	19,600	13,000	10,900	10,300	9,800

TIPS ON GROWING CORN FOR GRAIN:

1. Select a hybrid that has a good chance to mature in your area. Early maturing hybrids have an advantage when the growing season is cool, when August-September moisture is short and/or when fall frost comes early. Rate of planting studies have shown that yields of early maturing hybrids can be increased consistently by thicker planting.
2. Hybrid corn companies are continually improving their hybrids. Dealers may be offering improved hybrids which have not been entered or have not been tested long enough to be included in this report. New hybrids offered by reliable companies are usually an improvement.
3. For high quality grain production choose a hybrid that will mature in most years rather than a late maturing hybrid. The yield tables show that a good yield does not depend on late maturity. Advantages of early maturing hybrids are as follows:
   a. They usually mature before killing frosts.
   b. Good yielding early hybrids on the average yield as much or more than late hybrids in most areas.
   c. Lower moisture content at harvest permits safer storage. You will take more clean, sound high-quality corn out of the crib or bin.
   d. Mature, dry corn makes better livestock feed.
   e. You can harvest earlier in the fall when weather conditions are most favorable. Early harvest does reduce corn losses resulting from broken stalks and dropped ears in the field.
   f. Early hybrids with lower moisture content at harvest reduce cost for drying and market discount for moisture.
   g. Fall plowing of corn stubble on heavy soils is possible with early hybrids, which usually results in a higher yield of the following crop.
4. Single crosses and three-way crosses have greater uniformity than other types of crosses. For this reason, they may fluctuate more widely in performance in response to favorable or unfavorable weather conditions. Double crosses have been more reliable under North Dakota conditions. However, a well adapted single or three-way cross may be outstanding under conditions favoring high production.
5. Planting rates in dryland areas should be at about 14,000 to 18,000 plants per acre in the east and 12,000 to 14,000 in the west. Slightly higher rates can be planted for silage.
6. When irrigated, corn populations should be at 18,000 to 20,000 plants per acre for grain and 20,000 to 22,000 for silage.
7. Plant corn as early as the seasonal conditions permit for highest yield.
8. Keep weeds under control either by shallow cultivation to avoid root pruning and moisture loss, or by chemical herbcides.
9. A clean, well kept corn field will not only yield more but the crop to follow also will yield more.

Table 6. Annual corn grain yields and ear moisture percentages at harvest of five relative maturity (RM) hybrids and their averages in Fargo open pedigree hybrid test (12,000 plants/Acre).

	AES 101 75 RM		ND307 83 RM		ND502 95 RM		MH 608 100 RM		MH519 105 RM	
Year	bu/A	Moist %	bu/A	Moist %	bu/A	Moist %	bu/A	Moist %	bu/A	Moist %
1955	54.0	21.4	63.7	29.7	67.2	31.5	64.5	37.1	65.2	38.9
1956	53.2	13.2	67.7	19.1	69.3	20.0	65.1	22.5	58.2	22.6
1957	65.7	21.9	73.1	25.0	70.3	28.9	71.0	33.4	62.6	50.2
1958	58.0	25.1	64.0	33.3	71.8	33.8	71.4	36.8	66.2	51.8
1959	61.0	19.9	65.8	25.0	72.0	27.1	61.4	31.1	58.5	36.7
1960	60.4	21.5	69.5	30.5	68.6	30.9	69.0	37.7	74.2	40.6
1961	59.8	21.2	67.7	29.8	68.4	33.7	77.5	36.1	74.4	43.5
1962*	17.9	37.8	17.8	41.2	18.2	50.7	18.7	58.9	19.6	53.2
1963	64.3	17.2	72.9	22.4	79.9	27.5	88.4	28.4	93.6	32.9
1964	57.8	13.7	58.8	17.8	59.0	23.1	58.7	24.9	52.1	28.6
1965	69.1	33.5	73.9	35.0	77.4	36.8	76.1	41.6	68.9	50.2
1966	71.0	19.7	77.9	24.0	79.8	28.7	80.0	28.5	78.2	35.1
1967	63.7	21.1	56.3	23.0	69.4	28.0	76.2	31.1	51.7	41.4
Average	58.1	22.1	63.8	27.3	67.0	30.8	67.5	34.5	63.3	40.4

*Corn planting was delayed by excessive rain.

Table 7. 1966-67 average of ear moisture percentage (M.) and yield per acre (Bu.) of hybrid corn trials in five counties and North Dakota relative maturity rating[1].

Hybrid	N. Dak. R.M.	Cass[3]		Richland[2] Low		Richland[2] High		Ransom Irrig.[4]		Grand Forks		Morton	
	days	M%	bu.	M%	bu.	M%	bu.	M%	bu.	M%	bu.	M%	bu.
Hybrid AES101	75	25.8	61.8	-	-	-	-	-	-	20.2	64.6	12.1	44.8
United-Hagie SX108	77	27.5	73.9	-	-	-	-	-	-	21.7	74.4	-	-
Haapala H-399A	83	30.3	65.0	-	-	-	-	-	-	26.5	77.3	-	-
Pioneer 3891	83	32.2	61.4	-	-	-	-	-	-	25.7	66.6	13.2	50.7
Pioneer 3884	83	-	-	-	-	-	-	-	-	25.0	67.8	14.2	54.5
Nodakhybrid 307	84	31.6	67.1	20.5	78.3	20.3	85.2	27.2	94.0	27.2	75.2	16.8	53.5
N.D. Exp. SX B564	85	31.1	77.8	-	-	-	-	-	-	30.6	74.1	18.4	61.4
Weathermaster EPX-1	85	-	-	20.8	82.2	21.4	101.1	28.7	101.1	31.0	75.6	17.5	55.4
Weathermaster 20	85	-	-	-	-	-	-	-	-	-	-	17.5	53.2
Haapala H-230	85	31.7	69.4	-	-	-	-	-	-	31.1	78.0	-	-
Kingscrost KC3	85	31.9	64.4	-	-	-	-	-	-	29.2	79.4	19.0	52.9
Pioneer 3872	86	30.8	69.4	-	-	-	-	-	-	-	-	16.9	54.7
Pioneer 3854	86	40.7	59.0	22.4	80.5	23.6	85.4	-	-	-	-	-	-
Sokota 225	87	32.6	64.0	-	-	-	-	-	-	-	-	-	-
Haapala 305	88	32.7	66.0	-	-	-	-	-	-	-	-	-	-
N.D. Exp. SX E399	94	31.8	61.9	21.3	76.6	25.1	93.5	33.2	104.0	-	-	-	-
Kingscrost KE435	94	34.4	66.3	-	-	-	-	-	-	30.2	72.8	16.3	48.1
Sokota 211	94	-	-	-	-	-	-	-	-	30.2	68.4	-	-
Pioneer 3862	94	38.6	63.9	23.1	77.9	20.8	84.6	-	-	-	-	-	-
United-Hagie 3H11	94	-	-	-	-	-	-	-	-	31.0	76.1	-	-
Nodakhybrid 502	94	34.9	66.5	25.4	81.0	23.1	89.8	34.3	93.3	33.1	74.8	19.8	54.2
Minhybrid 612	94	35.3	68.1	-	-	-	-	-	-	-	-	-	-
N.D. Exp. DX N45	94	35.6	64.9	25.7	80.7	24.6	87.6	32.2	102.2	31.4	72.7	19.0	55.5
N.D. Exp. DX N87	94	-	-	25.3	82.1	24.9	93.3	-	-	32.0	75.0	19.9	55.9
N.D. Exp. DX N95	95	35.7	67.5	27.7	83.6	27.4	98.8	33.1	102.2	33.7	75.8	22.7	59.3
Kingscrost KE445	95	36.1	69.5	-	-	-	-	-	-	32.4	70.7	20.8	57.9
Kingscrost KE449	95	38.9	60.0	27.8	78.8	26.8	87.5	-	-	-	-	-	-
Weathermaster EPX-2	97	-	-	26.5	84.1	27.1	87.5	-	-	-	-	-	-
Pioneer 3943	97	-	-	26.7	80.7	27.7	92.3	36.0	104.2	-	-	-	-
Sokota TS-49	100	-	-	29.1	90.5	29.0	88.5	40.4	107.7	-	-	-	-
Minhybrid 608	100	38.7	61.9	25.0	84.5	25.8	97.0	34.4	97.2	-	-	-	-
Sokota TS-50	100	-	-	28.5	82.9	30.2	86.0	-	-	-	-	-	-
South Dakota 250	100	40.7	55.3	28.6	72.2	31.4	81.1	-	-	-	-	-	-
Haapala H-340	100	42.1	59.8	29.1	84.4	31.9	90.1	-	-	-	-	-	-
Pioneer 3911	100	-	-	29.2	79.8	30.5	96.0	38.5	105.2	-	-	-	-
Weathermaster EPX-3	100	-	-	29.4	84.5	29.3	94.2	38.7	106.3	-	-	-	-
Pioneer 3676	101	44.7	55.1	31.3	80.7	32.1	90.6	-	-	-	-	-	-
T-E Hastymaker	102	45.0	57.9	30.9	75.4	31.7	85.8	39.1	97.3	39.0	71.0	26.4	59.5
Kingscrost PX527	102	45.0	56.1	-	-	-	-	37.6	97.7	-	-	-	-
Kingscrost PX480	102	-	-	31.0	87.8	32.4	84.5	38.7	101.6	-	-	-	-
Kingscrost KE477	102	45.0	57.0	31.0	86.6	32.0	93.8	-	-	-	-	-	-
N.D. Exp. DX N113	103	45.2	60.7	31.5	80.0	32.9	87.9	38.6	101.7	-	-	-	-
Weathermaster EP30	103	-	-	-	-	-	-	39.4	115.4	-	-	-	-
Weathermaster EPX-4	103	-	-	-	-	-	-	40.2	115.7	-	-	-	-
Pioneer 3681	105	48.0	57.4	32.0	77.9	31.0	93.9	-	-	-	-	-	-
Kingscrost KE497	105	48.9	54.6	-	-	-	-	41.9	106.0	-	-	-	-
Minhybrid 519	105	54.2	46.8	-	-	-	-	41.2	100.8	-	-	-	-
Pioneer 3773	107	-	-	-	-	-	-	44.0	118.0	-	-	-	-
T-E Suremaker	107	-	-	34.7	72.1	35.2	84.1	44.0	92.0	-	-	-	-
T-E Profitmaker	107	53.1	55.3	35.0	79.2	37.3	84.1	42.7	99.7	-	-	-	-
Pioneer 3775	110	56.1	56.9	35.5	81.0	36.9	87.4	41.8	110.2	-	-	-	-

1/See Hybrid Corn Performance Trials for 1967 NDSU Agric. Exp. Sta. Cir. 102. Feb. 1968.

2/ Two plant populations; low - 13.068 plants per acre high - 17,424 plants per acre.

3/ 1966 trial was destroyed by hail 1965 and 1967 data used.

4/ Not irrigated in 1967.

Cooperative Extension Service, North Dakota State University of Agriculture and Applied Science, and U.S. Department of Agriculture cooperating. A.H. Schulz, Director, Fargo, North Dakota. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.