VARIATION IN RATE OF DEVELOPMENT OF AN EARLY AND LATE MATURING HYBRID CORN AT DIFFERENT PLANTING DATES

By

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INTRODUCTION

Since the development of hybrid corn, many problems have arisen in regard to proper planting time, number of days to maturity, and relative growth rate.

Very often it is ncessary to plant corn a second time when the first planting comes up to a poor stand. The problem that then faces the grower is whether to replant a hybrid corn of similar maturity or to plant an earlier maturing hybrid, since it will be a late planting.

As a rule a late maturing corn will outyield an early maturing one in regions where frost damage is not a major problem. Therefore any information that might show what possibilities a delayed planting of late maturing corn can offer as compared with an early maturing corn would be of help to growers.

The use of single crosses of different maturity in hybrid seed production requires different planting dates for the two single crosses in order to produce flowering at the same time. Different climatic conditions during the growing season may alter the relative maturity of the single crosses. Information as to rate of plant development and the time of tassel initiation might help in the understanding of some of these problems.

The objectives of these investigations were to determine:

1. The progressive development of hybrid corn strains at different planting dates.

2. The influence of planting date on development of hybrid corn strains of different maturity.

REVIEW OF LITERATURE

Some of the early workers realized the value of determining the optimum planting time for corn. Others realized the value of information pertaining to progressive growth of the corn plant.

Brown and Garrison (2) [1] made a study of the effects of planting date on germination, growth and development of corn. They observed 8 strains for a three year period at Arlington Farm near Washington, D. C. The plantings were made April 19, May 20, June 21, and July 20. In all their experiments there was a consistent decrease in the number of days from seeding to emergence as the date of seeding was delayed. The maximum plant heights of most of the varieties were obtained in the June seedings. The May seedings ranked second, the July seedings third and the April seedings fourth in plant height. The daily increase in height was greatest from the June planting. The shortest plant height and the slowest rate of increase resulted from the April planting.

Six open pollinated dent corn strains were planted by Alberts (1) at 7 day intervals from May 2 through August 1. From the results of these plantings he found the number of days from planting to silking were progressively less for each planting from May 2 through the July 5 planting. From the July 11 planting through the August 1 planting, the number of days from silking to denting remained fairly constant for all planting dates.

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[1] Numbers in parenthesis refer to Literature Cited, Page 25.

In determining the daily growth of maize, Loomis (5) used plants growing in the greenhouse. For the month of March he showed a high correlation between mean daily temperature and mean daily growth of the corn plant. For the other months used in the experiment he found no correlation, and explains this discrepancy by saying the relative humidity was too low for these months. He concluded by making the following statement: "The growth of maize depends upon a liberal water supply at the growing point. In order of effectiveness such a supply is reduced and growth checked by (a) direct sunlight, (b) deficient soil moisture, and (c) low relative humidity."

Kiesselbach (3) studied the progressive weekly changes in corn plants in Nebraska. He found that the plants grew at an average rate of 1.9 inches per day and 13.2 inches per week. The plants gained their maximum height at nine weeks after emergence. The average maximum stem height for the two year period was 119 inches. Although the plants stood 44 inches high at the end of the fifth week, the stem had attained a height of only 20 inches. During the following four weeks the stems gained 99 inches or an average of 25 inches per week. The ear length measurements were from 0.2 inches at seven weeks to the maximum of 10.2 inches by the end of the eleventh week. Maximum tassel length of 19 inches was obtained at eight weeks after emergence.

In determining the time relationship in tassel development of inbred and hybrid corn Leng (4) planted two inbred lines at an early and late date. These plantings were then compared for number of days from planting to tassel initiation. It was found that the later plantings showed tassel initiation an average of 8.3 days earlier than the early plantings for 1949 and 1950. In 1950 the effect of planting on rate of tassel development, time to half silk, and leaf number was studied. The early planting was May 10 and the late planting was June 9. The number of days from planting to tassel initiation was shortened 7.3 days, tassel initiation to anthesis was shortened 1.5 days, planting to anthesis was shortened 8.7 days and planting to half silk was shortened 7.6 days by the later planting. If all lines were considered together, a delay of 30 days in planting resulted in highly significant decreases in length of developmental periods preceding anthesis. Total number of foliage leaves was not significantly affected by planting date. Leng concluded that the development of the corn plant from planting to anthesis occurs in two phases. The first phase includes the period in which vegetative structures are being differentiated and ends with the elongation of the growing point. The elongation of the growing point marks the beginning of differentiation of the tassel. The second phase extends from tassel initiation to anthesis and is the period during which reproductive structures develop.

MATERIALS AND METHODS

The preliminary work for this experiment was done in 1950. The actual data presented here represent experiments conducted in 1951 and 1952. All of the work was conducted on creek bottom land two and one-half miles east of Stillwater, Oklahoma.

An early maturing hybrid, U. S. 13, and a late maturing hybrid, Texas 26, were used. The six planting dates were April 15, May 1, May 15, June 1, June 15, and July 1.

The field design was a split plot with four replications. The six planting dates were made the main plots and the two varieties were used as the sub-plots.

Each variety was planted in 3 row plots 40 hills long within each planting date. The row spacings were 42 inches and the hill spacings were 42 inches in the row. The April 15 planting in both 1951 and 1952 was planted with a modified two row check row planter. The remaining five plantings were planted with a hand planter. Each planting was fertilized at the rate of approximately 175 pounds of Ammonium Phosphate (16-20-0) per acre as a starter fertilizer. The plots were planted at the rate of four per hill and later thinned to two plants per hill to assure a uniform stand.

All measurements were made from the middle row of each 3 row variety plot. The readings for each sampling date were from two plants in the same hill, and alternate hills were used for the successive readings. By using alternate hills any effects of unequal competition were avoided. All measurements were made with a centimeter scale.

To study the rate of development of the two hybrids at the different planting dates measurements were made for stem length at 30, 40, 50, and 60 days from planting; ear length measurements at 50, 60, and 70 days; and tassel length measurements at 40, 50, and 60 days.

The stem length measurements were made by dissecting the young corn plant and measuring from the adventitious roots to the growing point for the 30 day interval. The 40, 50, and 60 day measurements were made by measuring the stem length from the adventitious roots to the base of the tassel.

The ear length measurements were made by removing the husk and measuring the length of the ear from the butt to the tip.

The tassel length measurements were made by measuring the main axis of the tassel from the base to the uppermost tip.

Three hundred eighty-four plants were dissected and measured for the stem length data, and 288 plants each for ear length and tassel length data, making a total of 960 plants.

The analysis of variance method was used to estimate the significance of the data obtained.

RESULTS AND DISCUSSION

In using the analysis of variance method, each sampling period for all six planting dates was treated separately making a total of 20 separate split plot analyses. Because of the differences in the two growing seasons it did not seem feasible to combine the analyses for the two years, however general trends were evaluated by considering averages of the two years data.

Stem Length

1951 Data

An analysis of variance of the results of this study are given in Table 1.

For the 1951 data a mean square for planting date significant at the one per cent level was obtained for all sampling dates, which shows the growth rate was different for the different planting dates.

Since varieties showed highly significant mean squares at 30 and 40 days, this means one variety grew at a greater rate than the other variety at these two intervals. Fifty and sixty days from planting showed no significant difference in growth attained.

The interaction varieties x dates significant mean squares for 30, 40, and 50 days from planting indicate that the amount of growth of the two varieties was not the same at each planting date.

1952 Data

The 1952 data shows significance for planting date at 30 days and highly significant mean squares at 40, 50, and 60 days indicating that the amount of growth was different for the different planting dates.

The mean squares for varieties showed no significant difference at 30, 40, 50, or 60 days from planting.

The varieties x dates interaction significant mean square at 30 days indicates that the amount of growth of the two varieties was not the same for all planting dates at this interval. No significant difference was obtained for this interaction at 40, 50, and 60 days from planting.

In 1951 there was a significant difference for varieties at 30 and 40 days from planting, but none for any of the sampling dates in 1952. The reason for this probably lies in the fact that the 1952 growing season was less favorable at these two intervals and both varieties made such small amounts of growth that statistically no difference could be shown. This reasoning may also explain why varieties x dates interactions were significant at 30, 40, and 50 days for 1951 and only at 30 days for 1952. For the intervals at 50 and 60 days from planting for both years the varieties appear to have leveled off and grown at about the same rate.

The averages presented in Table 2 are for two measurements from each of four replications taken at 30, 40, 50, and 60 days from planting for each of the six planting dates.

By studying these averages it appears that in both a favorable growing season, 1951, and a less favorable one, 1952, later plantings increased the growth rate of both hybrids. The 1951 and 1952 averages were combined in the graphs presented in Figures 1 and 2.

From the graphs it can be seen that the early variety, U. S. 13, starts its growth somewhat earlier and grows slightly faster than the late variety, Texas 26.

The April 15 planting made the slowest growth and shortest plants, while the July 1 planting showed the most rapid growth, and except for Texas 26 at 60 days from planting, the tallest plants.

The data show a proportional increase in growth for each succeeding planting date except for the June 15 planting. An attempt was made to show the effects of temperature and deficient soil moisture for the period following this planting. Although this did not explain the discrepancy completely it is believed that environmental factors were responsible.

Table 1.--Analysis of variance for stem length 30, 40, 50, and 60 days from planting.

1951

Source of variation	d.f.	Days from planting 30	40	50	60
		Mean square			
Total	95	14.82	308.73	1,647.59	2,051.64
Replications	3	20.70	25.08	862.85	853.94
Planting date	5	147.33**	4,056.35**	16,336.26**	30,232.18**
Error A	15	13.37	220.89	3,363.27	615.80
Plots of dates	23	41.02	1,029.15	5,857.35	7,085.20
Varieties	1	99.43**	3,067.95**	2,244.65	552.48
Varieties x dates	5	22.55*	276.02**	6,769.14**	1,163.40
Error B	66	69.50	69.68	587.12	566.30

1952

Source of variation	d.f.	Days from planting 30	40	50	60
		Mean square			
Total	95	2.19	176.23	415.79	922.72
Replications	3	0.51	133.70	142.31	516.77
Planting date	5	11.46**	2,015.97**	4,819.94**	7,767.28**
Error A	15	2.58	105.44	372.46	1,321.07
Plots of dates	23	4.24	524.58	1,309.29	2,617.51
Varieties	1	2.98	122.62	0.35	587.57
Varieties x dates	5	6.69**	160.44	263.11	1,380.00
Error B	66	1.74	86.92	296.21	626.28

* Significant difference at 5% level
** Significant difference at 1% level

Table 2.—Average stem length in centimeters at 30, 40, 50, and 60 days from planting.

1951

Planting date	U. S. 13 Days from planting 30	40	50	60	Texas 26 Days from planting 30	40	50	60
4-15	1.4	4.3	27.1	70.0	1.1	2.8	17.7	47.1
5-1	2.5	10.4	48.6	127.9	2.0	4.5	41.4	111.3
5-15	4.6	37.2	89.0	155.6	2.6	25.2	80.5	169.2
6-1	9.4	33.1	107.9	152.6	3.0	16.6	84.6	171.3
6-15	4.4	15.4	27.2	77.4	1.7	7.9	28.1	65.8
7-1	9.6	57.2	117.0	125.0	9.4	32.7	106.4	114.5

1952

Planting date	U. S. 13 Days from planting 30	40	50	60	Texas 26 Days from planting 30	40	50	60
4-15	1.1	3.9	34.0	91.9	1.1	3.4	21.8	53.4
5-1	2.6	15.9	29.6	51.5	1.8	9.2	32.5	44.3
5-15	2.4	6.9	31.3	48.2	2.2	9.1	36.3	65.3
6-1	2.8	7.7	31.1	62.1	2.7	13.4	38.3	67.3
6-15	2.2	26.6	60.4	104.6	5.1	24.2	66.3	99.3
7-1	1.8	38.8	70.8	98.5	2.1	26.9	62.9	86.4

Figure 1.—Average stem length in centimeters 30 and 40 days from planting.

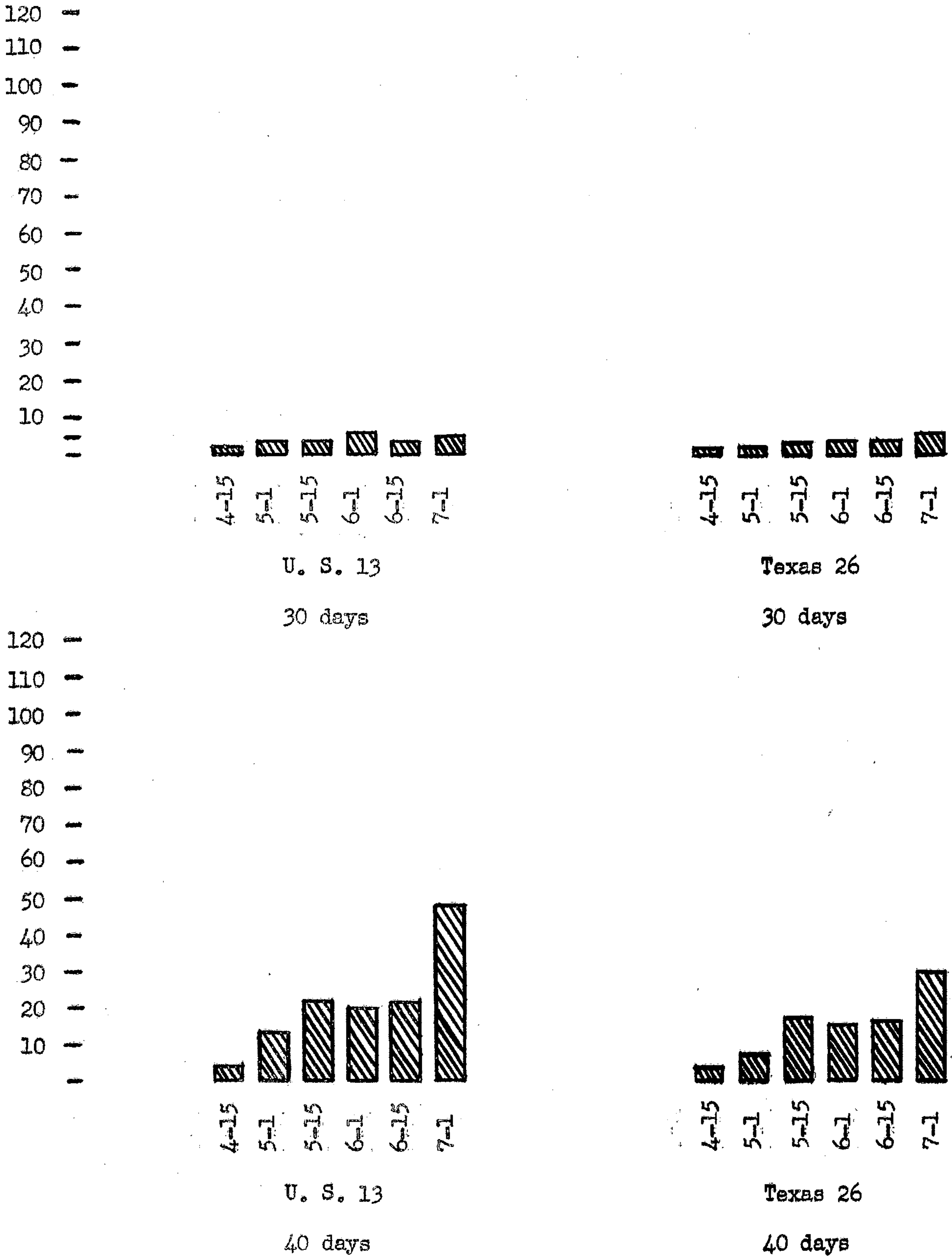
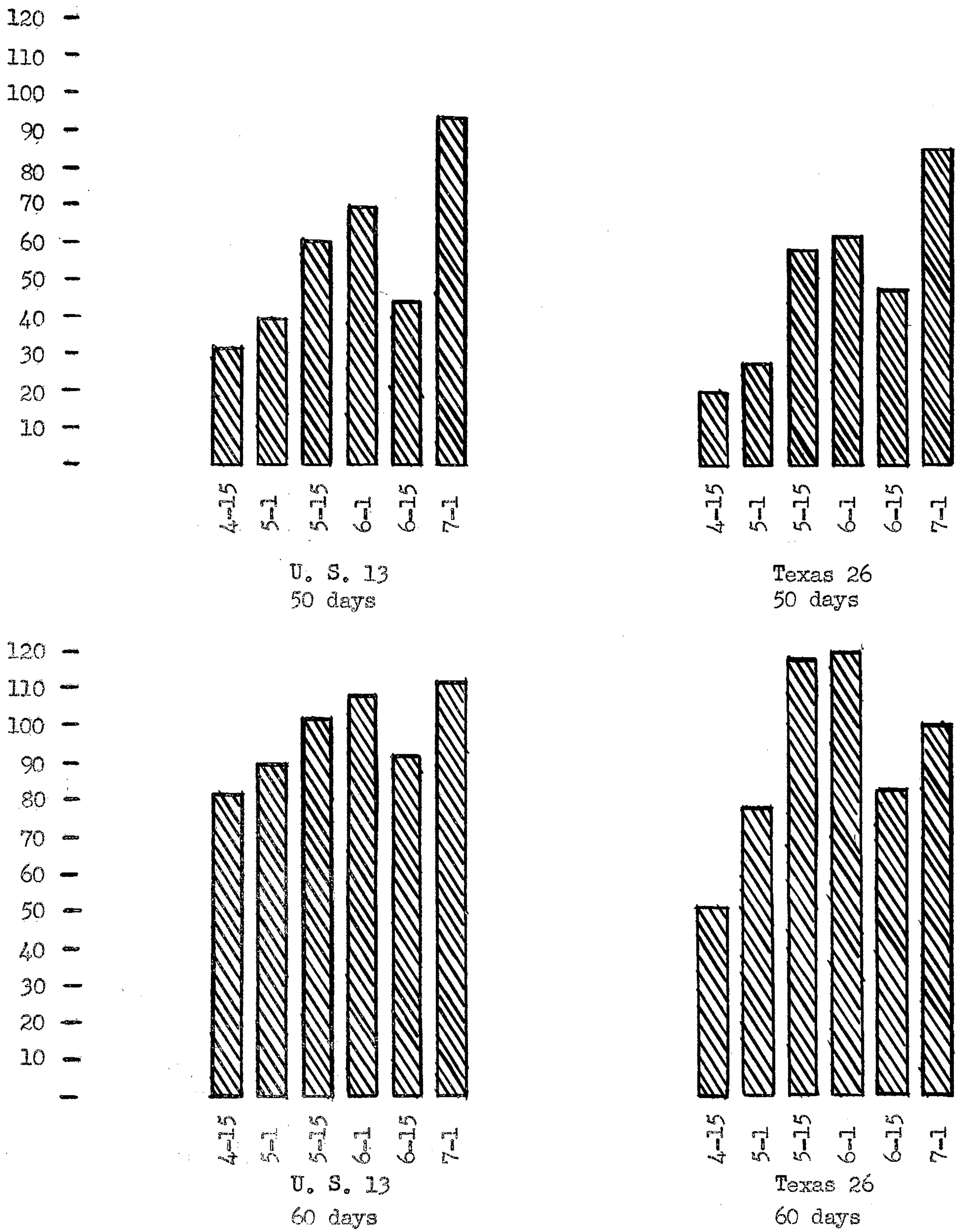


Figure 2.—Average stem length in centimeters 50 and 60 days from planting.



Ear Length

1951 Data

The analysis of variance of the ear length data are given in Table 3.

Since the 1951 planting dates showed significant mean squares for 50, 60, and 70 days from planting it may be assumed that there was a significant difference in the amount the ears grew at the six planting dates.

The significant mean squares for varieties at 50, 60, and 70 days from planting indicate that the ears of one variety grew faster than the ears of the other variety at these periods.

The varieties x dates interaction showed no significance at 50, 60, or 70 days from planting.

1952 Data

For the 1952 ear length data, the planting dates showing significance at 50 and 60 days means that there was a difference in the amount of ear growth for the different planting dates. The 70 days from planting showed no significance.

Mean squares obtained for varieties at 50, 60, and 70 days were not significant.

The interaction varieties x dates significant mean square for 50 days shows that the ear growth of the two varieties was not the same at each planting date. Since no significance was obtained in 1951 or 1952 for the other sampling periods, this mean square may be a chance variation.

Table 3.--Analysis of variance for ear length 50, 60, and 70 days from planting.

1951

Source of variation	d.f.	Days from planting 50	60	70
		Mean square		
Total	95	10.65	25.98	21.40
Replications	3	2.10	16.32	3.80
Planting dates	5	145.99**	337.59**	292.78**
Error A	15	1.78	13.64	5.70
Plots of dates	23	33.17	84.41	67.86
Varieties	1	48.16**	164.59**	110.94**
Varieties x dates	5	6.84	8.27	8.69
Error B	66	3.03	8.70	6.28

1952

Source of variation	d.f.	Days from planting 50	60	70
		Mean square		
Total	95	2.53	18.64	38.43
Replications	3	0.87	7.39	24.09
Planting dates	5	32.91**	269.05**	52.35
Error A	15	0.41	6.91	37.98
Plots of dates	23	7.53	63.96	141.70
Varieties	1	2.28	1.53	0.38
Varieties x dates	5	2.83*	6.30	8.81
Error B	66	0.89	5.95	14.98

* Significant difference at 5% level
** Significant difference at 1% level

Table 4.--Average ear length in centimeters at 50, 60, and 70 days from planting.

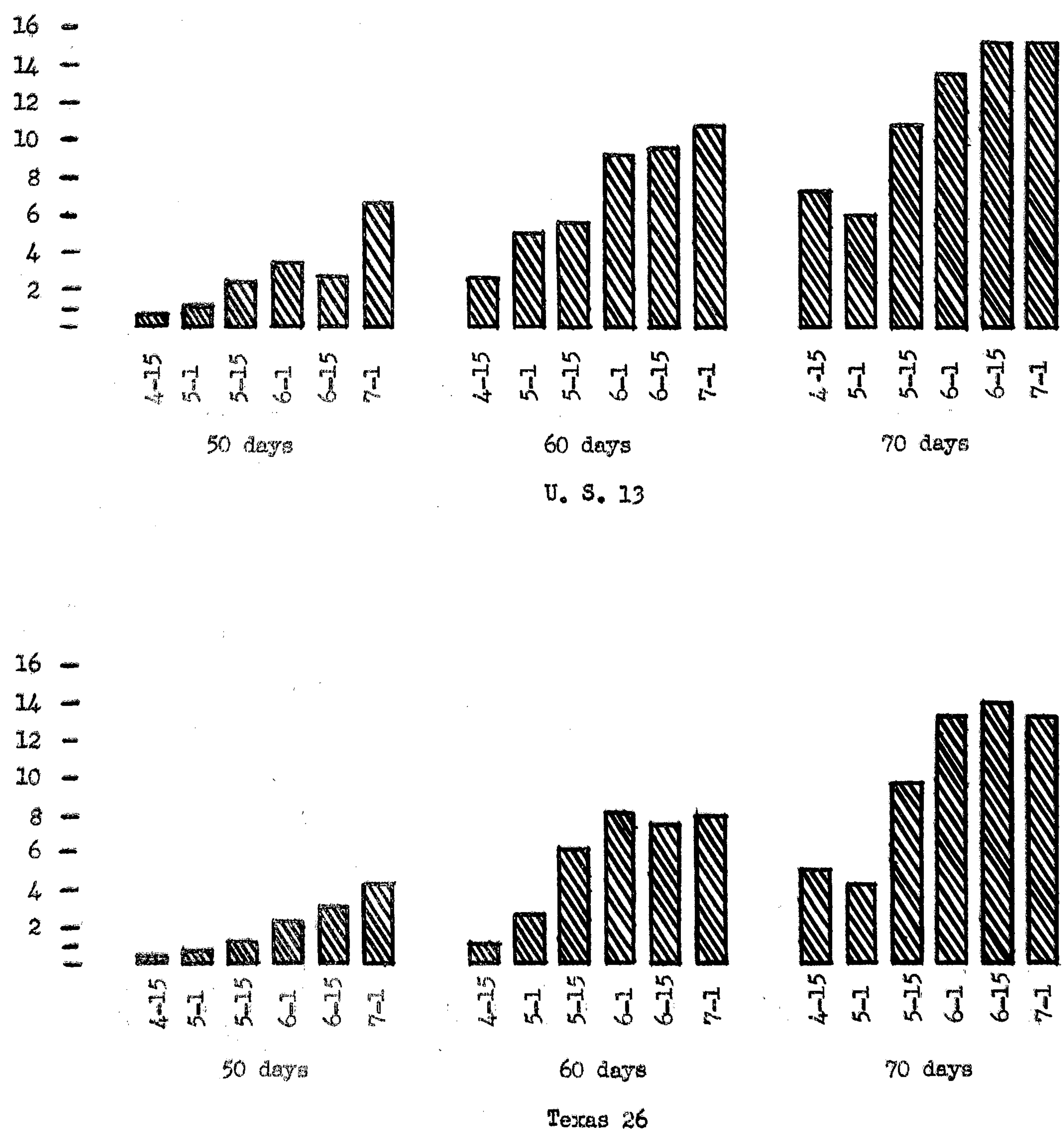
1951

Planting date	U. S. 13 Days from planting 50	60	70	Texas 26 Days from planting 50	60	70
4-15	0.5	2.5	8.0	0.2	0.9	5.1
5-1	0.9	8.2	9.9	0.6	3.3	6.8
5-15	3.6	9.1	12.0	1.4	8.3	11.0
6-1	5.5	14.3	16.5	2.9	12.5	14.2
6-15	1.0	6.0	12.2	1.0	3.0	8.1
7-1	9.7	15.0	19.3	6.9	10.5	16.4

1952

Planting date	U. S. 13 Days from planting 50	60	70	Texas 26 Days from planting 50	60	70
4-15	0.7	2.5	6.4	0.5	1.2	5.2
5-1	1.1	1.8	2.1	0.7	1.9	1.9
5-15	1.1	2.1	9.6	1.2	4.0	8.4
6-1	1.2	4.0	10.4	1.7	3.6	12.3
6-15	4.4	13.5	17.9	4.4	11.9	20.0
7-1	3.4	5.5	10.8	1.5	5.3	10.2

Figure 3.—Average ear length in centimeters 50, 60, and 70 days from planting.



The averages presented in Table 4 are for two measurements from each of four replications taken at 50, 60, and 70 days from planting for each of the six planting dates. From these averages it can be seen that the ears of both varieties made less growth in 1952 than was attained the previous year. The smaller growth in 1952 has contributed to greater similarity between the two varieties and probably explains the non-significant mean squares for varieties in 1952. The ears of both varieties made more growth in 60 days in 1951 than was made in 70 days in 1952, indicating that an unfavorable season during early developmental stages might reduce yield by limiting early ear development

These 1951 and 1952 averages were combined to show the growth trend in the graphs presented in Figure 3.

As the plantings are delayed ear development proceeds at a faster rate. Just as in the stem length, U. S. 13 starts ear development earlier and grows at a slightly faster rate than Texas 26.

Tassel Length

1951 Data

The analysis of variance for tassel length is shown in Table 5. Planting dates for the 1951 data showed significant mean squares for 40, 50, and 60 days from planting indicating the tassel growth was different for the different planting dates.

Since the variety mean squares show significance at all three sampling dates, it seems evident that the tassels of one variety grew at a more rapid rate than the tassels of the other variety.

The varieties grew at different rates at the different planting dates for 40 and 60 days from planting since the mean squares for varieties x dates interaction are significant at these periods. No significance was shown at 50 days from planting.

1952 Data

For the 1952 data the significant mean squares obtained for planting dates indicate as above that the tassel growth of the two varieties was not the same for the different planting dates.

The significant varieties mean squares at 40 and 50 days from planting indicate that the tassel growth of one variety was greater than for the other varieties at these periods. No significance was shown for 60 days from planting.

The interaction varieties x dates shows significant mean squares at 40 and 50 days indicating the tassel growth of the two varieties was not the same at the different planting dates. The mean square for 60 days was not significant.

The two-year average tassel length for the six planting dates at 40, 50, and 60 days from planting are shown in the graphs in Figure 4.

It is evident from these graphs, and the data presented in Table 6 that the July 1 planting makes the earliest growth, especially in the case of U. S. 13. As in the case of stem length and ear length the later plantings grow more rapidly. There is some indication of more uniform growth rates at the June 15 and later planting dates.

Table 5.—Analysis of variance for tassel length 40, 50, and 60 days from planting.

1951

Source of variation	d.f.	Days from planting 40	50	60
		Mean square		
Total	95	122.53	265.03	967.15
Replications	3	5.54	66.23	12.19
Planting dates	5	1,143.38**	3,749.64**	833.99**
Error A	15	25.07	112.08	68.31
Plots of dates	23	265.63	8,968.72	227.44
Varieties	1	2,345.31**	414.59*	682.13**
Varieties x dates	5	515.81**	134.81	283.37**
Error B	66	15.14	80.92	44.24

1952

Source of variation	d.f.	Days from planting 40	50	60
		Mean square		
Total	95	28.08	181.55	129.13
Replications	3	9.90	6.78	83.05
Planting dates	5	211.07**	2,609.42**	1,000.80**
Error A	15	20.24	60.79	189.70
Plots of dates	23	60.38	607.80	352.12
Varieties	1	144.79**	331.89**	141.13
Varieties x dates	5	90.38**	91.27**	185.97
Error B	66	15.38	5.17	93.82

* Significant difference at 5% level
** Significant difference at 1% level

Table 6.—Average tassel length in centimeters at 40, 50, and 60 days from planting.

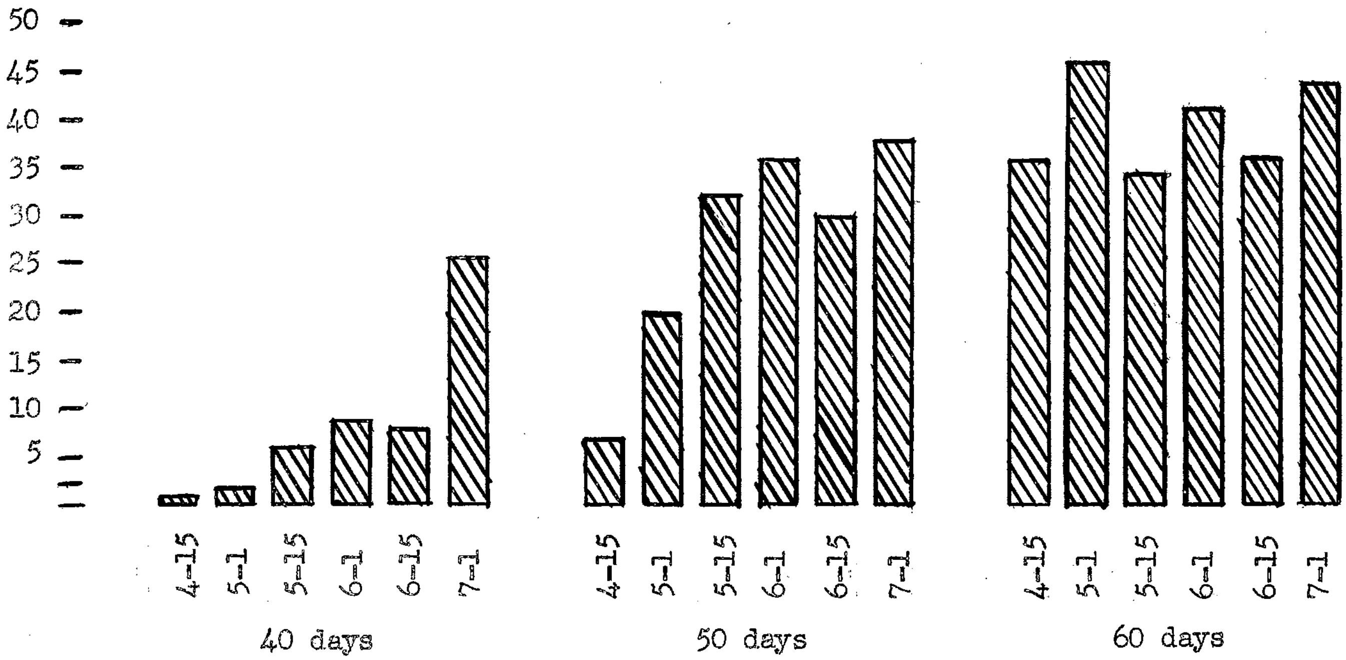
1951

Planting date	U. S. 13 Days from planting 40	50	60	Texas 26 Days from planting 40	50	60
4-15	0.4	8.6	38.6	0.3	0.9	21.6
5-1	0.9	18.5	56.3	0.5	6.0	41.6
5-15	11.7	40.8	34.6	1.6	35.7	43.2
6-1	15.7	45.2	42.7	4.0	38.2	39.9
6-15	8.9	20.4	30.8	3.5	19.6	32.3
7-1	35.1	38.8	41.3	7.8	38.9	42.6

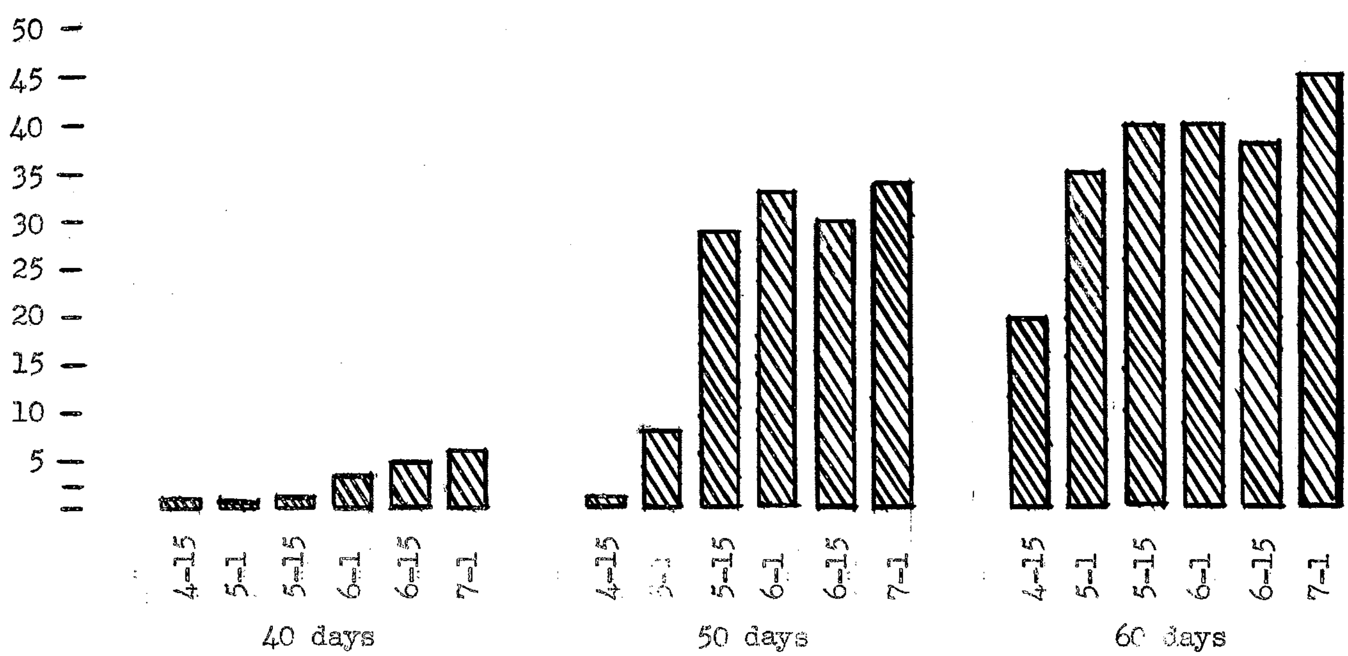
1952

Planting date	U. S. 13 Days from planting 40	50	60	Texas 26 Days from planting 40	50	60
4-15	1.3	5.2	32.1	0.7	1.1	17.7
5-1	2.0	20.9	34.5	0.7	10.6	27.8
5-15	1.2	23.6	34.0	0.8	21.3	35.3
6-1	1.2	25.9	39.5	2.7	27.9	40.0
6-15	7.2	39.4	40.9	5.3	39.8	44.1
7-1	15.7	36.0	45.8	3.8	27.9	47.3

Figure 4.—Average tassel length in centimeters 40, 50, and 60 days from planting.



U. S. 13



Texas 26

SUMMARY AND CONCLUSIONS

A study of the variation in rate of development of an early and late maturing hybrid corn at six different planting dates was conducted on creek bottom land two and one-half miles east of Stillwater, Oklahoma in 1951 and 1952. A total of 960 plants were used in this study.

Significant mean squares were obtained for planting dates at all sampling intervals for stem length, tassel length, and with one exception, ear length.

The two-year graphs and the analyses of variance show that as planting is delayed growth rates increase for all three characters studied.

The early variety, U. S. 13, began stem growth at a faster rate, and started ear and tassel initiation earlier than the late variety, Texas 26.

From the evidence presented here, it appears that a late maturing corn will develop almost as rapidly as an early maturing corn when planted at the later planting dates.

Since the 1951 and 1952 growing seasons were quite different in so far as favorable growing seasons were concerned, it is evident that extreme weather conditions can affect the pattern of growth of both early and late varieties of corn at all planting dates.

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