For Silage

For Grain

EARLY MATURING CORN

• more dependable

• by William Wiidakas

Corn grown for grain must be early enough to mature in a normal growing season, yield satisfactorily, resist lodging and have ears high enough on the plant to permit efficient harvesting with a mechanical picker.

Relatively early maturing hybrids have, on the average, produced as high a yield as later maturing kinds. Early maturing hybrids also permit harvesting the crop early, so the land can be prepared for next year's use.

Corn used for silage should produce well glazed or dented ears, since the ears make up a high proportion of the feed value in silage. Since corn is cut for silage while it is still green, the lodging tendency of some hybrids or varieties is not as objectionable as it is when corn is to be harvested for grain.

As an application of fertilizer nearly always helps to produce good vegetative growth, fertilizer use, together with thicker planting, usually assures a higher yield of corn silage. Since full maturity is not essential for silage production, slightly later maturing hybrids may be used for this purpose.

For the studies reported here the corn was considered to be physiologically mature when the kernels were well dented and hardened. At this stage (glazing) corn ears contain about 45 percent moisture.

The corn maturity zone map of North Dakota, (Fig. 1) shows where the corn hybrid varieties of a given maturity rating (in days) have matured satisfactorily in the average growing season.

Climatic factors contributing to rapid development and early maturity are warm temperatures (expressed in degree days), adequate moisture, soil fertility and the length of the frost free period.

The cumulative degree-days of heat received (degrees of mean temperature for each 24-hour period minus 50° F.) from May 20 to Sept. 15, the occurrence of the first fall frost and the stage of corn maturity in the last 10-year cycle at Fargo.

	Years 1948	1949	1950	1951	1952	1953	1954	1955	1956	1957
Degree days (cum)	2,059	2,059	1,840	1,657	2,053	2,060	1,963	2,272	1,944	2,032
First fall frost September[1]/	17	24	23	23	19	21	21	10	6	16
Maturity of corn	good	good	fair poor	very poor	good	good	poor	good	good	fair

1/Corn leaves were frozen.

William Wiidakas is Associate Agronomist.

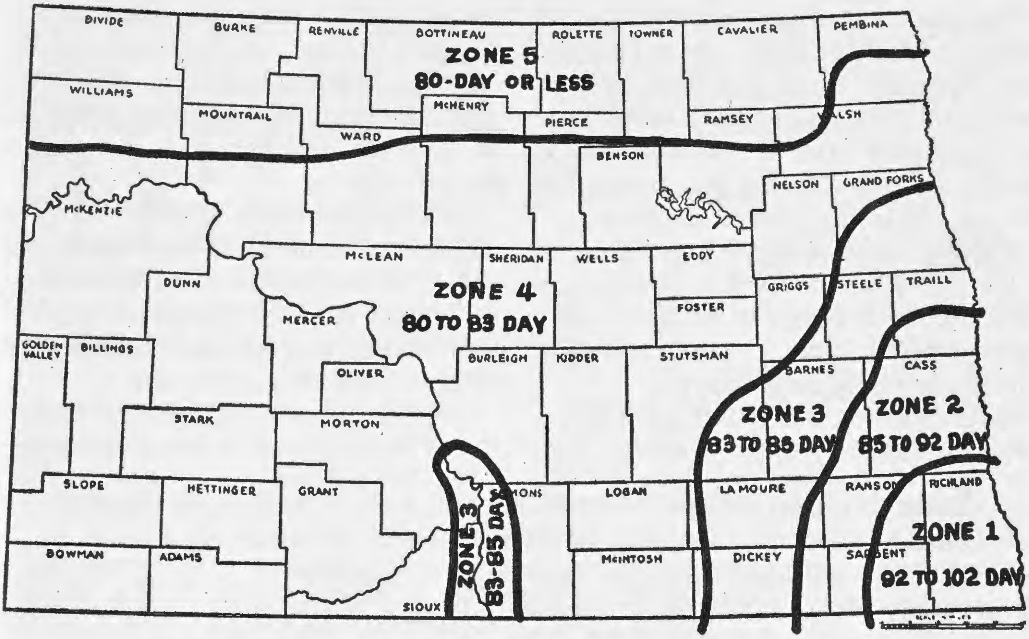


FIG. 1. - CORN MATURITY ZONES OF NORTH DAKOTA

The following hybrids are suggested for grain or silage production in the different maturity zones of North Dakota.

	For Silage	For Grain
Zone 1	Hybrids in maturity similar to **95 to 100 day R.M.** Sokota 250, 270 Minhybrid 608, 607 Wis. 355, 341, 464	Hybrids in maturity similar to **90 to 95 day R.M.** Sokota 220, Nodak 502, 307 Wis. 341, 355, 313 Sokota 250
Zone 2	**90 to 100 day R.M.** Wis. 341, 355, 313 Minhybrid 608 Sokota 250 Nodakhybrid 502, 403	**84 to 90 day R.M.** Nodakhybrid 307, 502, 301, 306, 307 Sokota 220, Wis. 279
Zone 3	**85 to 90 day R.M.** Nodakhybrids 301, 306, 307, 305, 403 Sokota 220, Wis. 279 Rainbow (Mandan)	**83 to 85 day R.M.** Nodakhybrids 307, 306, 301 Wis. 279. In Northern area AES 101, Morden 77, Wis. 240
Zone 4	**83 to 85 day R.M.** Nodakhybrids 307, 301, 306, 305, 208 Wis. 279, Rainbow (Mandan)	**80 to 83 day R.M.** Morden 77, Wis. 240 AES 101, Falconer Nodakhybrids 208, 301, 306, 307
Zone 5	**80 to 83 day R.M.** Nodakhybrids 208, 301, 305, 306, 307 Morden 77, AES 101 Rainbow (Mandan) Falconer	**75 to 80 day R.M.** AES 101, Wis. 240 Morden 77, Falconer, Nodakhybrids 208, 301, 306

Many commercial seedsmen's hybrids of comparable maturity are satisfactory.
See hybrid corn field trials reports.

The moderate, even temperatures that occurred in 1956 were more effective than excessive highs and lows that occurred in 1957 and 1955. Warm and dry conditions after the killing frost in the fall promoted curing and drying, but did not add to the growth and yield.

Yields of open pedigree hybrids tested at the North Dakota Agricultural Experiment Station at Fargo in the last 3 years are reported in Table 1. Fargo is in Zone 2 of the maturity zone map, Fig. 1.

Late maturing 95 to 100-day relative maturity (RM) hybrids produced high yields of silage and grain. However, the ear corn of these was immature, particularly in unfavorable seasons of 1950 and 1951. It contained too high a percentage of moisture, and ears were not suitable for safe storage.

Medium maturing hybrids, 83 to 94 day R.M., produced as high yield, were usually better matured and the moisture content in the ears was lower to permit safe storage or shelling in seasons with favorable growing conditions.

Very early maturing hybrids, 76 to 82 day R.M., although of lower yielding ca-

Table 1. YIELD OF SILAGE AND GRAIN AND OTHER AGRONOMIC CHARACTERS OF LEADING OPEN PEDIGREE HYBRIDS AT FARGO.[1]

Hybrid variety	N. D. rel. mat. R. M.	Moisture % 2/	Silage tons/A. at 70% moisture 1957	2 yrs. 1956-57	3 yrs. 1955-57	Grain bu./A. at 15% moisture 1957	2 yrs. 1956-57	3 yrs. 1955-57	Comparative at Fargo 1957 3/ Lodge %	Rating 1 to 5 Plants	Ears
Early—75 to 82 day R.M.											
Hybrid AES 101	76	18	9.0	9.4	......	65.6	56.4	57.6	8	2	2-3
Falconer O.P.	80	24	7.8	8.9	8.3	49.1	51.7	50.7	45	4-5	2-3
Hybrid UM 164	80	......	7.8	......	......	62.9	......	......	12	3	3
Northwestern O.P.	82	......	7.0	......	......	45.0	......	......	26	3	4
Nodakhybrid 208	81	21	8.2	9.3	9.0	53.1	61.3	59.0	35	4-5	4
Morden 77	82	18	8.9	9.4	......	63.2	60.2	60.2	19	3-4	2-4
Medium 83 to 94 day R.M.											
Nodakhybrid 301	83	21	9.1	9.9	9.9	65.7	64.4	64.2	10	2	2-3
Nodakhybrid 306	83	19	9.4	10.2	10.6	67.0	64.3	64.3	15	2-3	2-4
Nodakhybrid 305	84	25	10.9	11.1	10.4	60.3	61.6	60.5	12	2-3	3-4
Nodakhybrid 307	84	22	10.6	11.2	......	73.1	70.4	68.3	8	1-2	1-2
Hybrid AES 201	84	21	9.0	......	......	65.6	60.8	......	11	1-2	2
Hybrid AES 202	84	......	9.7	......	......	73.8	......	......	18	2	1
Hybrid AES 203	84	......	10.6	......	......	73.6	......	......	21	2-1	2-1
Minn. 13 (Honey) OP	85	25	......	......	......	59.1	56.7	56.5	35	2-3	3-4
Rainbow (Mandan) OP	86	28	10.5	10.9	10.8	57.7	60.3	59.5	40	3-4	3-4
Minhybrid 804	86	22	10.1	......	......	74.4	71.3	......	20	1-2	2-3
Wis. Hybrid 279	85	22	8.6	......	......	66.5	62.2	61.6	18	1-2	2-3
Sokota 220	90	22	10.3	10.6	10.5	73.0	68.3	66.0	11	1	2-3
Nodakhybrid 403	88	25	10.7	11.2	......	66.6	65.5	......	30	1-2	1-3
Northern King	88	25	9.1	10.4	10.7	60.0	59.2	......	29	2-3	3-2
Nodakhybrid 502	94	25	11.4	11.6	......	70.3	69.8	68.9	10	1-2	2-3
Late 95-105 day R.M.											
Wis. Hybrid 313	95	33	10.1	10.7	......	69.0	65.7	......	8	1-2	2
Wis. Hybrid 355	95	30	10.3	......	......	69.0	64.7	63.3	8	1-2	3-2
Wis. Hybrid 341	95	30	10.2	10.8	10.7	62.7	63.2	62.1	6	1-2	3-2
Synthetic 95	95	......	9.3	......	......	66.4	......	......	16	2-3	2-3
Minhybrid 608	100	28	11.1	11.9	12.1	71.0	68.0	66.9	3	1	1-2
Sokota 250	100	31	11.1	11.8	12.0	71.4	66.0	65.8	4	1	1
Michigan MS 250	100	35	10.6	......	......	62.6	60.4	......	5	1	2-3
Wis. Hybrid 525	105	......	10.3	......	......	70.1	......	......	4	1	2-3
Wis. Hybrid 464A	105	35	......	......	......	64.6	59.7	59.9	7	1	3-2
L.S.D.			1.32	1.05	0.82	7.2	5.4	4.3			

1/Results of earlier trials were reported in Bimonthly Bul. No. 5, Vol. 18, 1956. 2/1956-57 average moisture in ears at harvest. Tight husked varieties like Falconer, Rainbow and some hybrids were physiologically earlier maturing than the moisture percent indicated.
3/Appearance rating: 1—very good; 2—good; 3—fair; 4—poor; 5—very poor.

pacity, were well matured. These early maturing hybrids have been used satisfactorily when corn was planted late. The yields of early maturing hybrids was increased in thicker plantings.

Yield at Different Stages of Growth

Comparative proportion of dry matter yield produced at different stages of growth cycle, as presented by Hopper1/, is given in Fig. 2. At the glazing stage the yield of dry matter of fodder and stover was highest, and the average amount of dry matter for all varieties in fodder, ears and stover was about 33, 51 and 24 percent, respectively.

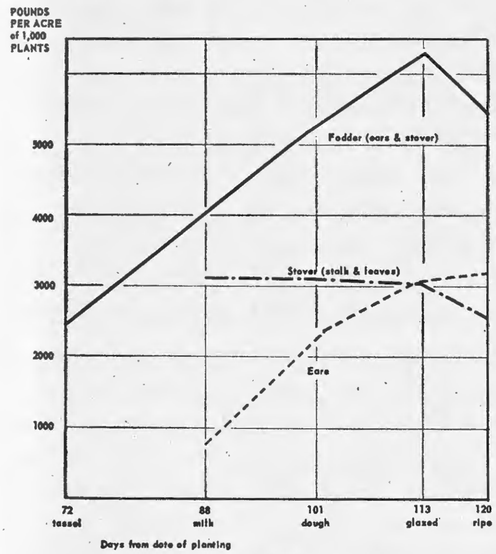


Fig. 2. Yield of Dry Matter.

Loss of leaves and tops after the glazing stage accounted for the lower yield of dry matter in fodder and stover, while the slight increase in ear yield was due to filling of kernels on the ears. Hopper characterized glazing stage as when the kernels were fully glazed on 90 percent of the ears and indentation on dent varieties became pronounced.

Days between silking and other substages of growth as reported by Hopper on the average were:

Silking to milk stage .... 16 days
Milk to dough stage .... 13 days
Dough to glazing stage .... 12 days
Silking to glazing—total .... 41 days average
Glazing to ripe .... 7 days (about 42% moisture in ears)

The growing days required between different stages of corn growth vary, due to environmental conditions, dates of planting, temperature, rainfall and inherent characteristics — earliness, lateness and type of variety. The greatest difference between early and late maturing varieties of corn was from the planting (or emergence) to the silking or tasseling. With present hybrids this period, from emergence to silking, varied from 50 days for early maturing to 74 days for very late maturing varieties.

The days interval between the silking and glazing (physiologic maturity) stages was also influenced by the environmental conditions and inherent character of the varieties but to a lesser degree. It ranged from 38 to 50 days. The (average) days interval between different stages of growth with hybrids tested at Fargo in recent years was:

Planting to emergence (normal seasons) .... 7 to 10 days
Emergence to silking stage .... 50 to 74 days
Silking to glazing stage .... 36 to 50 days
Glazing to ripe (normal season) .... 7 to 10 days

The days interval between different stages was influenced by the environmental conditions. Warm temperatures during any of the stages of development usually telescoped or shortened the differences while cool temperatures prolonged or increased the number of days needed. At the close of the growing season, in the fall, a sudden and prolonged drop in temperatures to lower than 50 degrees has occurred frequently. Under these temperatures, days required from tasseling to glazing or ripe stage were increased.

Some difference was also observed due to the inherent characteristics of varieties. Deep kerneled and usually late maturing varieties required a longer period from silking to glazing stage than the shallow kerneled and usually early maturing varieties or hybrids.

Plant Early Maturing Hybrids at Thicker Rate

Thicker plantings have not always produced higher yields. The results given in Table 2 show that increased yields from thicker plantings (16,000 plants per acre) were obtained when the moisture and other growing conditions were adequate to support the thicker stand.

At Fargo the **very poor moisture condition of August and September** in 1955 was enough to maintain normal plant development of a 16,000 plant population in the very early maturing AES 101 but not the later maturing Nodakhybrid 301 or Wis. Hybrid 355, where the yields were 11 percent lower in the 16,000 plant population.

The **fair to poor moisture condition** in the fall of 1956 was enough to support 16,000 plant populations of up to 94-day R. M. Nodakhybrid 502 but the later maturing hybrid, Wis. 355, was damaged, and lower yield resulted in the higher plant population. In the **very good August and September moisture condition** of 1957, the 16,000 plant population in all maturity levels produced higher yields.

The early maturing hybrids are smaller, have lower yield capacity per plant, and normally require less moisture and plant food per plant than the later maturing larger kinds. Increasing plant population in early maturing hybrids

Table 2. EFFECT OF FALL MOISTURE CONDITION ON THE YIELD OF EARLY AND LATE MATURING CORN AT NORMAL RATE (12,000 PLANTS) AND THICKER RATE (16,000 PLANTS) OF PLANTING AT FARGO STATION.

Hybrid	R.M. da.	Fall moisture condition 1955 Very poor 12000	1955 Very poor 16000	1956 Fair to poor 12000	1956 Fair to poor 16000	1957 Very good 12000	1957 Very good 16000
Hybrid AES 101	75	62.7	68.9	58.7	71.5	63.5	78.8
% yield increase 16M/12M		......	+9.8%	......	+21.8%	......	+24.1%
Nodakhybrid 301	83	65.7	58.4	72.1	81.2	70.1	86.6
		......	—11.1%	......	+12.6%	......	+23.5%
Nodakhybrid 306	83	......	......	......	......	66.1	79.5
		......	......	......	......	......	+20.3%
Nodakhybrid 307	84	......	......	......	......	72.8	90.2
		......	......	......	......	......	+23.9%
Nodakhybrid 502	94	......	......	70.4	79.5	73.1	93.5
		......	......	......	+12.9%	......	+27.9%
Wis. Hybrid 355	95	52.7	46.7	64.5	61.6	......	......
		......	—11.4%	......	—4.5%	......	......
First fall frost		Sept. 10 and 23		Sept. 6 and 14		Sept. 16 and 22.	
Departure from normal of August and Sept. rainfall			—2.07		—1.87		+3.36

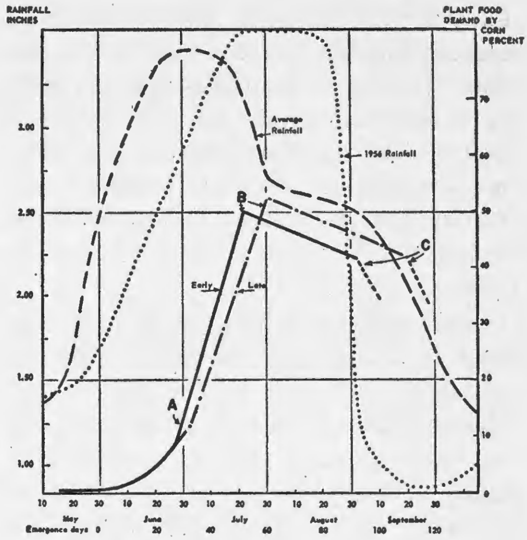
from 12,000 to 16,000 (about 4 plants of early maturing to 3 plants of later maturing in a 40-inch row) is likely to produce consistently higher yields and yet assure a good maturity. The yield depends on the size and number of ears produced.

Conlon and Douglas at the Dickinson Experiment Station concluded that the higher yield of silage was produced in 6 to 12-inch spacing, and the best grain yields in 12 to 18-inch spacing in 42-inch rows. The trend favored 12 to 18-inch spacing for all-round purposes. (Bimonthly Bulletin, No. 4, Vol. 19, 1957).

Early maturing corn can be harvested earlier, which permits fall plowing and preparation of land for the following season, particularly in the heavy clay soils of eastern North Dakota.

In testing the effect of row width on the yield of corn in 1955 and 1956 in Fargo, when the number of plants per acre or an area were held the same, difference in yield was not significant when the rows were 36, 40 or 48 inches apart. However, when the rows were 60 inches apart, the yield was reduced about 10 percent. To have the same number of plants per acre, the stand was too thick in 60-inch rows; the ears were small and many plants were barren.

The effect of moisture on the growth and yield of early and late maturing corn is shown in Fig. 3. The growing corn plant needed and used a large amount of moisture and plant food during the rapid elongation stage, beginning before the silking stage "A", reached the peak at the silking stage "B" and extended through the ear development and kernel filling to the glazing stage "C". (Pattern of plant food demand through the courtesy of G. E. Smith, Corneli Seed Company).



Pattern of Plant Food Demand of Early and Late Maturing Hybrids and Rainfall—30-year Average in East Central Crop Reporting District and 1956 Rainfall at Fargo.

The amount of available moisture depended upon the rainfall plus subsoil moisture. The long time mean precipitation for the East Central Crop Reporting District (2) and the rainfall for 1956 season at Fargo (3) are plotted in the chart, Fig. 3. The high demand for moisture of the early maturing hybrid ("A" to "C") was within the favorable moisture supply in the average and 1956 seasonal rainfall. However, the average and 1956 seasonal rainfall curve cuts across the ear development and kernel filling line "B" to "C" of the late maturing hybrid.

Increasing the plant population from 12,000 to 16,000 plants per acre also created a proportionately higher need for moisture. The larger plants of the late maturing hybrids, especially in the thick planting (16,000 plants per acre) apparently absorbed normally available soil moisture and reached the critical moisture need, which brought about lower yields in the deficient August and September rainfall seasons of 1955 and 1956. Very early maturing hybrids, however, had completed the ear development and kernel filling before the moisture conditions became critical and, thereby, the yields were increased in the thicker planting rates as is shown in Table 2.

Abnormally high rainfall in 1957 was more than adequate for high moisture need and resulted in higher yield in the thicker planting rates for all hybrids. As the 3-year average yield of medium maturing Nodakhybrid 301 exceeded that of very early maturing AES 101, it may suggest that Nodakhybrid 301 is early enough to be included in the thicker planting rates in normal rainfall seasons at Fargo.

Other environmental conditions, such as early fall frost, hail, windstorm, diseases, abnormally cool temperatures in September or lack of adequate soil fertility, may also affect the normal processes of ear development and result in lower grain yields.

As the normal rainfall in August and September is light in the central and western areas of North Dakota it is assumed that the available moisture is frequently the main cause of low corn grain yields in those areas. Second in importance, perhaps, is the early fall frost and cool fall temperatures that end the growing season before the normal ear development and kernel filling are completed.

Late maturing corn, although potentially higher yielding, is more frequently subjected to late season drouth, frost and cool weather hazards than the early maturing varieties and, therefore, are not likely to produce yields to their maximum capacity.

1/Hopper, T. H. Composition and Maturity of Corn. N. Dak. Agr. Exp. Sta. Bull. 192, 1925.

(2) 1921 to 1950 mean precipitation in East Central Crop Reporting District, N. Dak. Weekly Weather and Crop Report. Oct. 9, 1956.

(3) USDC Weather Bureau.

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