A RELATIVE MATURITY STUDY OF FIFTY
CORN BELT HYBRIDS
IN OKLAHOMA

By

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I INTRODUCTION

Corn has long been a favorite crop of American farmers, but its production has been limited by the environmental conditions. The environmental conditions include the factors of temperature and moisture which are the cause of much concern by farmers and research workers.

In the Corn Belt area, it is usually the temperature which provides the greatest hazard. The farmers of that area desire a late freeze in order to avoid a soft corn caused by insufficient drying. This type of corn has a reduced dry matter content and a high moisture percentage which lowers the test weight and feeding value, and also causes a storage problem. Soft corn has caused a loss of 10% or more of Iowa's corn crop in eight of the last thirty-seven years (28).[1] The Oklahoma farmer has just as big a threat to his corn crop as does the Corn Belt farmer, but one of a different nature. Dry, hot summers are constantly plaguing the Southwest. The severe months are July and August, when the corn is setting its seed. The result is a dried plant with little, if any, seed set.

These two problems do have one thing in common, the need for a corn plant which will mature early. The research workers of the Corn Belt states have accomplished a great deal in producing faster maturing plants.

[1]Figures in parentheses refer to "Literature Cited," page 23.

In this experiment, several of these Corn Belt hybrids were grown under Oklahoma conditions during 1958. The 50 included in the test represented the seven maturity series of 100 through 700. The major objective of this study was to compare these hybrids from the Corn Belt area according to their rate of maturation under Oklahoma conditions. To attain this objective, it was necessary to determine the approximate time each of these hybrids reach 50% silk and 40% moisture in the grain. From these data, an attempt was made to predict the time of maturity of the hybrids when planted at different dates, under Oklahoma conditions of 1957 and 1958.

II REVIEW OF LITERATURE

In studying corn maturity, there are several factors which determine the time or date of maturity. The influence of climate seems to be important in this study, since it is a study of northern hybrids under southwestern conditions. One major climatic difference in these two areas is the distribution of rainfall. Eisele (7), studying environmental factors, found that the rainfall of the growing season, May, June, July, and August, was a better criterion for predicting corn yields than the rainfall of the entire year. He also found that thick planting produced and resulted in earlier pollen shedding. Magoon and Culpepper(17) showed that the rainfall greatly influenced the length of time between planting and maturity. Kiesselbach (13) found that the growing corn was unable to extract moisture after reaching the point of 16% soil moisture. In other climatic studies, Jones and Huntington (11) reported that all plants have a definite climatic optimum, and that the yield varies with the length of the favorable period. They offered a possible example, such as a corn variety produced in the South might be expected to produce better as it is taken farther north. It is then killed or checked by the growing season becoming too short. Andrew, et al, (3) found that uniform rainfall, soil fertility, and amount of disease were the major differences between Wisconsin and the Netherlands in yield of corn. Two American-bred hybrids were used in this experiment with the Netherlands averaging 24.8

more bushels per acre than the Wisconsin tests.

Other climatic factors are light and temperature. Kiesselbach (13) concluded that the different length photoperiods were an important factor in the latitudinal adaptation of corn. He also reported that varieties which differ in ultimate plant height and time of maturity had very similar growth rates except that the later varieties continued growth after the early ones ceased. Garner and Allard (9) found that the distinguishing factor between spring and winter oats was photoperiod. Wiggans (31) in a study of oats, reported that temperature seems to be the primary factor affecting maturity, although variation may be caused by disease, rainfall, soil type, plant population, fertility, and depth of planting. Kincer (15) showed that in corn a certain minimum temperature is required before growth can take place, even if light and moisture are favorable. Katz (12) concluded that as the temperature goes above the required minimum, so does the rate of growth until it reaches a certain maximum where growth ceases. Scott (26), in a study of peas and corn, found that minimum temperatures for growth will vary according to the species. In corn, the minimum is 50 degrees Farenheit, whereas, in peas, the minimum temperature for growth is 40 degrees Farenheit.

Several different factors, other than climatic, are also used to determine maturity. In most experiments, moisture percent of the grain and accumulative degree hours are used. Miles and Remmenga (20) showed that there is higher moisture in the grain of stored corn than in the cob; thus, the kernel moisture would be a little higher than ear moisture. Whereas, Down, et al, (6) found that, under field conditions, the grain has a lower moisture content as maturity progresses than the whole ear samples. This was attributed to the lagging of the cob in drying during the ripening period. Rinke, et al, (24) based their maturity ratings on the ear moisture content at the time of harvest. They made the comparison of ear moisture contents with varieties of known maturity and adaptation.

In the determination of moisture percentages, several different methods are used. Sayre and Morris (25) compared four methods: air drying, alcoholic extraction, toluene distillation, and sap expression. All of these are old methods, but air drying is still used today. They found that air drying showed slightly lower readings than the other three methods, but all four showed good correlation. Warren and Demmock (30) tested three methods of measuring moisture content; Brown-Duvel oil distillation tester, ear shrinkage method, and the electrical tester. They used the vacuum oven test for a check. Their results showed the electrical tester to be the fastest, but sufficiently still accurate. The Brown-Duvel method was very accurate, but slow, and the ear shrinkage test was less reliable. Fetzer (8) concluded that the bulk of the moisture is removed easily by any method, but differences occur between methods in removing the last 10% of the moisture. Thus, the variation in results will decrease as the moisture content increases.

Accumulated degree hours are useful in determining maturity but, Lana and Haber (16) found that the actual corn harvest dates cannot be made with confidence because of interaction of various factors which influence the effect of accumulated degree hours. According to Phillips (22), the factors of soil type, slope, plant stand, vigor of seed, drought, depth of planting, drainage, and light intensity probably influence degree hours accumulation. Neal and Strommen (21) used thermal units for nine years of testing, and there seems to be a correlation between the thermal units and the corn crop evaluation.

Silk date and dry matter content are other ways of determining maturity. Shaw and Thom (27) considered maturity to be the stage when corn reaches maximum dry weight. Snelling and Hoener (29) reported that dry matter content of the grain seems to be the best measure of relative maturity if taken at a proper stage, which is when a wide range of dry matter content is found between the earliest and latest corn lines. They found dry matter content was a poor method of measurement when all the material being tested reached a uniform dry matter content. Rather and Marston (23), using ten varieties, found that all varieties attained maximum total dry matter at about 50% moisture. They also used 40% moisture as a definition of maturity, and concluded that a favorable season caused the different maturity groups to be closer together than an unfavorable one. Aldrich (2) reported that corn is mature when it reaches the maximum dry weight of grain, which is approximately 65% dry matter. He also pointed out that the percent of dry matter in the grain is the best maturity measure, and 50% silking date is the next best measure.

Hopper (10) and Albert (1) found that the time of silking is a significant way of measuring maturity. Meyers (18) reported the date of appearance of the first silk to be misleading due to the individual differences. He concluded that 10% or 25% silking was good, but that 50% silking was the most consistent.

With all methods considered it still seems difficult to pinpoint the exact time of maturity. Dessureaux, et al, (5) found that maturity of corn is influenced by the actions of both genetic and pathological factors, stalk rot produced a pathological condition which seems to hasten maturity. Crim, et al, (4) noted variation between the varieties registered for the northern zone of Minnesota and Miles (19) found some variation between varieties when comparing moisture content and test weights.

Maturity is not only difficult to determine, but a desired maturity may be difficult to breed into a plant. Kiesselbach (14) showed that several characters seem to be transmitted together: early maturity, small stature, slender ear, ears low on the stalk, small leaf area, and shallow kernels with horny endosperm.

III MATERIALS AND METHODS

Field experiments were conducted in 1957 and 1958 at the Paradise Farm, located eighteen miles southwest of Stillwater. These plots were planted on a Vanoss loam soil, and 200 pounds of 16-20-0 fertilizer was applied.

In this experiment 50 Corn Belt hybrids were used. The hybrids were selected to represent the seven different maturity series as used by the North Central Corn Breeding Research Committee. The hybrids were tested under a code number without regard to hybrid name or pedigree. These maturity series are numbered 100 through 700 with the lower numbered being the earliest in maturity. Of the fifty hybrids used, five were of the 100 series, six from the 200 series, eight from each of the 300, 400, and 500 series, nine from the 600 series, and six from the 700 series.

The hybrids were planted as a randomized block design with three replications. Each replication consisted of four, ten hill rows of each hybrid. Three kernels were planted per hill, and later thinned to two plants per hill. The hills were spaced forty inches apart with a forty inch spacing between the rows.

A seven-day recording hygro-thermograph was placed in the field to measure relative humidity and temperature. From the temperature data, the thermal units were determined by using 50 degrees Farenheit as the base temperature, according to the work of Scott (26). The plus difference between the average of the minimum and maximum, and the 50 degrees Farenheit base temperature gives the thermal units for that day. A mercury thermometer was also placed in the meteorological cage to check the hygro-thermograph. Accumulated thermal units were recorded from the time of planting to harvest.

Plant and silk counts were taken six times, beginning on June 17 and ending on July 4, and the average 50% silking date was determined. Six harvests were made at weekly intervals beginning on July 21. The first harvest given in Table I included all hybrids. The other harvests began with the earliest maturity series and continued down the maturity series scale as the ear moisture neared the 45% mark. This was done because of the wide range of maturity. The row to be harvested from each plot was selected at random for each harvest.

Wet harvest weights were taken at each harvest on each row to determine the percentage of moisture at harvest. After the material had dried on racks, it was weighed to determine the amount of moisture lost in drying. Then, it was shelled, and the grain was placed in a Steinlight electrical moisture tester to determine the percentage of moisture of the dry grain.

Data collected in 1957 were included in this study to show a comparison between the two years. The 1957 material was collected by Dr. J. S. Brooks and Mr. Hartwill Pass in a similar study, but using some different hybrids.

Predictions based on the 1957 and 1958 data were made as to the time of maturity of these hybrids in Oklahoma. Predictions were based on calculated data; (1) days required for the hybrids to reach 40% grain moisture, and (2) thermal units required for the hybrids to reach 40% grain moisture. These were both calculated for four different planting dates.

TABLE I

Time of Harvest of the Seven Maturity Series

Maturity Series	July 21	July 28	Aug. 4	Aug. 11	Aug. 18	Aug. 25
100	X	X	X	X		
200	X	X	X	X		
300	X	X	X	X		
400	X		X	X	X	
500	X		X	X	X	
600	X			X	X	X
700	X			X	X	X

IV RESULTS AND DISCUSSION

The results show that the seven maturity series classifications are reasonably accurate since most of the hybrids react accordingly. Figure I which gives the approximate date of 40% grain moisture indicates that only a few hybrids are misclassified as to their maturity series under Oklahoma conditions. Hybrid numbers 6 and 43 show deviation from the average in the 100 series, also numbers 35 and 38 show large deviations in the 300 series. Hybrid number 32 is somewhat low in the 500 series. The other hybrids appear well placed in the correct series. Figure I also shows that the higher series numbers have the later maturity dates. The 100 series had an average 40% moisture date of July 25, which is 18 days earlier than the latest (700) series, which is August 12. If the plants containing 40% moisture content in the grain are mature, the maturity rating difference between series 100 and 200 would be only one day. The difference between the 200 and 300 series would be almost five days as the 200 series reached maturity on July 26 and the 300 series on July 31. The difference between series 300 and 400 is four days with average dates of July 31 and August 4. Less difference is shown between the 400 and 500 series with only a two-day separation. The separation of series 500 and 600 is rather wide, from August 6 to

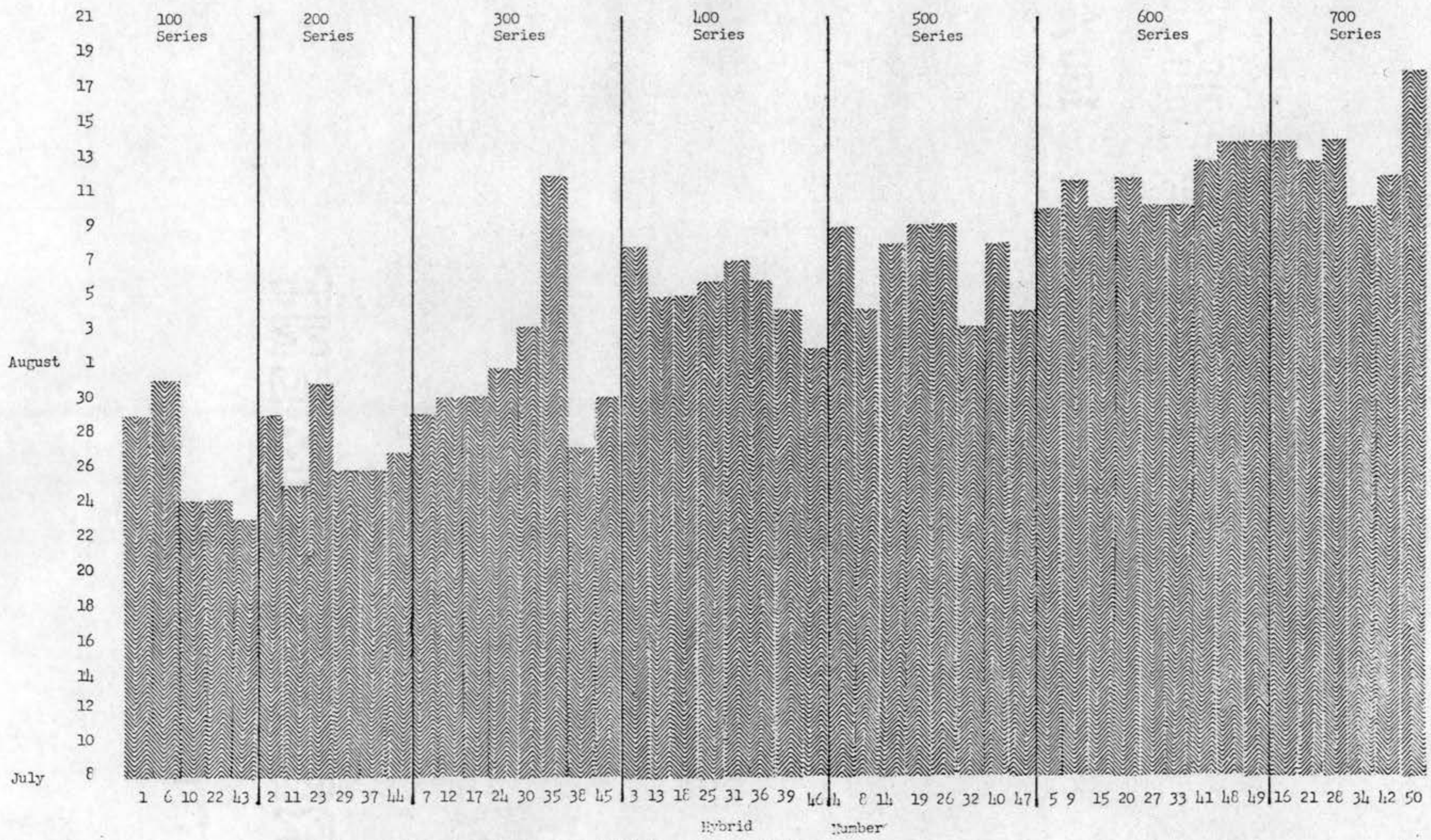

Figure 1. The Approximate Date of 40% Grain Moisture

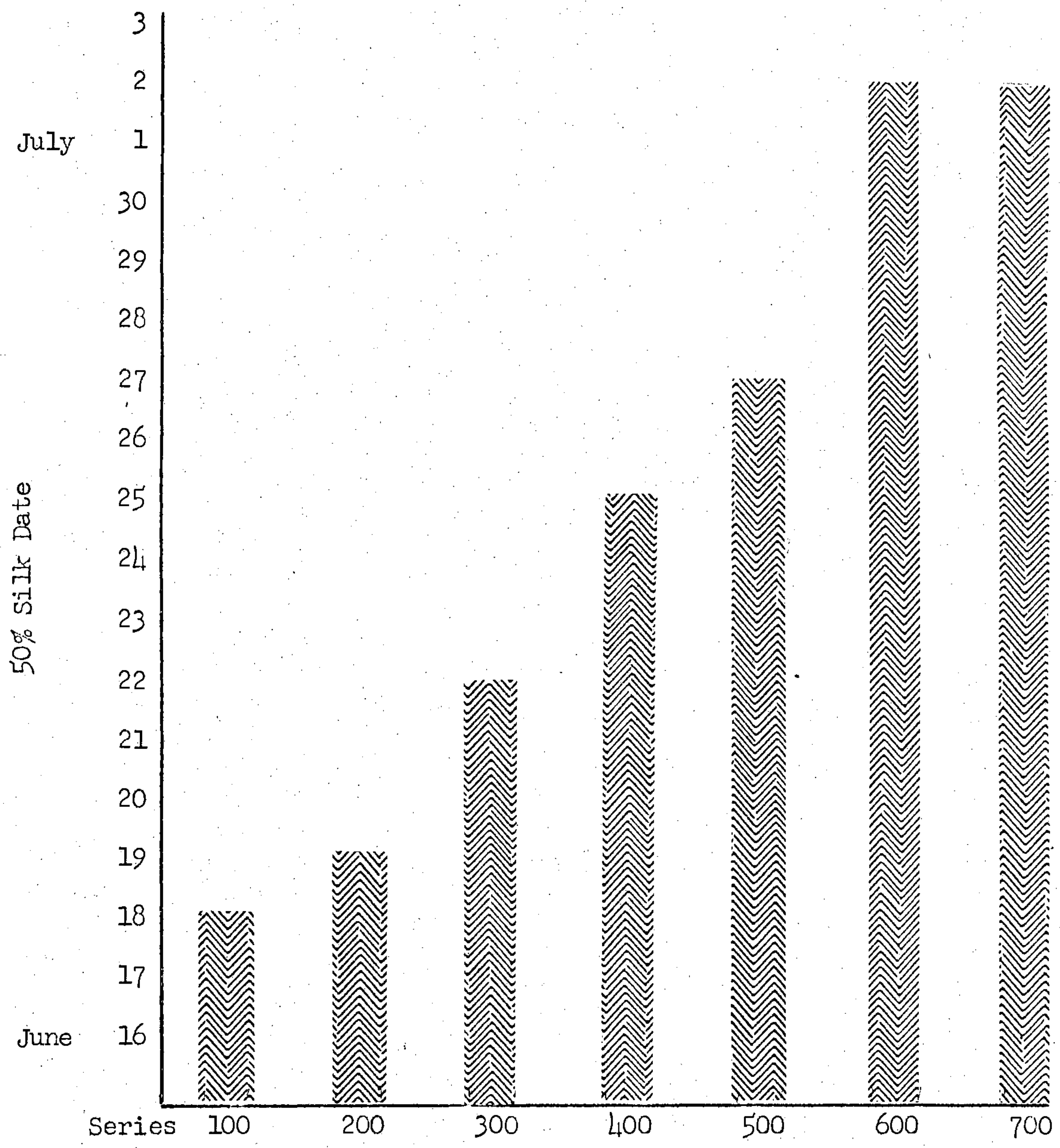

Figure 2. Average 50% Silk Date of the Seven Series in Oklahoma in 1958.

August 11. The 600 and 700 series show only one day difference in maturity date.

The date of 50% silking gave a pattern similar to that of the maturity dates. Figure II shows the average date of 50% silking for each of the seven series. The 100 and 200 series have an average of only one day difference, the 200 and 300 series show three days difference, and there is a three day difference between silking dates of the 300 and 400 series. Series 400 and 500 have only two days separating their averages. The continued later silking is rather regular through the series until the 600 series is reached. Then, there is a five-day separation between series 500 and 600. Also, the regular stair-step pattern is broken when both the 600 and 700 series had a 50% silking date of July 1. The earliest series had a 50% silking date of June 18 which shows a difference of fourteen days between the 100 and 700 series.

The average data obtained from each hybrid for Oklahoma are shown in Table II. These results are from the 1958 planting. They show the average silk date of each hybrid, the average date the grain reached 40% moisture content, and the averages for each of the seven series. This table reveals any deviation from the average within a series. Hybrids number 23 shows deviation in the 200 series, 35 and 38 in the 300 series, and 32 in the 500 series. These results suggest that hybrid numbers 35 and 38 may be misplaced as they show extreme deviation. Others show variation, but to a lesser degree.

The maturity series averages for 50% silk and 40% moisture are shown on Table III. This table includes the results of 1957 and 1958. The 1957 material was grown under drier conditions than the 1958 material; also, there is almost a month difference in the planting dates. These two things may account for part of the 7 to 11 day variation of days to

Table II

MATURITY OF 1958 HYBRIDS AS DETERMINED BY SILKING DATE AND MOISTURE IN GRAIN

Hybrid	Av. 50% Silk Date	Av. 40% Moisture Date
100 Series		
1	June 17	July 28
6	" 20	" 30
10	" 18	" 23
22	" 17	" 23
43	" 17	" 22
Average	" 18	" 25
200 Series		
2	June 18	July 28
11	" 19	" 24
23	" 23	" 30
29	" 19	" 25
37	" 18	" 25
44	" 19	" 26
Average	" 19	" 26
300 Series		
7	June 25	July 28
12	" 23	" 29
17	" 19	" 29
24	" 23	" 31
30	" 24	Aug. 2
35	" 25	" 11
38	" 18	July 26
45	" 19	" 29
Average	" 22	" 31
400 Series		
3	June 25	Aug. 7
13	" 25	" 4
18	" 25	" 4
25	" 25	" 5
31	" 23	" 6
36	" 29	" 5
39	" 25	" 3
46	" 23	" 1
Average	" 25	" 4

Table II (continued)

Hybrid	Av. 50% Silk Date	Av. 40% Moisture Date
500 Series		
4	June 25	Aug. 8
8	" 29	" 3
14	" 29	" 7
19	" 27	" 8
26	" 27	" 8
32	" 24	" 2
40	" 29	" 7
47	" 25	" 3
Average	" 27	" 6
600 Series		
5	July 1	Aug. 9
9	" 2	" 11
15	" 1	" 9
20	" 1	" 11
27	" 1	" 9
33	" 1	" 9
41	" 2	" 12
48	" 1	" 13
49	" 1	" 13
Average	" 1	" 11
700 Series		
16	July 1	Aug. 13
21	" 1	" 12
28	" 2	" 13
34	" 1	" 9
42	" 2	" 11
50	" 1	" 15
Average	" 1	" 12

Table III

TWO YEARS' AVERAGES OF MATURITY SERIES FOR 50% SILK AND 40% GRAIN MOISTURE

Series	Date Planted	Days to 50% Silk	Thermal Units to 50% Silk	Days to 40% Moist.	Thermal Units to 40% Moist.
100	5-29-57	47	1333	86	2645
	4-26-58	54	1286	91	2313
200	5-29-57	47	1333	87	2679
	4-26-58	55	1315	92	2343
300	5-29-57	49	1408	89	2741
	4-26-58	58	1376	97	2511
400	5-29-57	52	1521	90	2777
	4-26-58	61	1435	101	2635
500	5-29-57	54	1594	92	2852
	4-26-58	63	1468	103	2704
600	5-29-57	56	1659	97	3026
	4-26-58	67	1581	108	2855
700	5-29-57	58	1720	104	3197
	4-26-58	67	1581	109	2894

50% silk. There is also some variation in the number of thermal units to 50% silk and to 40% grain moisture. The days to 40% moisture show less difference between the two years than the days to 50% silk.

Table IV gives the averages of Table III. These two-year averages should be good estimates of the number of days and thermal units required to mature corn in Oklahoma, using the 40% grain moisture date as the maturity date. The estimated days to 50% silk are also shown. With these estimates, it is possible to predict the approximate maturity date for any of the seven series with any given planting date. Using the average number of days and thermal units required to reach 40% grain moisture, Table V shows the approximate dates at which each of the seven maturity series would be expected to mature if planted at any of the four dates listed. These dates were obtained from the combined studies of 1957 and 1958. The average of the two years was determined and is shown in Table IV. From these data, the predictions were made. The thermal unit predictions were based on the average daily temperatures of the 1957 and 1958 seasons. The maturity predictions which are based on days show that a longer period of time would elapse between the maturity dates of the first and last plantings than those predictions based on thermal units. This can be seen in the April 1 and May 25 plantings. In the April 1 planting, the predicted maturity dates for the early series occur in the first part of July using days, and in the last of July using thermal units. In the May 25 planting, the predicted maturity dates occur in the last part of August and the early part of September using days and in the last of August using thermal units. This difference may be explained by the large number of thermal units accumulated during July and August which would cause the predicted maturity dates to be earlier than the predictions by days. The predicted maturity dates show both days and thermal units to 40% grain moisture to give

Table IV

AVERAGE DAYS AND THERMAL UNITS REQUIRED TO BRING HYBRIDS TO 50% SILK AND 40% GRAIN MOISTURE IN OKLAHOMA IN 1957 AND 1958

Series	Days from planting to 50% Silk	Days from planting to 40% Grain Moisture	Thermal Units from planting to 50% Silk	Thermal Units from planting to 40% Grain Moisture
100	50.5	88.5	1309.5	2479.0
200	51.0	89.5	1324.0	2511.0
300	53.5	93.0	1392.0	2626.0
400	56.5	95.5	1478.0	2706.0
500	58.5	97.5	1531.0	2778.0
600	61.5	102.5	1620.0	2940.5
700	62.5	106.5	1650.5	3045.5

Table V

THE PREDICTED MATURITY DATES OF HYBRIDS
IN OKLAHOMA AT DIFFERENT
PLANTING DATES

Using Days to 40% Grain Moisture

Series	Planting Dates April 1	April 20	May 5	May 25
100	June 28	July 18	Aug. 2	Aug. 22
200	June 29	July 19	Aug. 3	Aug. 23
300	July 2	July 22	Aug. 6	Aug. 26
400	July 5	July 25	Aug. 9	Aug. 29
500	July 7	July 27	Aug. 11	Aug. 31
600	July 12	Aug. 1	Aug. 16	Sept. 5
700	July 16	Aug. 5	Aug. 20	Sept. 9
	Using Thermal Units			
100	July 25	July 29	Aug. 3	Aug. 14
200	July 26	July 30	Aug. 5	Aug. 15
300	July 29	Aug. 2	Aug. 8	Aug. 19
400	July 31	Aug. 5	Aug. 11	Aug. 22
500	Aug. 3	Aug. 7	Aug. 13	Aug. 25
600	Aug. 8	Aug. 12	Aug. 18	Aug. 30
700	Aug. 11	Aug. 15	Aug. 22	Sept. 2

similar results. Both of these methods are practical for measuring length of time required to reach maturity.

V SUMMARY AND CONCLUSIONS

Fifty hybrid corns from the Corn Belt area were tested for their rate of maturity in Oklahoma. The experiment was set up in a randomized block design which included three replications. The 50 corn hybrids included in this experiment represented seven different maturity series, ranging from very early to late. Data from both 1957 and 1958 were used in the experiment to give a more accurate interpretation of the results. Maturity was measured as the time 40% grain moisture was reached and the time 50% silking was reached. Both accumulated thermal units and days were used to predict maturity dates.

The results of this study show the 50 Corn Belt hybrids to be generally well placed in their respective maturity series under Oklahoma conditions. Hybrids 6, 35, 38, and 43 showed variation which indicates that they may be misplaced. Hybrids 23 and 32 varied to a lesser degree.

The days to 40% grain moisture seem to be a better measure of maturity than days to 50% silk. The days to 40% grain moisture showed less differences between the two years than the days to 50% silk.

The earliest of the 50 Corn Belt hybrids reached maturity on an average of 89 days after planting, while the latest required 107 days. The thermal units averaged 2,479 for the earliest corn, and 3,046 for the latest maturing hybrid, under Oklahoma environmental conditions. Although the accumulated thermal units seemed to be a good way to measure maturity, there were great differences between the two years. The predictions were based on an average of the two years for both thermal units and days to 40% grain moisture. The predicted maturity dates indicate that both thermal units and days to 40% grain moisture are good methods to measure length of time required to reach maturity. The two methods showed similar results with some exceptions.

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