THE EFFECT OF PLANTING DATE AND ROW WIDTH ON THREE SOYBEAN VARIETIES

by

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INTRODUCTION

Soybean production in Kansas is of recent origin and has been accomplished with the use of machinery designed for other purposes, including planting, cultivating, and harvesting. In the early history of soybean production in Kansas most of the acreage was planted with a 40 inch horse drawn planter. Utilization of corn planting and cultivating equipment was used extensively in the production of soybeans.

In Kansas, soybeans have become the fourth major cash crop with 832,000 acres planted in 1963.

Since the introduction of chemical weed control and the practice of double cropping, farmers are seeking information on how to obtain maximum yields. They are especially interested in obtaining information on optimum planting dates and row widths.

The performance of soybeans when planted at different dates and row widths has not been investigated thoroughly in Kansas. There is no information on how the planting date or row width affected the individual soybean plant.

Information may be obtained from studies in other areas of the United States; however, those investigations used different varieties of soybeans than those planted in Kansas and they were not grown under Kansas conditions.

This study reports the investigation made of the influence of row widths and planting dates on seed yield and other plant characters of Shelby, Clark, and Kent soybeans.

REVIEW OF LITERATURE

Many investigations with soybeans have shown that variations in planting dates may not only affect yield but other plant characters as well.

Burlison et al (4) obtained highest soybean yields from May 20 plantings at Urbana, Illinois. However, yields of grain were higher where the soybeans were seeded in rows 24 inches apart, than where they were drilled solid.

Weiss et al (21) found the earliest variety did not differ significantly at various planting dates while yields of the latest variety decreased progressively with planting dates subsequent to May 1. They reported maturity of genetically early varieties was retarded more by delay in planting than the later varieties. Their results indicated no significant effect of planting date on lodging. Maximum plant height was at the second date of planting (May 12).

Other workers (16) found that a delay in planting was associated with a greater degree of lodging. They also found that the maturity date of later maturing varieties was affected less by delay in planting than was that of the earlier varieties. The maximum height of plants was attained at the first date (May 1) and decreased progressively with delay in planting. Their results also indicated seed weight was not appreciably affected by delay in planting, although there was a difference between varieties in this respect.

Several workers who have made previous studies (3, 16, 21) indicate that generally early plantings gave greatest seed yields. Feaster (8) found early varieties should be planted later than late varieties for highest yields, whereas, Weiss et al (21) found no significant differences for yield among planting dates of early varieties. A study by Torrie and Briggs (18) indicated planting date had little effect on the yield of early varieties, whereas, the yield of late varieties tend to decrease with plantings made after May 20.

Some basic research has been conducted to try to determine how day-length effects the soybean plant.

Four soybean varieties were studied by Garner and Allard (9). In greenhouse experiments in which the varieties were exposed to light periods ranging from 5 to 15 hours, they observed that when the daily illumination consisted of a single exposure of 12 hours or less, the length of the growing period from germination to blooming was only slightly shortened in the early variety; however, the shortening effect was proportionally greater for the genetically later varieties. In a later field study by these same workers (1), they obtained pronounced differences in the responses of the early and late varieties to changes in day length. They concluded under field conditions the differences in the responses of the early and late varieties with respect to time of flowering were largely due to the length of day. The variations in time from year to year appeared to be closely correlated with yearly variations in the prevailing temperatures.

Borthwick and Parker (2) concluded that certain soybean varieties initiated flowers only when subjected to short photoperiods, while others initiated flower primordia even though the plants received continuous illumination.

A study in Canada by Brown and Owen (3) showed that it was not the critical photoperiod, but the increase in night length as the season progresses which promotes maturity of late planted soybeans. They reported the real reason soybeans can be planted late is because flowers and pods develop over an extended period, sometimes a month or more, and the seeds in the pods ripen in the order the pods were initiated. Therefore, a frost will not destroy a crop completely and some seed can be harvested.

The between-row spacing of soybeans can have an effect on not only the yield but the yield components of the plant itself.

Several workers (5, 10, 22) report increases in seed yield as spacing between intertilled rows was decreased. However, in comparing intertilled rows with drilled plantings, Burlison et al (4), Mc Clelland (15) and Zahnley (23) obtained smaller yields from drilled plantings. However, Wiggans (22) found yields increased as distance between rows decreased, even in drill plantings.

All varieties do not seem to respond the same way. Probst (17) used four varieties at different spacings within the row, and reported they did not react in the same manner. The thicker stand did not mean the highest yields in some varieties. He also reported that spacing generally had little effect on seed size. His data also showed that varieties which were classed as susceptible to lodging when the plants were closely spaced may appear to be resistant to lodging when spaced farther apart. The distance between plants had little influence on the height of the plants. However, the plants spaced 5 inches apart were shorter than those spaced more closely. Probst (17) also reported plants spaced 2 to 5 inches apart matured earlier than those spaced 1 - inch in each variety.

Hanway (10) and Weber and Weiss (19) found branching increased as space between plants increased and Burlison et al (2) showed a decrease in the number of pods per plant as both spacing between row and spacing within row were narrowed.

Seed yields tended to be higher at the narrow spacing between rows according to Lehman and Lambert (13). The effects of spacing within the row were variable.

All four components of yield were affected to some degree by spacing. However, seed and pod numbers were affected more than seed weight and seeds per pod. The relative importance of branches varied with spacing for seed and pod numbers but had little or no effect on seed weight and seeds per pod according to Lehman and Lambert (13). A reduction in yield, resulting from delayed planting, caused by a reduction in the number of seeds produced, rather than by a decrease in seed size was reported by Dimmock and Warren (7).

Leffel and Barber (12) concluded that by increasing seeding rates, seed yields were decreased, plant maturity was delayed and plant lodging was increased. Row widths had greatest effects upon seed yield and plant height and both characters were maximum at a row width of two feet.

It is the consensus, based on reports of research in the north central and southern soybean-producing states, the importance of row spacing diminishes from north to south. Narrower rows may favor increased production in the South with late plantings. Full season plantings in the South, however, have shown no advantages of narrow rows over rows spaced 36 to 40 inches apart. Hartwig (11) reported optimum planting date for the southern states appears to be the date when the minimum soil temperature attains 65 degrees Fahrenheit and after the day length reaches or exceeds $14\frac{1}{2}$ hours.

Hail may inflict damage to soybeans at any stage of development. Investigations were conducted by Weiss (20) with simulated hail damage on soybeans.

Reduction in stand which occurs when some plants fail to recover from hail damage, was found to reduce yield in progressively greater amounts when inflicted at successively later stages of plant growth (Weiss 20). Little effect on date of maturity or plant height was apparent. Defoliation was found to reduce yield only slightly when inflicted prior to blooming. However, Weiss (20) stated that up to 83 percent reduction occurred with removal of all leaves during the critical stage when seed was developing in the lower pods. Seed size was reduced by defoliation during the seed developmental stage.

MATERIALS AND METHODS

The purpose of this study was to ascertain the effect of planting date and row width on yield components and other factors of Kent, Clark, and Shelby soybean varieties.

The field test was conducted at the Kansas State University Agronomy Farm at Manhattan, Kansas during the summer of 1964. The experiment was located on a well drained, moderately dark colored, medium textured bottomland soil of the Hobbs silt loam series. The subsoil texture and color of the azonal soil was variable. The slope was less than one percent. The A and AB horizons are greater than 12 inches in thickness. Soil test data for the location is given in Table 1.

Table 1. Soil test information for Agronomy Farm, 1964.

Location	Soil Type	Organic Matter %	pH	Available Phosphorus pounds/acre	Exchangeable Potassium pounds/acre
Agronomy Farm	Silt Loam	2.4	5.7	28	424

The arrangement of the experiment was a split-split-plot design, each treatment being replicated four times, with dates of planting as whole plots, row widths as sub-plots, and varieties as sub-sub plots.

Three soybean varieties commonly grown in Kansas were used. Shelby, Clark and Kent soybeans represented early maturing, intermediate maturing, and late maturing varieties, respectively. Row widths of 20, 30, and 40 inches were used. Plantings were made on the following four dates: May 9, May 18, June 9, and June 25.

Before planting a germination test of the seed was obtained and each row had the number of viable seed necessary for plants to be spaced approximately 1-inch apart. Weeds were controlled by hoeing. The seed was not inoculated with Rhizobium and the plots were not fertilized.

Moisture was supplied only be rainfall; thus, the plants were under stress during the latter part of July and most of the month of August. The plantings made May 9 and May 18 suffered severe damage during a hail and wind storm on July 3.

The variety plots consisted of 6 rows 16 feet long of the 20 inch row spacing and 4 rows 16 feet long of the 30 and 40 inch row spacing. The middle two rows of the 30 and 40 inch rows and the middle four rows of the 20 inch rows was harvested for yield. The remaining rows served as the source of plants for the individual plant study.

Data taken from the plants in the field consisted of: blooming date, maturity date, plant height and lodging.

Characters were evaluated in the following manner:

Blooming Date. Number of days from planting until the first flowers appeared on all of the plants in that variety.

Maturity Date. Number of days from planting until most of the leaves had dropped and 90 to 100 percent of the pods had ripened, as evidenced by their brown, dry appearance.

Height. The distance in inches from the ground level to the top of the mature plants.

Lodging score. Determined at maturity by assigning a score to each variety plot as follows:

1. All plants erect.
2. All plants leaning slightly or a few plants lodged badly.
3. All plants leaning moderately or approximately 25 percent badly lodged.
4. All plants leaning more than 45 percent from vertical or more than 50 percent lodged badly.
5. All plants nearly prostrate.

The plots were harvested when mature and threshed with an experimental plot thresher. Seed yield, seed size, and seed quality were measured after harvest.

Characters were evaluated in the following manner:

Seed Yield. Air-dried, threshed plot weights converted from grams to bushels per acre.

<u>Seed Size</u>. Weight of 100 whole seeds to the nearest 1/10 of a gram. The 100 seeds were taken from a composite sample of all replications.

<u>Seed Quality</u>. Rated on a scale of 1 to 5, with 1 being very good and 5 very poor. Characteristics considered in estimating seed quality were seed development, purple seed stain and other factors such as ground damage, mottled seed coat and immature beans.

Fifteen plants were collected at random from each variety in each row width at each of the four planting dates. The plants were removed at the ground level and were taken into the laboratory for individual plant study. Data were collected from each plant as to the following characteristics: height, number of nodes, total pod number, total seed number, number of branches from main stem, height to first pod or branch and average number of seeds per pod.

Yield was the only variable that was subjected to an analysis of variance. This was done by the Statistics Department at Kansas State University. When the analysis of variance showed a significant F value, the treatment differences were measured by the L.S.D. (Least Significant Difference) procedure at the 0.05 level of probability.

TEMPERATURE AND PRECIPITATION

Daily precipitation and temperature figures are presented in the Appendix Tables II-III.

Climatic conditions were not favorable for optimum plant growth. In this area one must expect extreme weather conditions, and 1964 was no exception. Above average rainfall in April made it impossible to plant on the intended planting date and harvest operations were hindered by excessive rainfall during parts of November.

Rainfall was below normal during the period of maximum plant growth. The period May through October was characterized by a rainfall deficit of 7.19 inches. This put severe stress on the plants during the growing season (Appendix Table II).

During the time of low rainfall in July and August the temperatures were relatively high. From July 15 through August 7 the maximum daytime temperature was 95 degrees or higher. The highest temperature was 106 degrees on July 23.

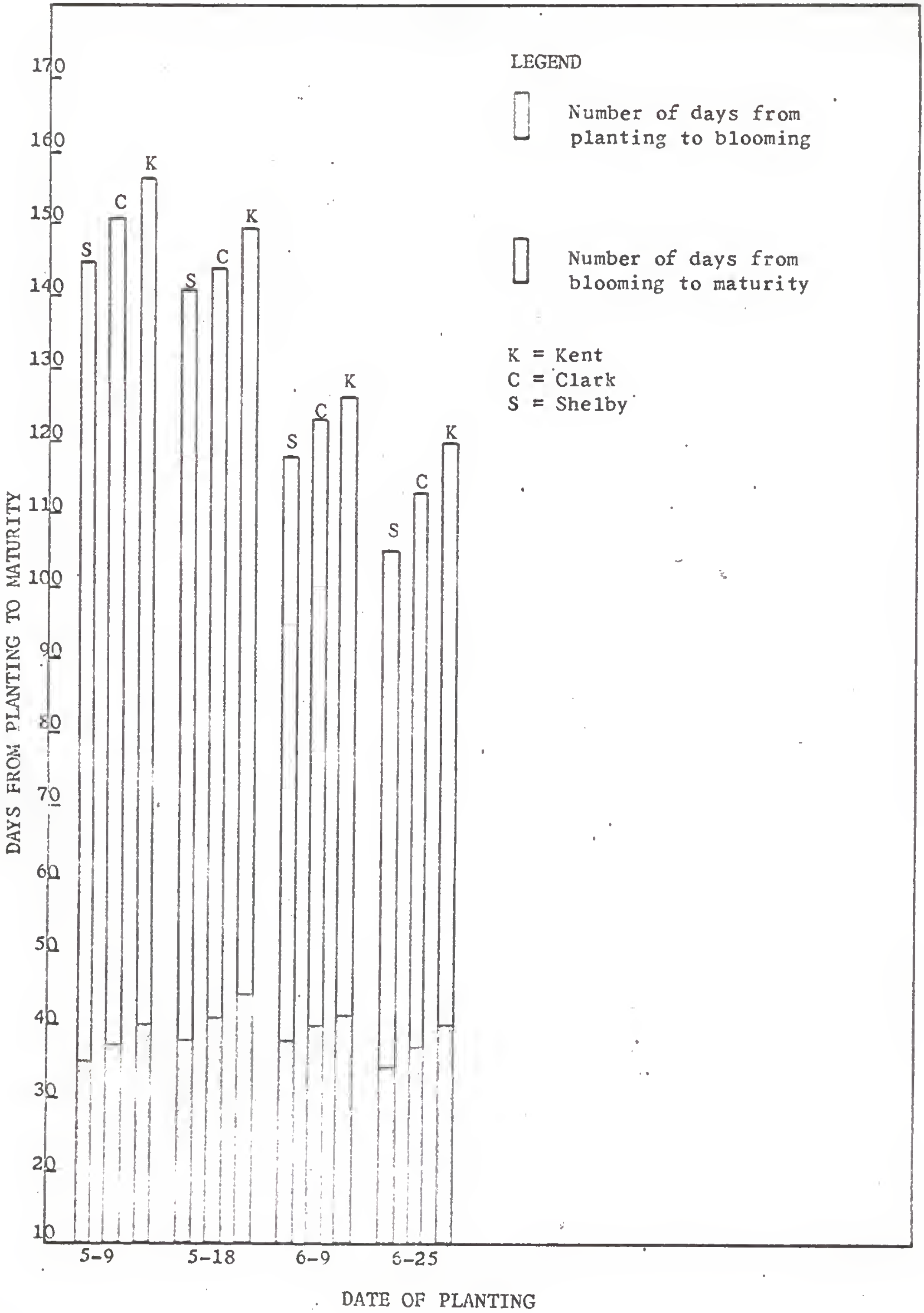
The first two planting dates suffered severe damage from rain and a hail that occurred on July 3. The two later plantings received only slight damage.

RESULTS AND DISCUSSIONS

The experimental results deal with the influence of row width and planting date on seed yield, plant maturity, plant height, seed size, and other yield components of the soybean plant. The results are broken into headings to present more clearly the information obtained from the investigation.

Plant Maturity. The length of time required for a plant to mature was not affected by row width. Shelby matured in 145 days, Clark in 151 days and Kent in 157 days when planted May 9 (fig. 1). In the June 25 planting, Shelby matured in 105 days, Clark in 113 days, and Kent in 115 days. Plantings made 48 days later delayed the time required for the plants to reach maturity for Shelby, Clark, and Kent by 40, 38 and

Figure 1. Influence of planting date on blooming and maturity for three soybean varieties at Manhattan, Kansas, 1964.

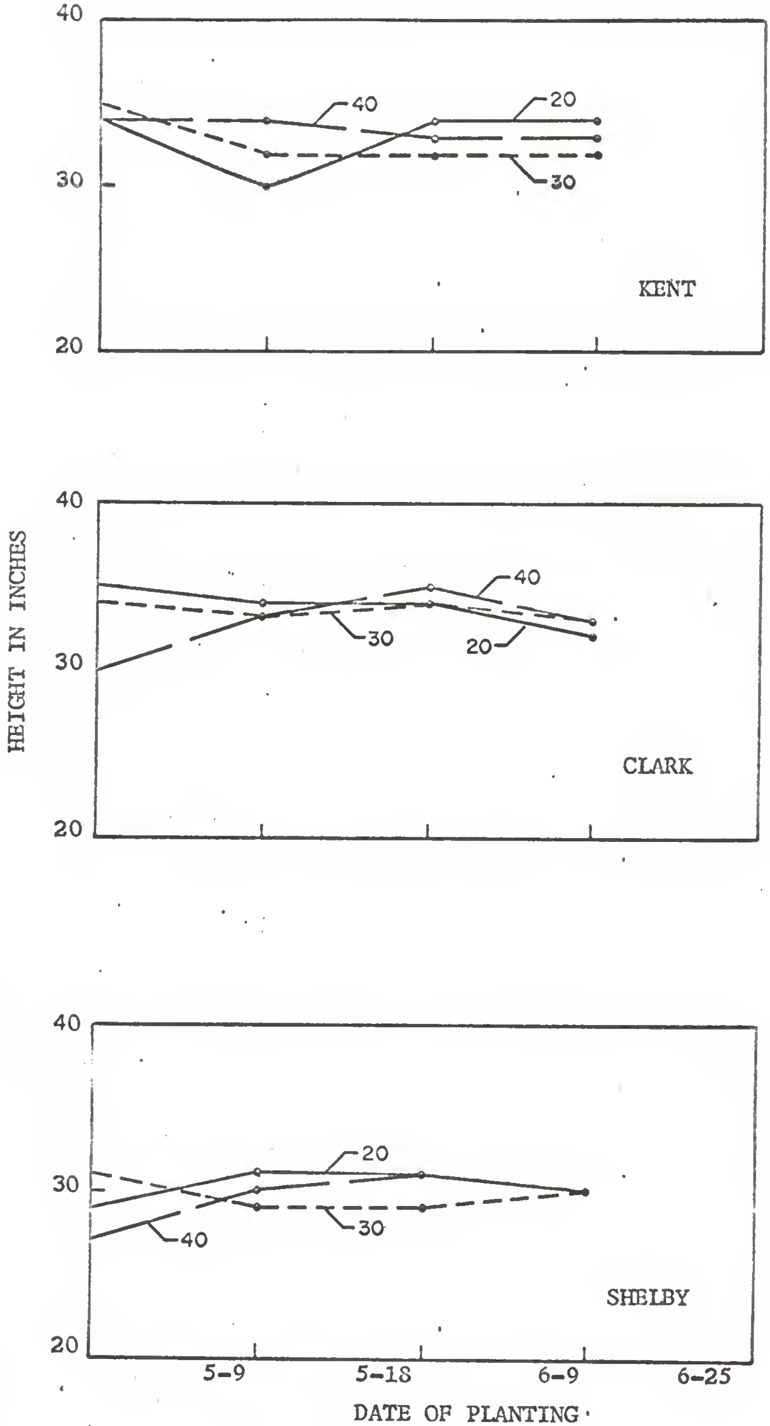

LEGEND
Number of days from planting to blooming
Number of days from blooming to maturity
K = Kent
C = Clark
S = Shelby
DAYS FROM PLANTING TO MATURITY
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
S
C
K
5-9
5-18
6-9
6-25
DATE OF PLANTING

42 days respectively (fig. 1). Delayed planting appeared to hasten the maturity of Clark and Shelby more than Kent. Plantings made May 18 and June 9 responded like the early and late plantings, and maturity was in the same order as they were planted. Kent required the longest period to reach maturity and Shelby matured in the shortest time in all dates of planting. This trend was more pronounced in the early and late plantings (fig. 1). A spread of 13 days existed between the maturity of Shelby and Kent in the May 9 planting, whereas plantings on June 25 showed a difference of 10 days between the same two varieties. Plantings made May 18 and June 9 showed a difference in the maturity of Shelby and Kent by 8 days.

Blooming Date. Row width appeared to have no appreciable influence on the time of flowering for any variety of the same date. There was a trend when the varieties were compared among all dates (fig. 1). Soybeans planted on May 18 required the longest time to initiate flowers, Shelby bloomed in 39 days: Clark in 41 and Kent in 44 days. In the June 25 planting, Shelby, Clark and Kent bloomed in 34, 37, and 40 days respectively (fig. 1). May 9 and June 25 plantings were similar in the time required for the varieties to bloom. This agrees with other workers (1, 2, 9) who found early and late plantings required less time to bloom than those planted at an intermediate date. They concluded the period of time from planting to blooming was regulated by daylength.

Plant Height. Apparently row width and planting date had some influence on plant height. The 40 inch row spacing of Shelby and Clark produced the shortest plants in the May 9 planting (fig. 2). However, in the June 9 planting the plants in 40 inch rows were the tallest in Shelby and Clark. Kent in the 20 inch rows appeared to have the most fluctuation

Figure 2. Influence of planting date and row width on the average height of three soybean varieties at Manhattan, Kansas, 1964.


40
30
20
40
20
30
KENT
HEIGHT IN INCHES
40
30
20
40
30
20
CLARK
40
30
20
20
40
30
SHELBY
5-9
5-18
6-9
6-25
DATE OF PLANTING

in height. They were tallest in the May 9 and shortest in the May 18 plantings. Plants in the 30 inch row spacing were tallest when planted May 9 for all varieties and plant height decreased or stayed the same in all other dates.

Seed Yield.

Yield as affected by row width

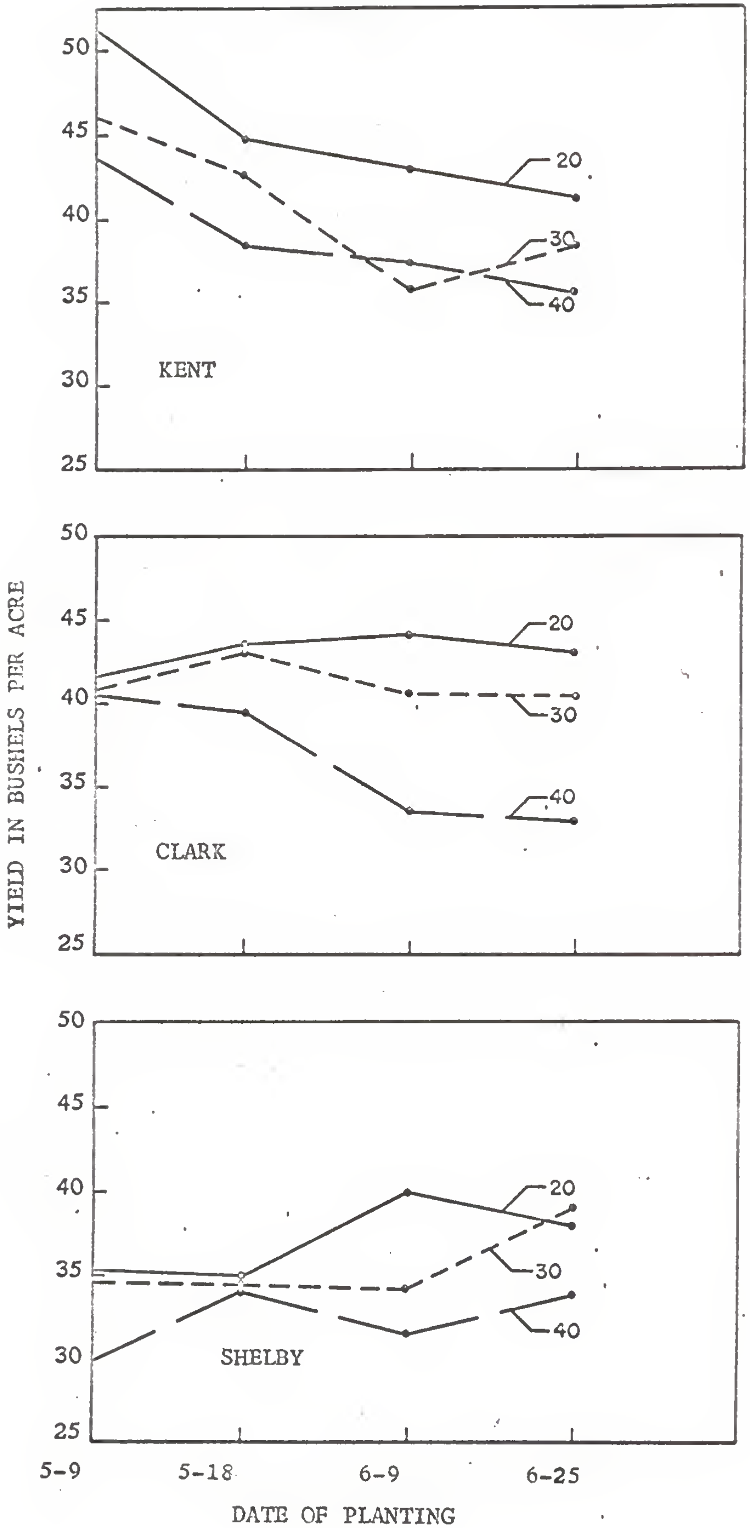
Yields obtained from all plots planted in the different row widths were significant at the 0.05 level of probability (Appendix Table 1). When yields are averaged for all varieties and all dates, plantings made in 20 inch rows produced higher yields than those planted in 30 inch rows and the 30 inch row widths produced higher yields than those made in the 40 inch row spacing. (Table 2). This fact not only held true for the average of the four planting dates but was also true for each individual date of planting and variety (fig. 3). It appears that the advantage of planting in 20 inch row spacing is greatest in the later planting dates (Table 2).

Shelby produced 21.1 percent (8.4 bushels/acre) more in the 20 inch rows than the 40 inch row spacing when planted June 9 (Table 4). Clark, planted June 9, produced 24.1 percent (10.6 bushels/acre) more in the 20 inch rows. However, Kent showed its highest increase in the 20 inch rows over the 40 inch row spacing from the May 9 planting date where it produced 14.6 percent (7.5 bushels/acre) more in the 20 inch rows than in the 40 inch row spacing.

Yield as affected by planting date

Analysis of variance of the yield factor showed no significant difference between dates of planting (Appendix Table 1). However, as one looks at the yields, it becomes apparent how this may have occurred (Table

Figure 3. Influence of planting date and row width on the average yield of three soybean varieties at Manhattan, Kansas, 1964.



50
45
40
35
30
25
20
30
40
KENT
YIELD IN BUSHELS PER ACRE
CLARK
SHELBY
5-9
5-18
6-9
6-25
DATE OF PLANTING

Table 2. Mean seed yield (bushels per acre), row width x planting date 1964.

Row width (inches)	DATE of PLANTING*				MEAN***
	May 9	May 18	June 9	June 25	
20	42.7a**	41.0a	42.3a	40.9a	41.7a
30	40.4a	40.1a	36.9b	39.3a	39.2b
40	37.9b	37.3b	34.1b	34.1b	35.9c
Mean	40.4	39.5	37.8	38.3	

* Any two means within a date followed by the same letter are not significantly different at the 0.05 level.
** L.S.D. for comparison of 2 row width means at the same date (5%)= 3.3 bu.
*** L.S.D. for comparison of 2 row width means (5%)= 1.7 bu.

Table 3. Mean seed yield (bushels per acre) planting date x variety 1964.

Variety	Date of Planting*				Mean***
	May 9	May 18	June 9	June 25	
Shelby	33.2a**	34.7a	35.2a	37.0a	35.0a
Clark	40.9b	41.9b	39.3b	38.9a	40.3b
Kent	47.0c	41.9b	38.8b	38.4a	41.5b
Mean	40.4	39.5	37.8	38.1	

* Any two means within the same date followed by the same letter are not significantly different at the 0.05 level.
** L.S.D. for comparison of 2 variety means at the same date (5%)= 3.1 bu.
*** L.S.D. for comparison of 2 variety means (5%)= 1.3 bu.

3). When the row widths are average for each variety, Shelby produced its lowest yield (33.2 bushels/acre) on May 9. The yield of Shelby increased progressively through the June 25 planting date where 37.0 bushels per acre were produced. Kent, on the other hand produced its highest yield (47.0 bushels per acre) on May 9 and progressively decreased through the June 25 and 38.4 bushels per acre was produced. The yield of Clark changed only slightly from one planting date to another. The highest yield (41.9 bushels per acre) was produced from the May 18 date of planting. The lowest yield (38.9 bushels per acre) was produced from the June 25 date of planting.

Yield as affected by variety

The analysis of variance of the yield showed a significant difference between varieties (Appendix Table 1). When yields are averaged for all row widths and planting dates, Shelby produced less than Clark and Clark produced a lower yield than Kent (Table 3).

Shelby consistently produced the lowest yield in all dates and row width when compared to Clark or Kent (Table 4).

Clark and Kent are not as consistent in their ranking among planting dates. Plantings made May 9 have Kent producing 6.1 bushels per acre more than Clark. However, in the May 18 planting the yields for both varieties average to be the same. The two later planting dates show a slightly higher yield for Clark than Kent. However, this difference is less than 1 bushel per acre when the 3 row width are averaged together. Clark produced slightly more in the 20 and 30 inch row spacings and Kent produced more yield in the 40 inch row spacing when planted June 9 and June 25. (Table 4)

Table 4. Yield averages, planting date, x row width, x variety. 1964.

Variety	Row width (in.)	Date of Planting: May 9	May 18	June 9	June 25	Average
Shelby	20	35.3	34.9	39.9	38.3	37.1
	30	34.7	34.7	34.3	39.0	35.7
	40	29.5	34.4	31.5	33.8	32.3
Average		33.2	34.7	35.2	37.0	
Clark	20	41.7	43.4	44.0	43.1	43.1
	30	40.5	43.0	40.6	40.5	41.2
	40	40.5	39.5	33.4	33.0	36.6
Average		40.9	41.9	39.3	38.9	
Kent	20	51.2	44.6	42.9	41.3	45.0
	30	46.1	42.7	35.9	38.5	40.8
	40	43.7	38.5	37.5	35.5	38.8
Average		47.0	41.9	38.8	38.4	

Yield Correlations.

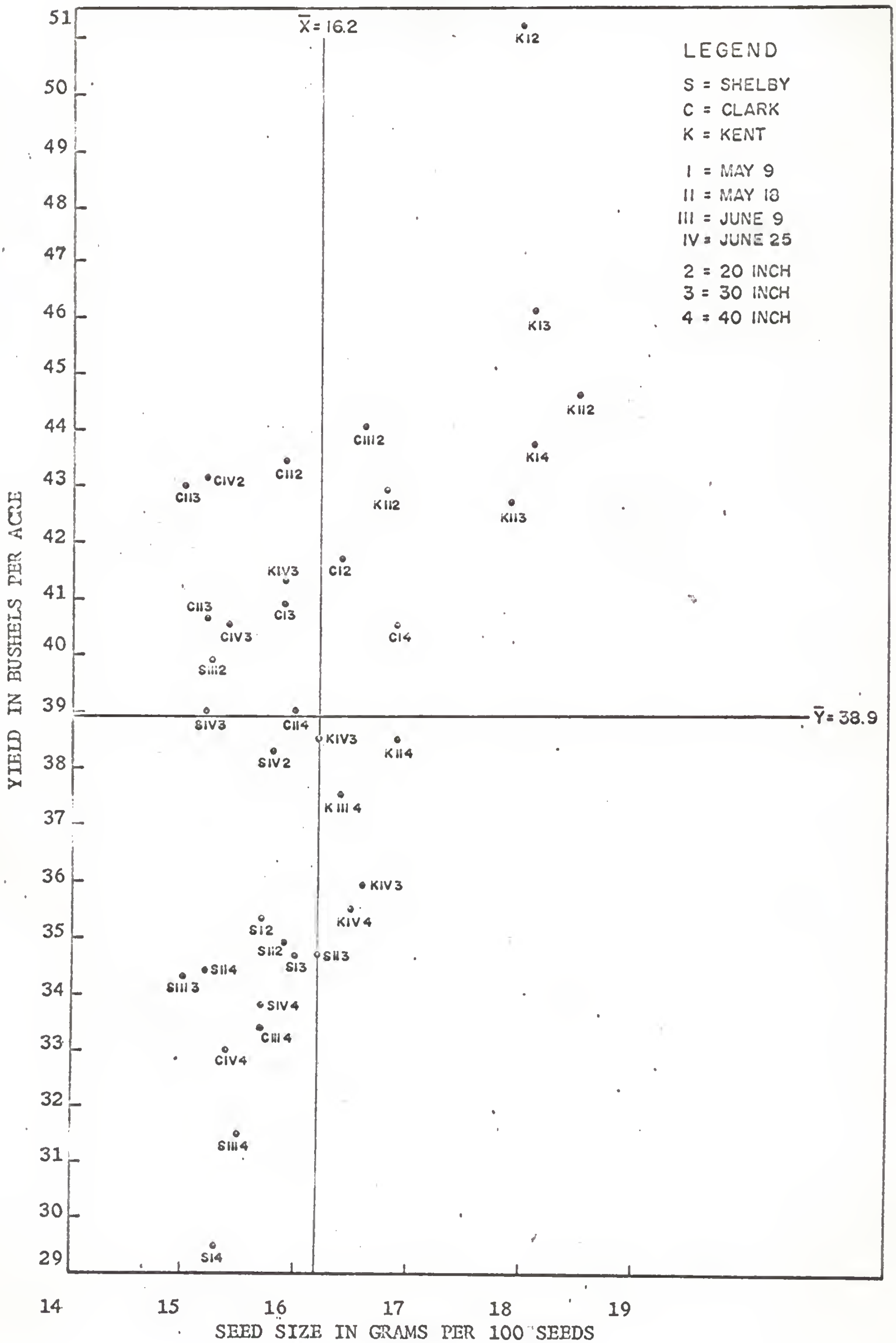
Seed size versus yield

A correlation between seed size and yield gave a significant correlation coefficient of $+0.87$. Shelby produced the lowest yield and smallest seed, whereas Kent produced the highest yields and the largest seeds (fig. 4). There appeared to be little effect due to row width. However, date of planting shows a trend, as the seed from plantings made June 25 and June 9 produced smaller than average seed. This too appears to be due to dry and hot weather during their podding stage of growth.

Plant height versus yield

The second correlation was made between plant height and yield. The correlation coefficient gave a significant value of $+0.65$. Shelby produced

Figure 4. The yield of three soybean varieties as affected by seed size, Manhattan, Kansas, 1964.



X̄ = 16.2
Ȳ = 38.9
LEGEND
S = SHELBY
C = CLARK
K = KENT
I = MAY 9
II = MAY 18
III = JUNE 9
IV = JUNE 25
2 = 20 INCH
3 = 30 INCH
4 = 40 INCH
KI2
KI3
KII2
KI4
KII3
CIII2
CII2
CIV2
CII3
KII2
KIV3
CI2
CII3
CI3
CIV3
CI4
SIII2
SIV3
CII4
KIV3
KII4
SIV2
K III 4
KIV3
KIV4
SI2
SII2
SI3
SII3
SII4
SIII3
SIV4
CIII4
CIV4
SIII4
SI4
YIELD IN BUSHELS PER ACRE
SEED SIZE IN GRAMS PER 100 SEEDS

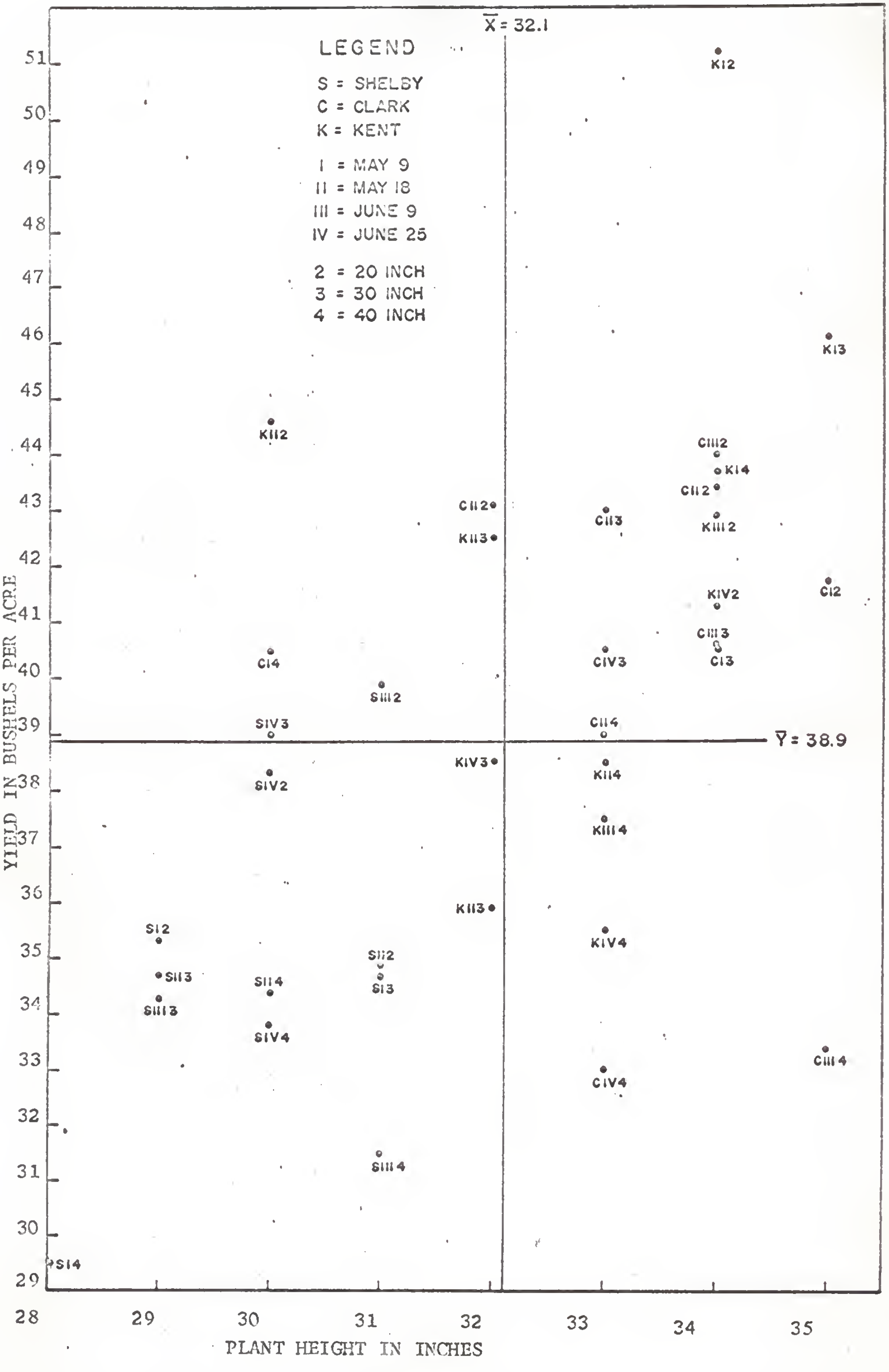
the shortest plants as well as the lowest yields whereas, Kent and Clark are both tall and produce higher yields (fig. 5). The plants in the 40 inch row spacing produced the lowest yields as was shown with the Analysis of Variance. Plant height is not only determined by variety but environmental factors play a big role.

Height to First Pod. Row spacing affected placement of the first pods on a variety to some degree. The 20 inch row spacing had plants with the first pods higher from the ground than plants in the 30 inch row spacing and the plants in the 30 inch row spacing had pods higher from the ground than did the plants in the 40 inch spacing (Table 4). This appears to be due to the competition for light associated with spacing. The greater number of plants per unit area caused the plants to pod higher on the stem. Kent appeared to be consistently higher in its placement of pods above the surface of the ground. Clark and Shelby were approximately the same for a given row width. This may be due to a genetic characteristic. Date of planting had no effect as to the placement of the first pod above the ground.

Table 4. Comparison of plant characters among row width and varieties.

	Kent			Clark			Shelby		
	20	30	40	20	30	40	20	30	40
Height to first pod in inches	4.4	3.8	2.8	2.9	2.4	1.8	2.9	2.3	1.5
Number of branches per plant	0.9	2.9	3.4	0.7	1.3	2.1	0.5	1.2	1.5

Figure 5. The yield of three soybean varieties as affected by plant height in Manhattan, Kansas, 1964.


LEGEND
S = SHELBY
C = CLARK
K = KENT
I = MAY 9
II = MAY 18
III = JUNE 9
IV = JUNE 25
2 = 20 INCH
3 = 30 INCH
4 = 40 INCH
X̄ = 32.1
Ȳ = 38.9
YIELD IN BUSHELS PER ACRE
PLANT HEIGHT IN INCHES
KI2
KI3
KII2
CIII2
KI4
CII2
CII3
KIII2
KII3
CI2
KIV2
CIII3
CI3
CI4
CIV3
SIII2
SIV3
CII4
KIV3
KII4
SIV2
KIII4
KII3
SI2
KIV4
SII2
SII3
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SII4
SIII3
SIV4
CIII4
CIV4
SIII4
SI4
28
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43
42
41
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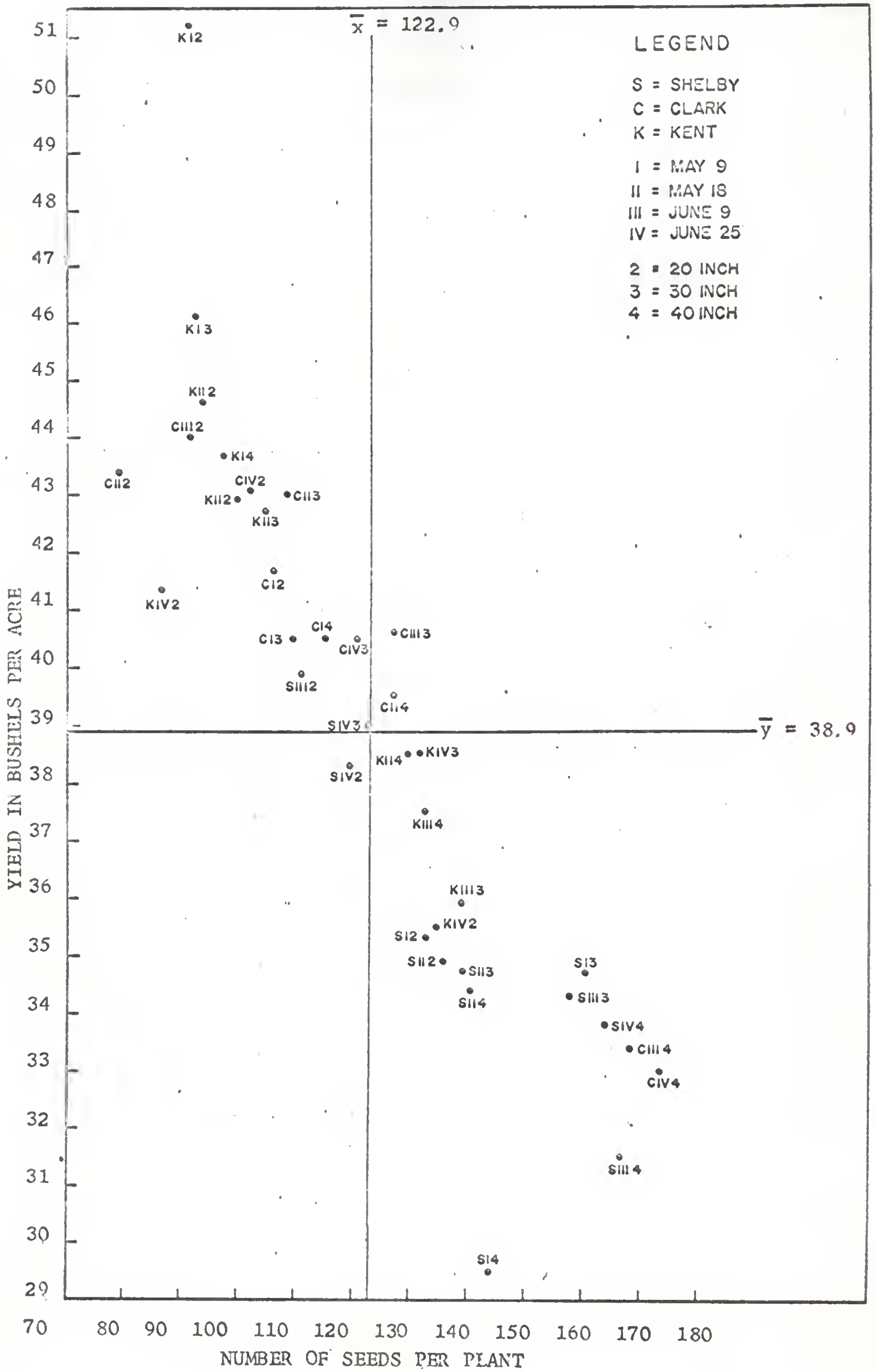
32
31
30
29

Figure 6. Yield of three soybean varieties as affected by the number of seeds per plant at Manhattan, Kansas, 1964.



x̄ = 122.9
ȳ = 38.9
LEGEND
S = SHELBY
C = CLARK
K = KENT
I = MAY 9
II = MAY 18
III = JUNE 9
IV = JUNE 25
2 = 20 INCH
3 = 30 INCH
4 = 40 INCH
KI2
KI3
KII2
CIII2
KI4
CII2
CIV2
KII2
CII3
KII3
CI2
KIV2
CI4
CI3
CIV3
CIII3
SIII2
CII4
SIV3
KII4
KIV3
SIV2
KIII4
KIII3
SI2
KIV2
SII2
SII3
SII4
SI3
SIII3
SIV4
CIII4
CIV4
SIII4
SI4
YIELD IN BUSHELS PER ACRE
NUMBER OF SEEDS PER PLANT
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
70
80
90
100
110
120
130
140
150
160
170
180

SUMMARY DATA

Table 5. Date of planting, row width, variety study, 1964.

Variety	Row Width (inch)	Yield bu./A	Seeds per Plant	Pods per Plant	Branches per Plant	Height to 1st Pod	Ht. in.	Seed Size
May 9								
Shelby	20	35.3	133.3	51.7	1.1	2.9	29	15.7
Shelby	30	34.7	160.4	60.7	1.7	2.3	31	16.0
Shelby	40	29.5	144.3	56.1	1.7	1.2	27	15.3
Clark	20	41.7	106.1	39.2	0.8	2.8	35	16.4
Clark	30	40.5	109.5	41.7	1.1	2.4	34	15.9
Clark	40	40.5	115.1	42.2	1.9	1.8	30	16.9
Kent	20	51.2	90.9	34.9	1.0	4.2	34	18.0
Kent	30	46.1	92.1	35.5	2.8	3.6	35	18.1
Kent	40	43.7	97.5	36.8	4.0	3.1	34	18.1
May 18								
Shelby	20	34.9	135.9	49.4	0.8	3.7	31	15.9
Shelby	30	34.7	139.0	53.6	1.0	2.0	29	16.2
Shelby	40	34.4	139.7	52.4	1.4	1.7	30	15.2
Clark	20	43.4	78.8	30.4	0.6	2.7	34	15.9
Clark	30	43.0	108.5	41.2	1.5	2.2	33	15.0
Clark	40	39.5	127.0	47.1	1.8	1.3	33	16.0
Kent	20	44.6	93.2	35.0	0.9	5.0	30	18.5
Kent	30	42.7	104.3	38.5	2.2	4.1	32	17.9
Kent	40	38.5	129.6	47.9	3.5	3.0	34	16.9
June 9								
Shelby	20	39.9	111.1	41.8	0.8	2.5	31	15.3
Shelby	30	34.3	158.3	59.7	1.5	2.3	29	15.0
Shelby	40	31.5	166.5	61.9	1.7	2.0	31	15.5
Clark	20	44.0	91.4	34.1	1.0	2.8	34	16.6
Clark	30	40.6	127.1	47.3	1.6	2.4	34	15.2
Clark	40	33.4	168.7	63.4	2.1	2.0	35	15.7
Kent	20	42.9	99.7	51.7	1.0	4.6	34	16.8
Kent	30	35.9	139.0	52.1	3.1	3.4	32	16.6
Kent	40	37.5	132.1	49.6	3.7	2.7	33	16.4
June 25								
Shelby	20	38.3	119.3	44.9	0.4	2.5	30	15.8
Shelby	30	39.0	122.9	44.2	0.8	2.4	30	15.2
Shelby	40	33.8	163.7	62.5	1.3	1.0	30	15.7
Clark	20	43.1	101.7	37.3	0.5	3.1	32	15.2
Clark	30	40.5	120.7	45.6	1.0	2.4	33	15.4
Clark	40	33.0	173.5	65.9	1.9	2.1	33	15.4
Kent	20	41.3	86.5	32.5	1.1	3.9	34	15.9
Kent	30	38.5	131.6	49.5	2.1	3.4	32	16.2
Kent	40	35.5	134.5	50.1	3.6	2.5	33	16.5

Number of Seeds. The number of seeds produced by a plant appear to be influenced by the row spacing (Table 5). Plants in the 20 inch row spacing produced the smallest number of seeds per plant, whereas plants in the 40 inch row spacing produced the greatest number of seeds per plant. As the number of seeds per plant increases, the yield decreases (fig. 6). Less seed is produced per plant in the 20 inch row spacing when compared to the 40 inch row spacing, but the higher plant population brings about the higher yields in the 20 inch row spacing.

Branching. The number of branches per plant appears to be influenced by row spacing (Table 4). The plants in the 20 inch rows had fewer branches then the plants in the 30 or 40 inch spacing. Plants in the 40 inch rows showed the largest degree of branching. Kent produced more branches at a given date than Clark, and Clark had more branches than Shelby (Table 4). Branching appears to be influenced by the number of plants per unit area. As the distance between rows increases the plants produce branches in order to produce more seed. Date of planting appeared to have little influence in the degree of branching for a given row width or variety (Table 5).

SUMMARY

Summarizing the results obtained in this experiment, it was found that:

Kent produced 3.0 percent (1.2 bushels) more soybeans per acre than Clark, and Clark produced 13.1 percent (5.3 bushels per acre) more than Shelby when the mean yield of all planting dates were averaged. The highest yield of Kent (47.0 bushels per acre) was produced from the May 9 planting date while that of Clark (41.9 bushels per acre) was from the May 18 planting date. The highest yield (37.0 bushels per acre) of Shelby was produced when planted the 25th of June.

...ntings made in 20 inch row widths produced an average of 6.0 percent more than the plantings made in 30 inch row widths and the 30 inch row widths produced an average yield of 8.4 percent more than the 40 inch row widths. The highest average yield for each variety and for each date was obtained from plantings made in the 20 inch row width.

A delay of 48 days in planting from early May until late June hastened the maturity of Shelby 40 days, Clark 38 days and Kent 42 days. The varieties of the early and late planting dates required less time to bloom than those at an intermediate planting date.

A correlation between seed size and yield showed that the highest yield was produced by plants with the largest seeds. Seed produced in the last two planting dates was smaller than the seed produced in the first two dates of planting. Kent produced the largest seed and Shelby produced the smallest.

The plants of Shelby were shorter than those of Clark and Kent and it also produced the lowest seed yield, while row width did not appreciably influence plant height.

The 20 inch row spacing had plants with the first pods higher above the ground than the plants with 30 inch row spacing and the plants in the 30 inch rows had pods higher above the ground than plants in the 40 inch row spacing. The pods on Kent were consistently placed higher above the ground than Clark or Shelby.

Plants in the 20 inch row spacing produced the smallest number of seeds per plant, whereas plants in the 40 inch rows produced the greatest number of seeds per plant.

The plants in the 20 inch rows had fewer numbers of branches per plant, while those in the 40 inch rows showed the highest degree of branching. Kent produced more branches at a given date than Clark, and Clark had more branches than Shelby.

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APPENDIX

Table I. Analysis of Variance for Yield.

Source of Variation	D.F.	Mean Square
Dates	3	48.80
Replications	3	1590.90**
Error (a)	9	84.48
Row Width	2	447.15**
Dates x Row Width	6	16.40
Error (b)	24	12.93
Varieties	2	556.60**
Dates x Varieties	6	92.88**
Row Width x Varieties	4	16.90
Dates x Row Width x Varieties	12	14.98
Error (c)	72	12.36

** Significant at the 0.01 level

Table II. Daily precipitation, Kansas State University, Agronomy Farm, Manhattan, Kansas. 1964.

Date	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1					.45				.91			
2					.08					T		
3		.23										
4		.06										
5				.77		.24	.66		.04			
6				.40	.17	.48			.02		.40	.16
7		T										.48
8	T	T	.30		.17	.10	.02	.27			.09	.34
9		T	.10				.04	T				
10		.01					.03					
11								.05				
12	.05			.01	.26	.28	.40	.01	T	.09		
13	T	.01		T	T	1.59	.03			.16		
14						.01						
15		.24	T			.11		1.02				
16		.03			.02	1.10		T				
17									.06		.12	
18									.44		2.65	
19		T						.02	.37		.04	
20		T	.21	.22							.26	
21			.71	.49				.50	.01		.08	T
22			.02	.19		.29		.34	T			
23												
24	.03			.91	.01	.92			.18			
25			.25		.07							
26			.02				.11	.05				
27				1.01	.15		.60	.03		.01		
28				.27	.32		1.75					
29				.05	.82			.75				
30												
31	.25							.20				
								T				T
Total	.33	.58	1.61	4.41	2.25	5.12	3.63	3.22	2.03	.26	3.64	1.98
Normal	.86	.96	1.71	2.60	4.37	5.11	4.00	4.18	3.71	2.32	1.24	.94
Dev.	-.53	-.38	-.10	1.81	-2.12	-.01	-.36	-.96	-1.68	-2.06	2.40	1.04

Total for year = 28.98 inches
Normal for year = 32.00 inches
Deviation for year = -3.02 inches

Table III. Daily maximum temperature, Kansas State University, Agronomy Farm, Manhattan, Kansas.

Date	April	May	June	July	August	September	October
1	72	62	70	92	96	82	79
2	84	65	72	94	98	91	83
3	78	75	71	97	103	92	71
4	52	84	80	93	104	94	81
5	41	86	67	94	95	80	66
6	53	77	62	103	95	80	63
7	66	79	80	104	96	92	73
8	45	79	82	96	92	92	79
9	50	79	90	88	87	92	58
10	71	76	90	89	89	93	61
11	75	81	90	89	94	86	66
12	64	72	84	85	79	71	60
13	82	62	86	83	77	72	71
14	62	73	83	86	71	77	70
15	65	80	85	95	65	83	73
16	83	85	80	98	68	75	77
17	88	89	85	96	72	67	83
18	75	91	85	98	81	67	80
19	65	89	93	96	85	78	64
20	68	90	95	98	90	87	62
21	77	90	94	100	86	--	81
22	69	90	88	103	82	76	74
23	72	90	92	106	76	81	66
24	68	92	81	101	80	71	67
25	73	92	85	104	92	73	75
26	74	95	86	95	70	82	63
27	67	94	84	95	84	73	65
28	54	58	88	98	84	63	66
29	61	69	90	95	79	69	69
30	66	70	90	97	89	76	67
31		66		97	81		81

THE EFFECT OF PLANTING DATE AND ROW WIDTH ON THREE SOYBEAN VARIETIES

BY

GARY LYNN KILGORE

B. S., Kansas State University, 1964.

AN ABSTRACT OF A MASTER'S THESIS

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KANSAS STATE UNIVERSITY
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Date of planting, row width, and variety studies on soybeans were conducted during the summer of 1964 on the Agronomy Farm of the Kansas Agricultural Experiment Station at Manhattan, Kansas.

The experiment included three soybean varieties representing three ranges of maturity: Shelby, a short season variety, and Clark and Kent, intermediate and full season varieties, respectively. These varieties were planted in 20, 30, and 40 inch row width and on four dates; May 9, May 18, June 9 and June 25.

The factors evaluated and reported were seed yield, plant maturity, blooming date, plant height, seed size, seeds per plant, pods per plant, branches per plant, and height to first pod. Analysis of variance was run only on the seed yield component.

Kent produced 3.0 percent (1.2 bushels) more soybeans per acre than Clark, and Clark produced 13.1 percent (5.3 bushels per acre) more than Shelby when the mean yield of all planting dates were averaged. The highest yield of Kent (47.0 bushels per acre) was produced from the May 9 planting date while that of Clark (41.9 bushels per acre) was from the May 18 planting date. The highest yield (37.0 bushels per acre) of Shelby was produced when planted the 25th of June.

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Plants in the 20 inch row spacing produced the smallest number of seeds per plant, whereas plants in the 40 inch rows produced the greatest number of seeds per plant.

The plants in the 20 inch rows had fewer numbers of branches per plant, while those in the 40 inch rows showed the highest degree of branching. Kent produced more branches at a given date than Clark, and Clark had more branches than Shelby.