July 17, 1950

To the Committee on Graduate Study:

I am submitting to you a thesis written by Donald T. Ferguson entitled "The Effect of Competition and Date of Planting on the Growth of Soybean Varieties Having Different Dates of Maturity." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

L. N. Skold

Major Professor

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and recommend its acceptance:

E. Winters

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Accepted for the Committee

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Dean of the Graduate School

THE EFFECT OF COMPETITION AND DATE OF PLANTING ON THE GROWTH OF SOYBEAN VARIETIES HAVING DIFFERENT DATES OF MATURITY

A THESIS

Submitted to
The Committee on Graduate Study
of
The University of Tennessee
in
Partial Fulfillment of the Requirements
for the degree of
Master of Science

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by

Donald T. Ferguson

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CHAPTER I

INTRODUCTION

An isolated plot of such a crop as soybeans, Glycine max, will exhibit border effect and competition. The outside rows frequently grow more vigorously than inside rows which have competing rows on both sides. Competition and border effects need to be considered in the evaluation of yield data on different varieties, particularly when each variety is represented by only one or two rows. This experiment was intended to study competition effects between unlike varieties, and to determine the need for three-row plots to eliminate any bias that may exist as a result of competition.

CHAPTER II

REVIEW OF LITERATURE

Arny[1] in 1920 and 1921 at the Minnesota Experiment Station studied border effect with spring wheat, oat and barley varieties by cropping the alleys between plots with winter wheat and comparing the resulting yields of these plots with the yields of plots where the alleys were not cropped. There was an increased yield in the outside and middle border rows for the wheat varieties where the alleys were not cropped. Where the alleys between plots were cropped to winter wheat the border effect was reduced so that it was not plainly evident at any time before the grain was harvested.

Brown[2] cites work that was done at Storrs Agricultural Experiment Station in Connecticut in 1917 relating to competition between variety plots of soybeans and oats. A small, early maturing soybean variety was used as a check. It was noted that when the check variety occurred between the varieties O'Kute, Swan, Mammoth Yellow, or Mongol, all of which were much larger and later than the check variety, the latter averaged 17.1 bushels per acre, or 63.6 percent of the average of all check plots. Oat varieties were drilled in

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[1] A. C. Arny, "Border Effect and Ways of Avoiding It," Journal of the American Society of Agronomy, 14:266-278, 1922.

[2] B. A. Brown, "Plot Competition with Potatoes," Journal of the American Society of Agronomy, 14:257-258, 1922.

four-row, 28-inch plots, and the two outside rows were harvested separately from the inside rows. The yield of the outside rows averaged 73.2 bushels of grain and 3,802 pounds of straw per acre as contrasted to yields of 52.3 bushels of grain and 2,464 pounds of straw per acre for the inside rows.

In his own experiment lasting from 1916 through 1921 with potatoes, and using Green Mountain as a check occurring every fifth plot, Brown[3] concluded that yields of potatoes are not influenced by competition between single-row plots.

An attempt was made in 1924 and 1925 by Garber and Odland[4] at the West Virginia Agricultural Experiment Station to correlate the height of adjacent rows of soybeans with the yields of the test rows. In conducting varietal experiments with soybeans, the border rows of each plot were ordinarily discarded, but in 1924 and 1925 these rows were harvested and the yields determined the same as for the inner rows. In 1924 the yields in tons of air-dry hay per acre were determined, and in 1925 the yields in bushels of seed per acre were determined for each border row. In addition to yield, the average height of the plants in each row was recorded. From these data it was possible to study the influence of yield and height of certain rows on adjacent rows. Garber and Odland found that varietal experiments carried on under the conditions they described did not

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[3] Brown, loc. cit.

[4] R. J. Garber and T. E. Odland, "Influence of Adjacent Rows of Soybeans on One Another," Journal of the American Society of Agronomy, 18:605-607, 1926.

show an appreciable effect of height or yield of one row upon the yield of an adjacent row, and concluded that under these conditions it is not necessary to grow border rows.

In 1937 a controversy arose between Quinby, Killough, and Stansel[5] on one hand and Christidis[6] on the other over the effects of competition between cotton varieties in adjacent rows. Quinby, Killough, and Stansel used data accumulated by Christidis[7] in an earlier experiment to substantiate their findings that as a general rule cotton varieties grown in Texas do not differ in ability to compete for moisture and plant food, and that it is desirable to use single-row plots and to use the land saved for additional replications. Although Quinby et. al. found no evidence of competition among cotton varieties, they admitted that such competition may conceivably exist, and in view of this possibility, they suggested that a random distribution of plots would be essential in cotton variety experiments.

According to Christidis, the conclusions reached by Quinby et. al. were fallacious, due to an error in calculation. The same data treated in the same manner but without arithmetic mistakes point to a completely contradictory conclusion, namely, that competition

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5 J. R. Quinby, D. T. Killough, and R. H. Stansel, "Competition Between Cotton Varieties in Adjacent Rows," Journal of the American Society of Agronomy, 29:269-279, 1937.

6 B. G. Christidis, "Competition Between Cotton Varieties, A Reply," Journal of the American Society of Agronomy, 29:703-705, 1937.

7 B. G. Christidis, "Intervarietal Competition in Yield Trials with Cotton," Journal of Agricultural Science, 25:229-237, 1935.

may cause a definite bias in estimating the comparative yielding value of cotton varieties.

In 1934 Immer[8] at the Minnesota Agricultural Experiment Station studied competition in yield trials with sugar beets using the commercial brands or varieties, Old Type and Extreme Pioneer. These varieties were grown alternately in one-row plots to determine whether the differences were of such magnitude as to affect yields seriously. As a standard for comparison, four-row plots of the same varieties were grown; at time of harvest each outer row was removed and the two center rows were harvested. At the conclusion of this experiment, Immer concluded that unequal competition effects were definitely demonstrated as far as yield of beets was concerned, but he could not discern similar effects of competition as far as sucrose percentage of the beets was concerned. Immer suggested that in variety trials with sugar beets involving varieties differing markedly in size of plants, plots at least three rows wide must be used and at least one border row on each side of the plot must be discarded at harvest.

Probst[9] at the Indiana Agricultural Experiment Station worked with soybeans to determine the border effect in soybean nursery rows and the resulting grain yields which might be obtained from trimming

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[8] F. R. Immer, "Varietal Competition As a Factor in Yield Trials with Sugar Beets," Journal of the American Society of Agronomy, 26:259-261, 1934.

[9] A. H. Probst, "Border Effect in Soybean Nursery Plots," Journal of the American Society of Agronomy, 35:662-666, 1943.

rows at maturity compared to trimming soon after emergence. Probst used Mukden, Mandell, Dunfield, and Illini varieties of soybeans planted in a split-plot, Latin square design, with four replications of each variety. Each row was trimmed to exactly 18 feet in length after the plants emerged and the plants were thinned in the row to approximately one inch apart. The border effect within the row was determined by removing four successive six-inch sections of plants from each end of each 18-foot row. Seed from the outer six-inch sections were combined and designated as section one; consecutively the remaining sections were combined and designated sections two, three, and four. After the four sections were removed, a 14-foot row remained. To obtain grain yields of rows trimmed at emergence the yields of the two outer sections were combined with the yield of the 14-foot row. Probst concluded from this experiment that border effect is extremely evident among the plants in the outer foot of soybean nursery rows adjacent to three-foot alleys. To eliminate this effect he suggested removing the outer foot of row length at maturity. He reported that yields were on the average 16 percent higher in single-row soybean nursery plots 16 feet long with 30 inches between rows when border effect was not removed. Probst also noticed that varieties responded differently with respect to border effect, but not enough to give a marked change in the relative yields.

In 1946-47, tests were conducted at the Delta Station,

Mississippi State College, by Henson and Carr[10] on the effect of time of planting upon yields of soybean varieties. The varieties were grouped according to maturity into early, medium, medium late, and late groups. The planting dates were April 22, May 27, and June 12, in 1947. The four varieties, S-100, C-100, Gibson, and Patoka, comprised the early group; Ogden, Dortchsoy 2, Burdette 19, and Arksoy 2913, the medium maturing group; Roanoke, Volstate, Palmetto, and the North Carolina strain, N44-774, the medium late group; while the late group was composed of Acadian, Yelnando, Momotan, and Mamloxi. The early maturing varieties exhibited the most striking response to time of planting. Yields, maturity, height, and percent oil and protein were all influenced. The highest yields were secured from the April planting of the early maturing varieties; the yields of these varieties were significantly and progressively reduced by late May and mid-June plantings. The yield of the late May planting of the later maturing varieties was equal to the yield of the April planting. In general, the June plantings resulted in lower yields, but the difference between late May and mid-June plantings was less with the later maturing varieties. The difference in maturity between the April and June plantings for the early varieties was 28 days; for the medium maturing varieties, 11 days; and three days for the medium late and late maturing varieties.

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10 P. R. Henson and R. B. Carr, "Soybean Varieties and Time of Planting Experiments," Mississippi State College Agricultural Experiment Station, Circular 140, March 1948.

Henson and Carr suggested that early varieties should be planted early in the season for maximum yields. Where growers are interested in growing several varieties to spread the optimum harvesting period, the varieties should be planted in order of maturity.

A similar experiment was conducted in southeast Missouri by Feaster[11] from 1942 through 1945. Five varieties were selected for testing. The days required for their maturity if planted on June 1 near Sikeston, Missouri, are: Ralsoy, 137; S-100, 124; Boone, 117; Chief, 109; and Dunfield, 100. Each variety was planted at 20-day intervals from April 20 through July 10. The date of maturity was influenced considerably by the date of planting. The date of maturity was influenced least among the late maturing varieties and most among the early maturing varieties. Early maturity was obtained by planting early maturing varieties at an early date; early planting of full season varieties resulted in advancing the maturity date only a few days. Maximum yields were obtained from planting a full season variety after the soil had become sufficiently warm in the spring. The most favorable period for planting early maturing varieties in Missouri was later than for planting late maturing varieties. Early maturing varieties bloom and begin seed development during the dry, hot period that usually occurs during the latter part of July and early August, and highest yields were obtained when planting so that blooming occurred after this period.

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[11] C. V. Feaster, "Effect of Planting Time on Maturity, Yield, and Quality of Soybeans in Southeast Missouri," University of Missouri, Agricultural Experiment Station Bulletin 514, 1948.

The date of planting had little effect on the quality of Ralsoy and S-100; the first two plantings of Boone and Chief were lower in quality than the seed from the last three plantings. Quality for Dunfield was poor for the first two plantings and progressively better with the later plantings. Feaster pointed out that seed quality is evidently influenced more by maturity date than by planting date. The poorest quality seed was from the earliest maturing varieties, and quality steadily improved with later maturity.

CHAPTER III

METHODS AND PROCEDURE

To measure competition between varieties of soybeans having different dates of maturity, a field test is necessary. The factors considered in this study are: the plan of the experiment, planting dates, organization of the sequence of planting, the varieties selected for competition, and collecting and analyzing the data.

Three varieties of soybeans were selected: Wabash, an early maturing variety; S-100, medium maturing; and Ogden, a late maturing variety. A split-plot design was used with four replications. Two planting dates, May 13, 1949, for the early planting, and June 11, 1949, for the late planting, were used. Figure 1 illustrates one replication of the planting plan used in the experiment.

The date of planting for each half replication was selected from the two planting dates by chance selection. The sequence of planting in each half replication was determined randomly but directed to the extent that each variety appeared once in competition with each of the three varieties in each half replication. The sequence of the later planting in the same replication followed the same sequence as the earlier planting, but the sequence for each replication was determined independently.

A border row of the same variety as the inside adjacent row was planted to border each half replication. In collecting data only those rows marked as test rows (Figure 1) were used. Each

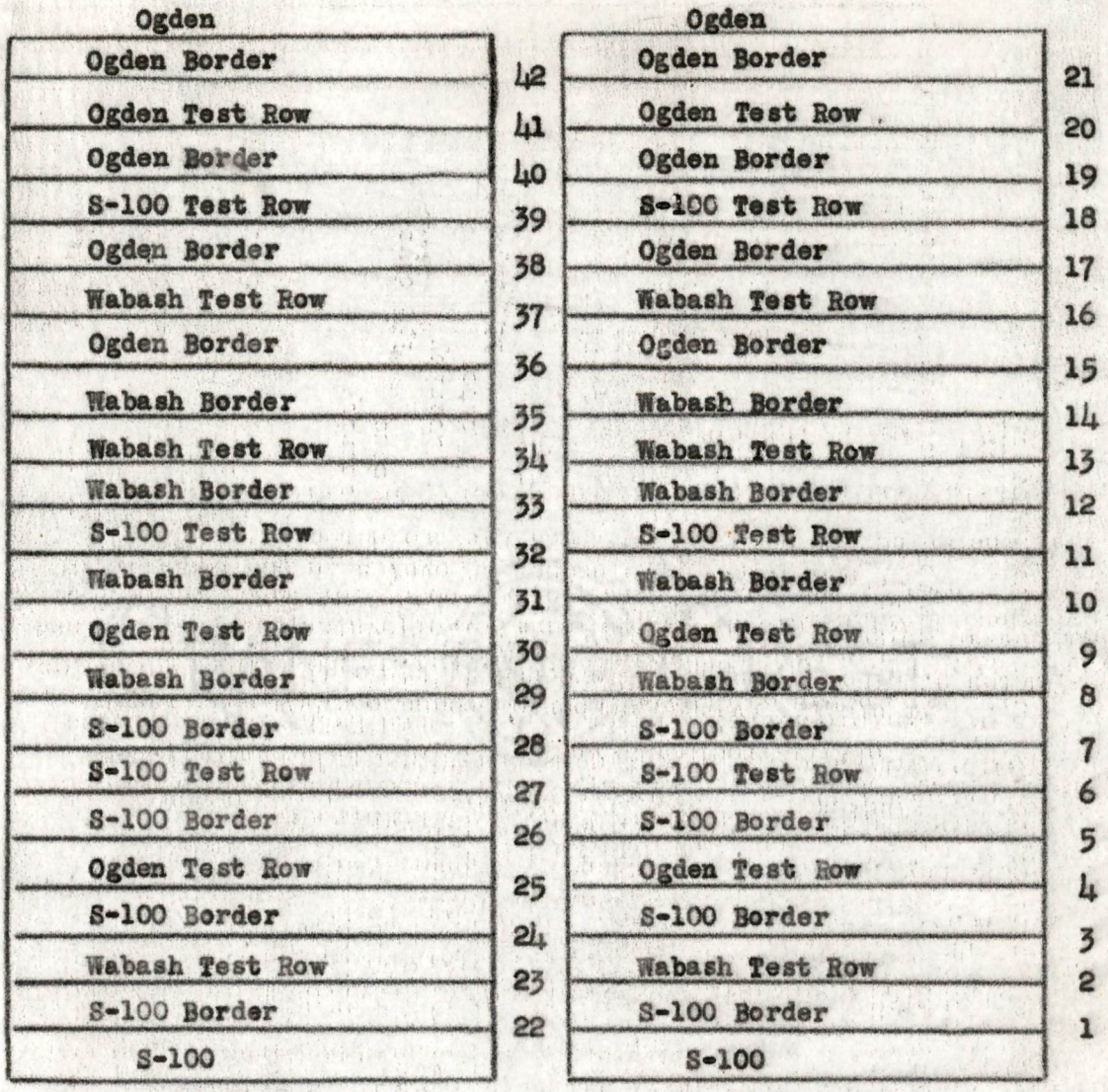


Figure 1. One replication of the planting plan used in the experiment.

variety was tested in competition with all varieties used in the experiment. Data were collected from 72 rows, and no data were taken on plants within two feet of the ends of each individual row.

A record of plant height was kept, and the height of the test rows was taken four times during the growing period and again at maturity. Height was measured at three randomly selected places in each row, and measurements were taken to the nearest inch.

The date of blossoming was recorded for each row, using the date when the majority of blossoms were open and the plants could be considered in full bloom.

The date of maturity was determined as that date when the majority of plants in each row were ready for harvesting with the combine-thresher.

The degree of lodging at maturity was noted and recorded numerically: (1) little or no lodging; (2) some lodging; (3) considerable lodging; and (4) lodged heavily.

Seed quality and weight per one hundred beans were determined from a sample taken from the threshed beans from each row. Seed quality was recorded numerically: (1) very good; (2) good; (3) fair; (4) poor; (5) very poor.

The number of ovules and beans in 500 pods was counted from a 500-pod sample taken from each row. This 500-pod sample was taken from plants selected at random in the row. All pods were removed from each selected plant.

The total yield of each row was determined by adding the threshed weight of beans to the weight of the beans in the 500-pod sample which was calculated from the weight per 100 beans for each row.

Results were tabulated according to variety, competing variety, and date of planting. Variance that was due to variety, date of planting, and competing variety was determined by the analysis of variance and significance determined by the "F" test.

CHAPTER IV

RESULTS

Data pertaining to yield, weight per 100 beans, number of ovules in 500 pods, number of beans in 500 pods, date of blossoming, maturity, plant height, and seed quality are presented in this chapter.

Yields:

The detailed data on yields appear in Appendix A and are summarized in Figures 2 and 3. All varieties produced highest yields of beans when bordered by the early maturing Wabash. The late maturing Ogden depressed yields of all varieties planted adjacent to it to a greater degree than did either of the other two varieties. The date of planting did not alter this sequence of competition (Figure 3) although the differences between treatments were not as large in the late planting. Competition might have been more evident in the late planting if closer spacing of rows had been used to compensate for smaller plant size.

The effect of the date of planting upon yield (Figure 3) was highly significant, with all varieties yielding higher in the early planting than in the late planting.

The three varieties yielded differently (Figure 3). Wabash was the lowest yielder under all treatments. The difference between the yields of S-100 and Ogden was not significant. Ogden competing with Wabash yielded the highest of all treatments.

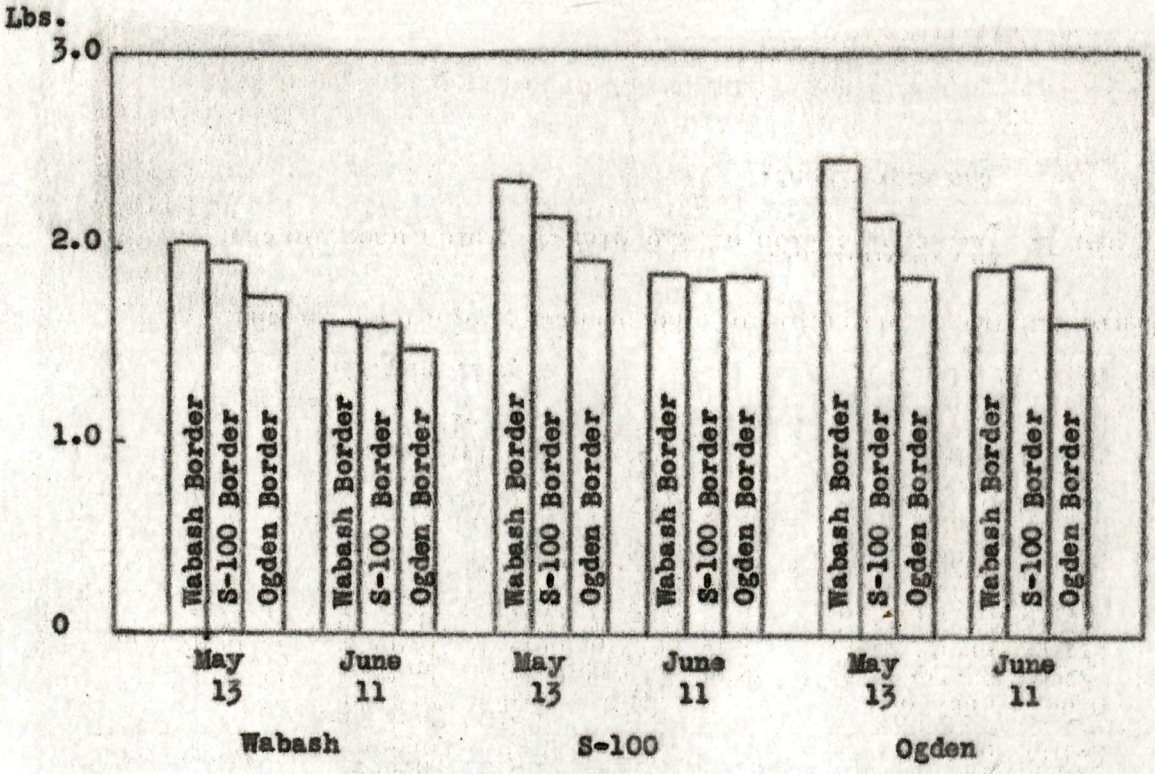


Figure 2. Average yield in pounds per plot of threshed beans for two dates of planting and when bordered by three different varieties.

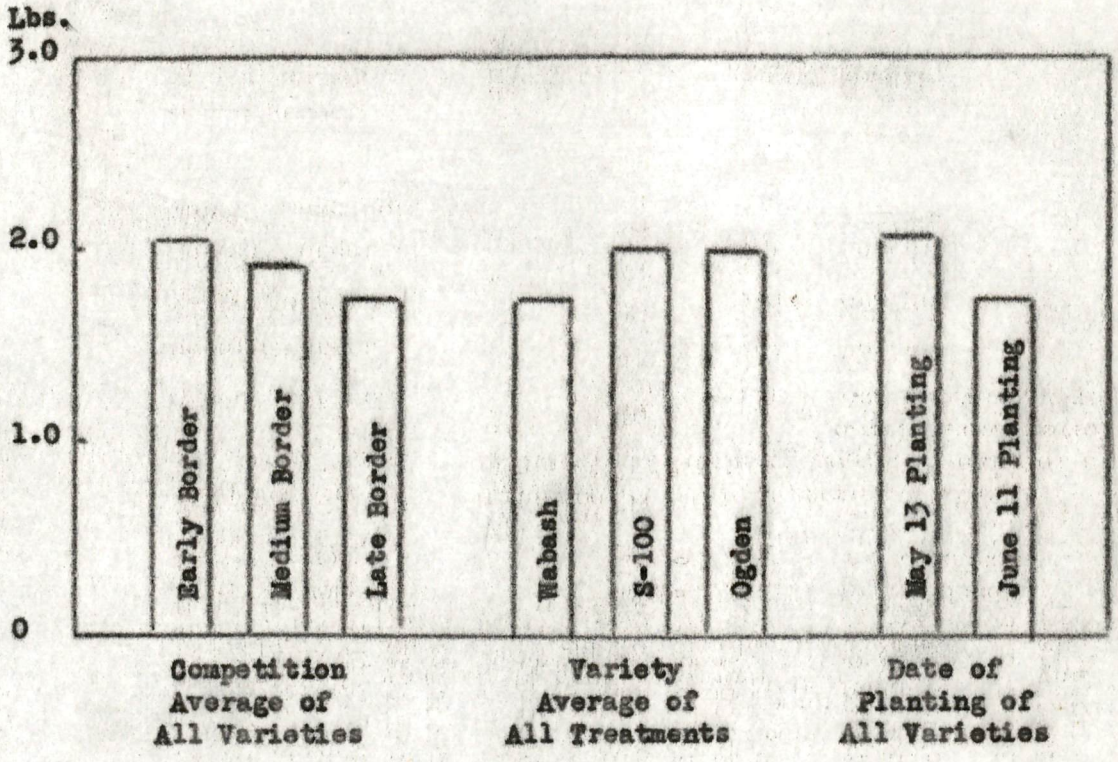


Figure 3. Average bean yield by competition, variety, and date of planting.

Weight Per 100 Beans:

Detailed data on weight per 100 beans appear in Appendix B. The data are summarized in Figures 4 and 5. Wabash had a lower weight per 100 beans than either S -100 or Ogden. The difference between the weight per 100 beans of S-100 and Ogden was not significant.

Competition had no significant effect upon weight per 100 beans (Figure 4).

Date of planting had more effect upon the weight per 100 beans in the late maturing Ogden than in either of the earlier maturing varieties (Figure 5). The weight per 100 beans of the late planting of Ogden was significantly lower than for the early planting.

Number of Ovules in 500 Pods:

Detailed data on number of ovules in 500 pods appear in Appendix C, and are summarized in Figures 6, 8, and 9. Wabash had more ovules per 500 pods than the other two varieties tested; in this variety there were also more pods having four ovules. Three ovules per pod was characteristic of S-100 while Ogden had more pods with two ovules.

Date of planting had some effect upon the number of ovules in 500 pods. There were more ovules present in 500 pods in the early planting of Wabash than in the late planting. This tendency was reversed in S-100, with more ovules present per 500 pods in the late planting. The early planting of Ogden had more ovules per 500 pods than the late planting, but the difference was not as large as noted in Wabash.

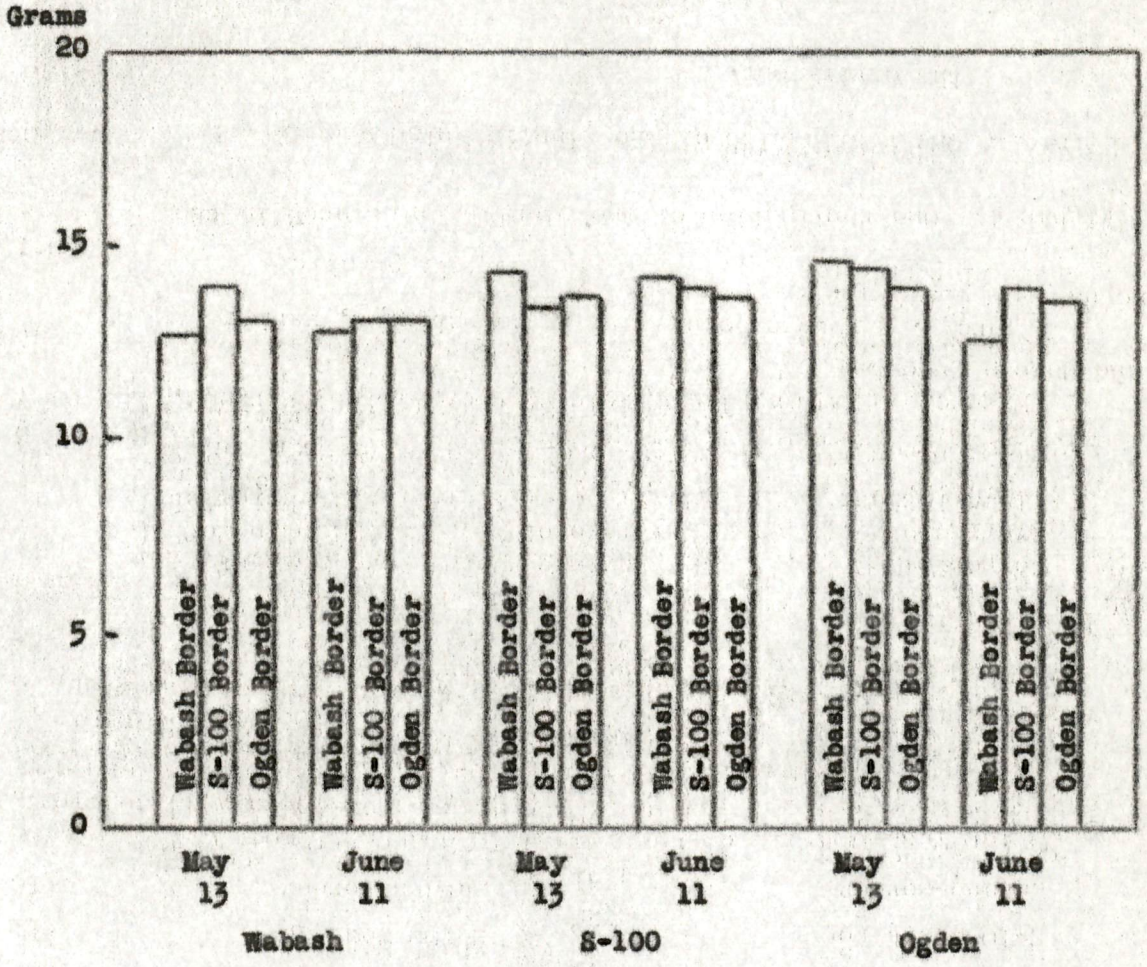


Figure 4. Average weight per 100 beans in grams for two dates of planting and when bordered by three different varieties.

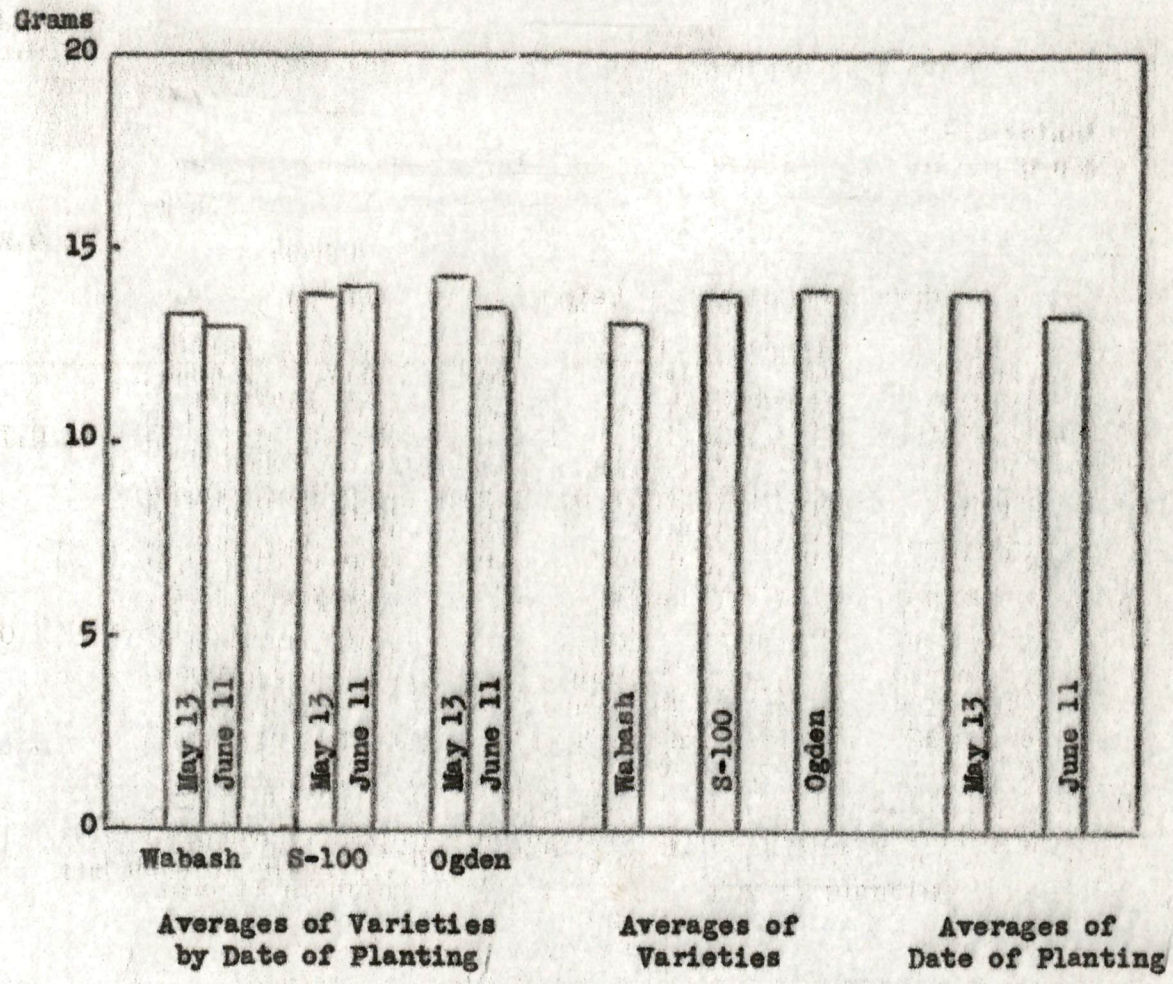


Figure 5. Weight per 100 beans in grams for each variety at each date of planting, average of each variety for all treatments, and average of all varieties for each date of planting.

Number of Beans in 500 Pods:

Detailed data on the number of beans in 500 pods appear in Appendix D. These data are summarized in Figures 7, 8, and 9. There was a tendency for more ovules to develop into seeds when a variety was bordered by the early maturing Wabash. When bordered by the medium maturing S-100 there were fewer seeds per pod in the varieties tested. When bordered by the late maturing Ogden the number of ovules that developed into seeds was lowest of the three treatments (Figure 7). This was true for both dates of planting.

In Wabash and S-100 there was a tendency toward a greater number of developed seeds per 500 pods in the June 11 planting (Figure 9), while in the late maturing Ogden the tendency was for the May 13 planting to have more developed seeds per 500 pods.

The varieties in order of greatest number of developed beans in 500 pods were S-100, Wabash, and Ogden (Figure 8).

In an over-all average of the entire 72 test rows the May 13 planting had fewer seeds per 500 pods than the June 11 planting.

Date of Blossoming:

Detailed data on date of blossoming appear in Appendix E. The growing period of all three varieties and dates of blossoming for both planting dates are given in Figure 10.

The May 13 planting of Wabash under all treatments blossomed uniformly and the majority of blossoms were open on July 4. In the June 11 planting blossoming was less uniform, extending from the 22nd through the 25th of July.

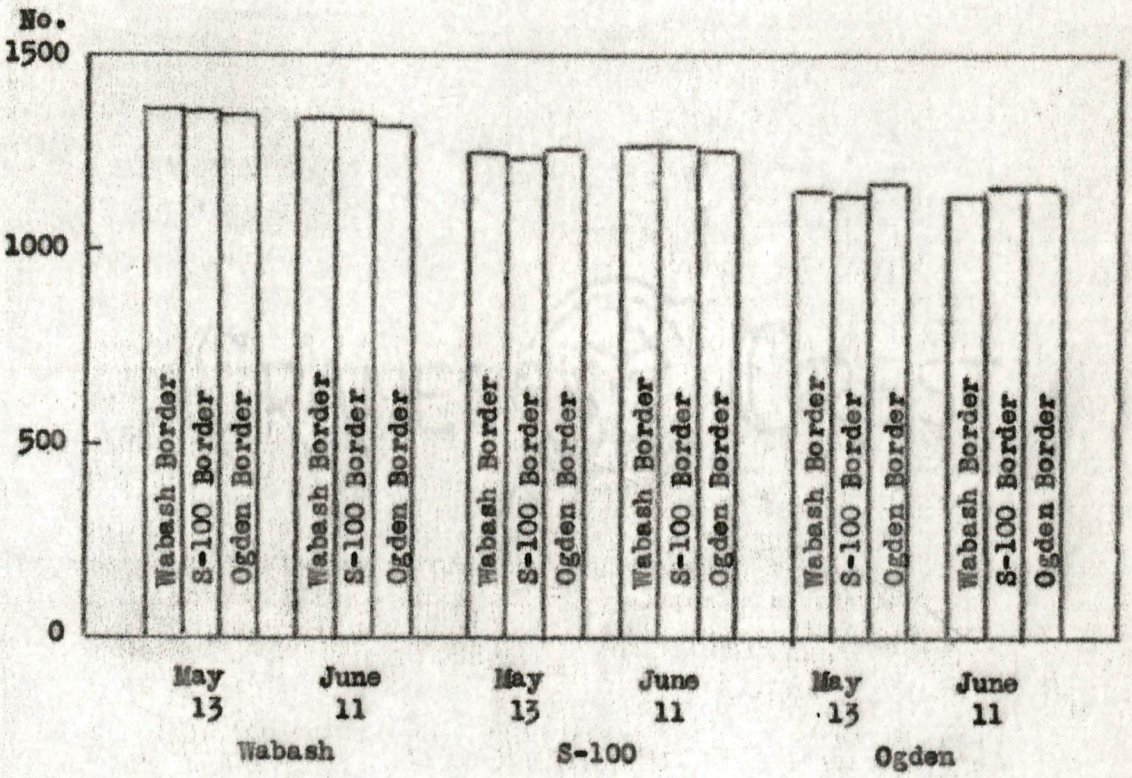


Figure 6. Average number of ovules per 500 pods for two dates of planting and when bordered by three different varieties.

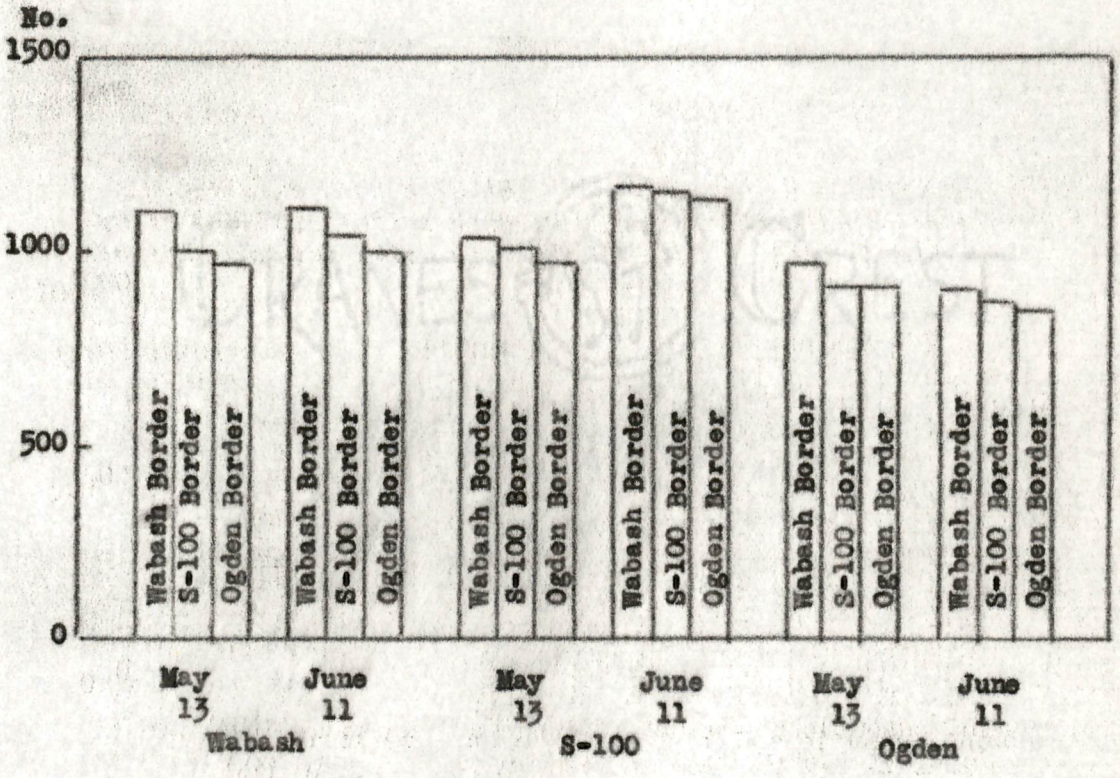
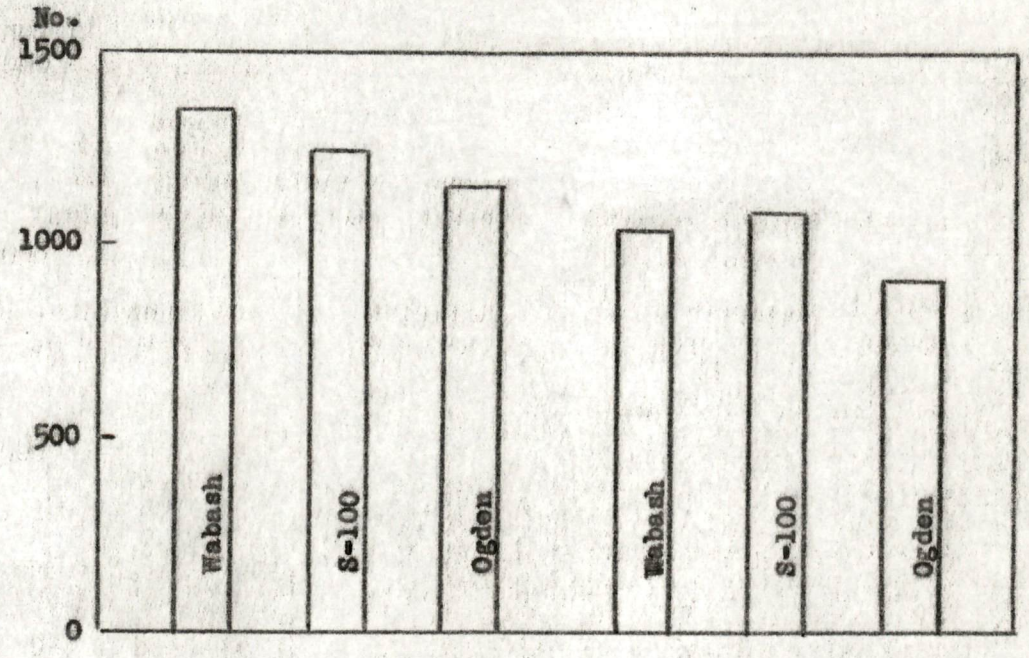


Figure 7. Average number of beans per 500 pods for two dates of planting and when bordered by three different varieties.



Number of Ovules in 500 Pods. Average of All Treatments and Both Planting Dates

Number of Beans in 500 Pods. Average of All Treatments and Both Planting Dates

Figure 8. Average number of ovules per 500 pods and average number of beans per 500 pods, for three varieties.

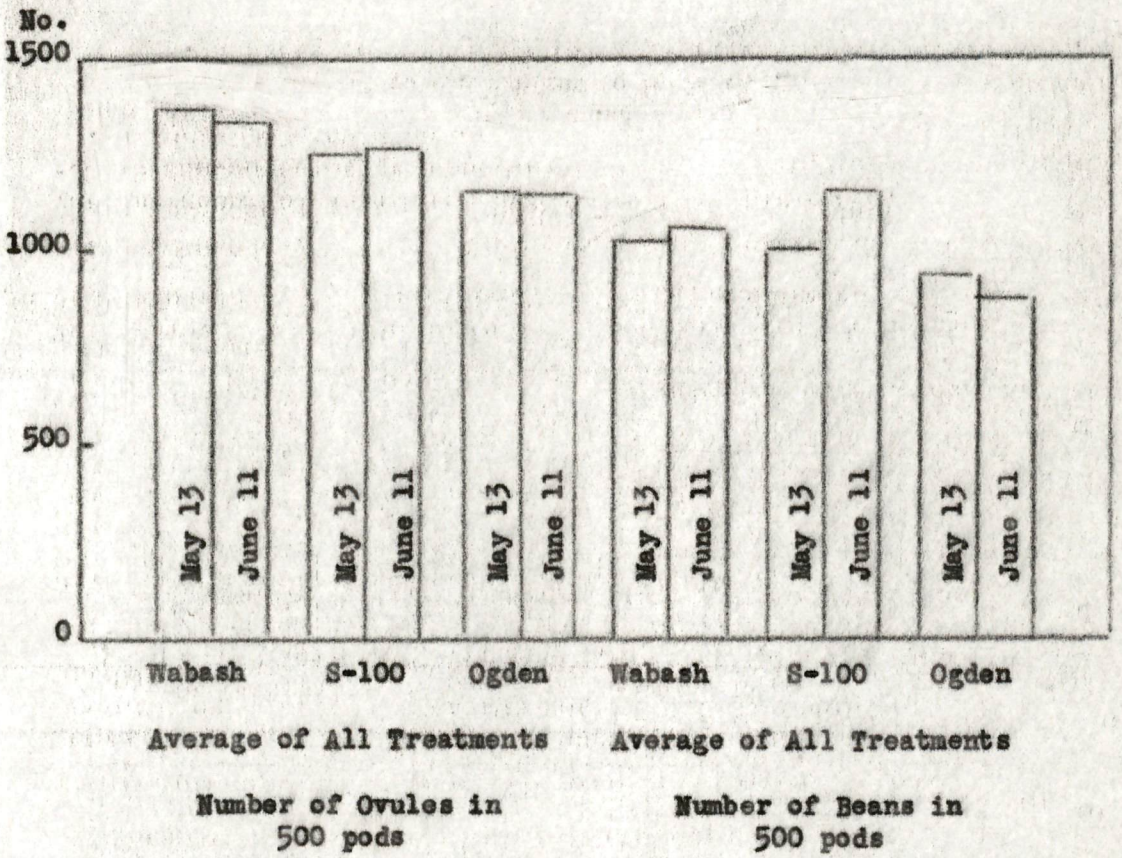


Figure 9. Average number of ovules in 500 pods and of the number of beans in 500 pods for two dates of planting.

A similar blossoming pattern was exhibited by the S-100 variety. The May 13 planting under all treatments blossomed fairly uniformly; all plots of this planting blossomed on July 7 with the exception of one plot bordered by S-100 that blossomed a day later. The June 11 planting of S-100 blossomed over an 11-day period, July 22 through August 1.

The Ogden variety showed less tendency toward uniform blossoming in either planting than did the Wabash and S-100 varieties. The May 13 planting of Ogden blossomed over a five-day period, July 25 through July 29. The June 11 planting of Ogden blossomed over a six-day period, August 9 through August 14.

Maturity:

Detailed data on date of maturity appear in Appendix F. These data are summarized in Figure 10.

The date of maturity showed no evidence of having been affected by competition; this appeared to be a varietal characteristic affected only by date of planting.

Wabash, when planted May 13, had a period of 121 days between planting and the date when ready for harvesting. When planted June 11, this period was shortened to 100 days. Planting 29 days later in the spring shortened the growing period of Wabash 21 days.

S-100 planted May 13 matured on September 11, and when planted June 11 matured September 19. The period from planting to harvesting for the early planting was 135 days and for the late planting, 114 days, a difference of 21 days.

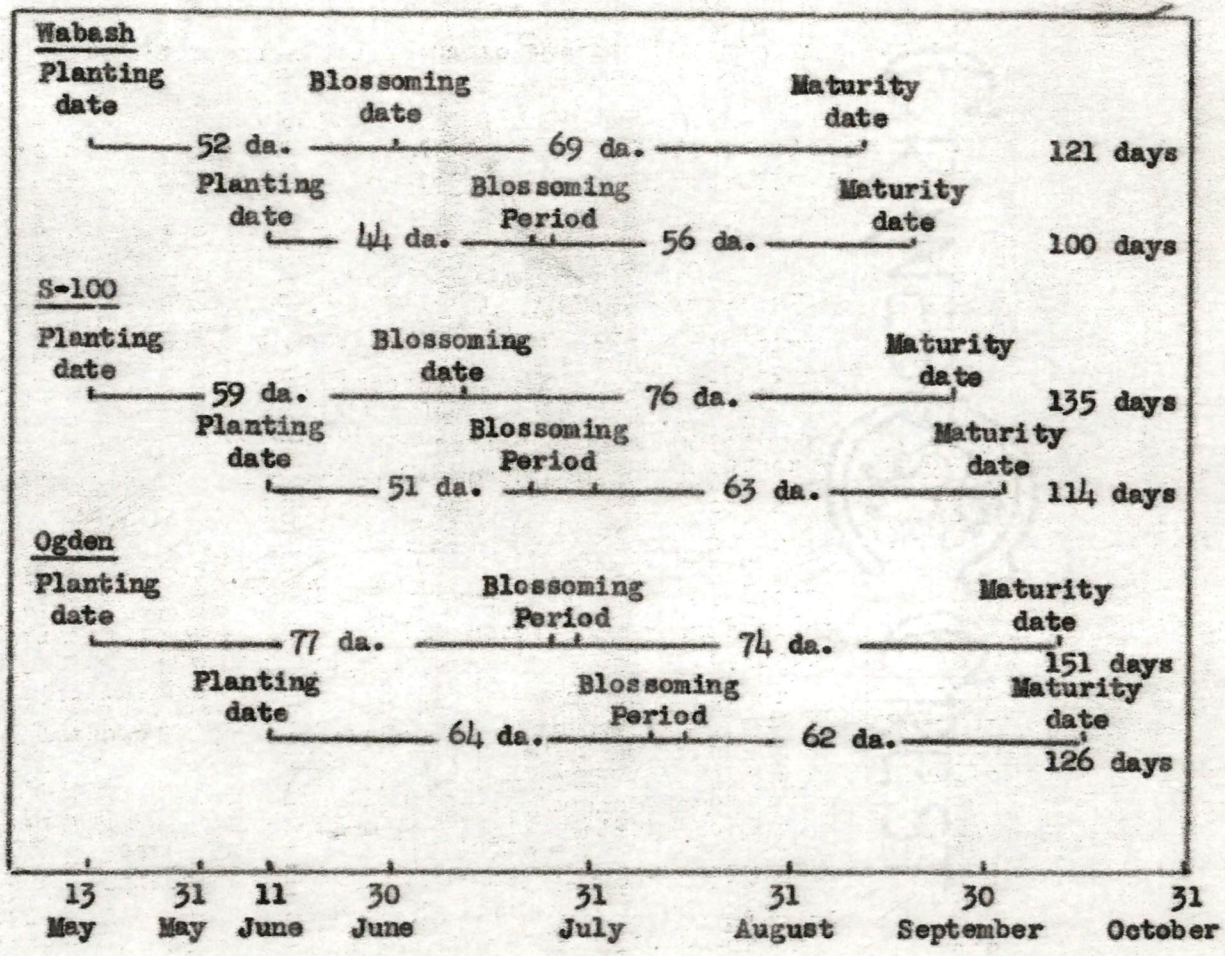


Figure 10. Growing periods of the three varieties.

The May 13 planting of Ogden matured 151 days after planting and the June 11 planting matured 126 days after planting. There was a difference of 25 days between the two growing periods.

The late planting of Wabash matured eight days later than the early planting. S-100 also had an eight day period between maturity dates of the early and late plantings. The late maturing Ogden showed less effect of date of planting on maturity date, there being only four days between the maturity dates of the two plantings.

Plant Height:

Growth curves for each variety under each treatment are shown graphically in Figures 11, 12, and 13. Competition had no visible effect upon growth. The June 11 planting did not attain the height of the May 13 planting. The growth curves are similar in all the varieties except that in the case of S-100 there was less loss in height at maturity.

Lodging:

Detailed data on lodging appear in Appendix G. These data are summarized in Figures 14 and 15. Lodging was definitely a varietal characteristic unaffected in most cases by either competition or date of planting.

Seed Quality:

Appendix H contains the detailed data on seed quality. Seed quality was not affected by competition or date of planting. The quality of seed in all the test rows ran relatively high. The quality of Ogden was very good; quality of Wabash was very good in 15 rows,

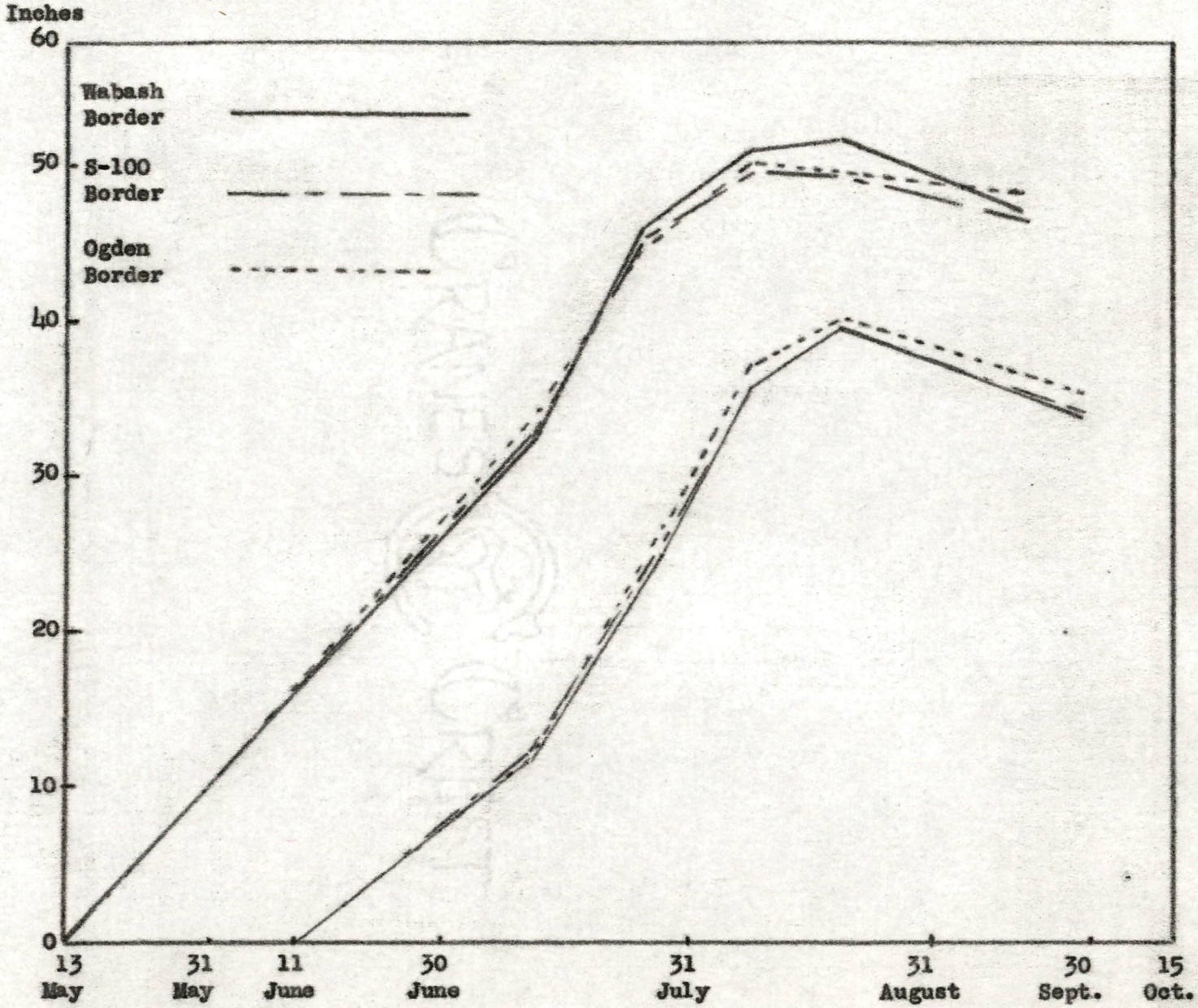


Figure 11. Growth curves for early and late planted Wabash.

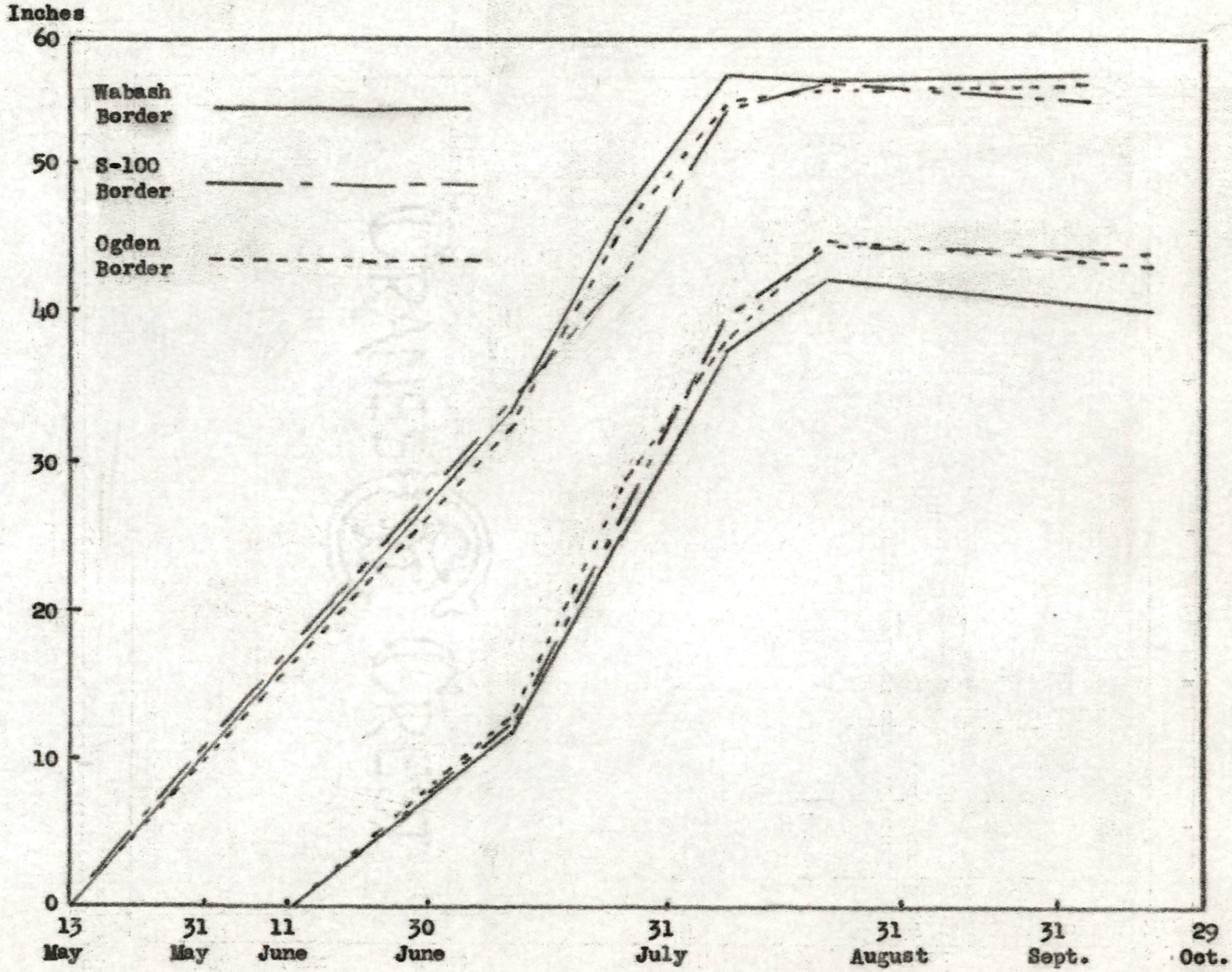


Figure 12. Growth curves for early and late planted S-100.

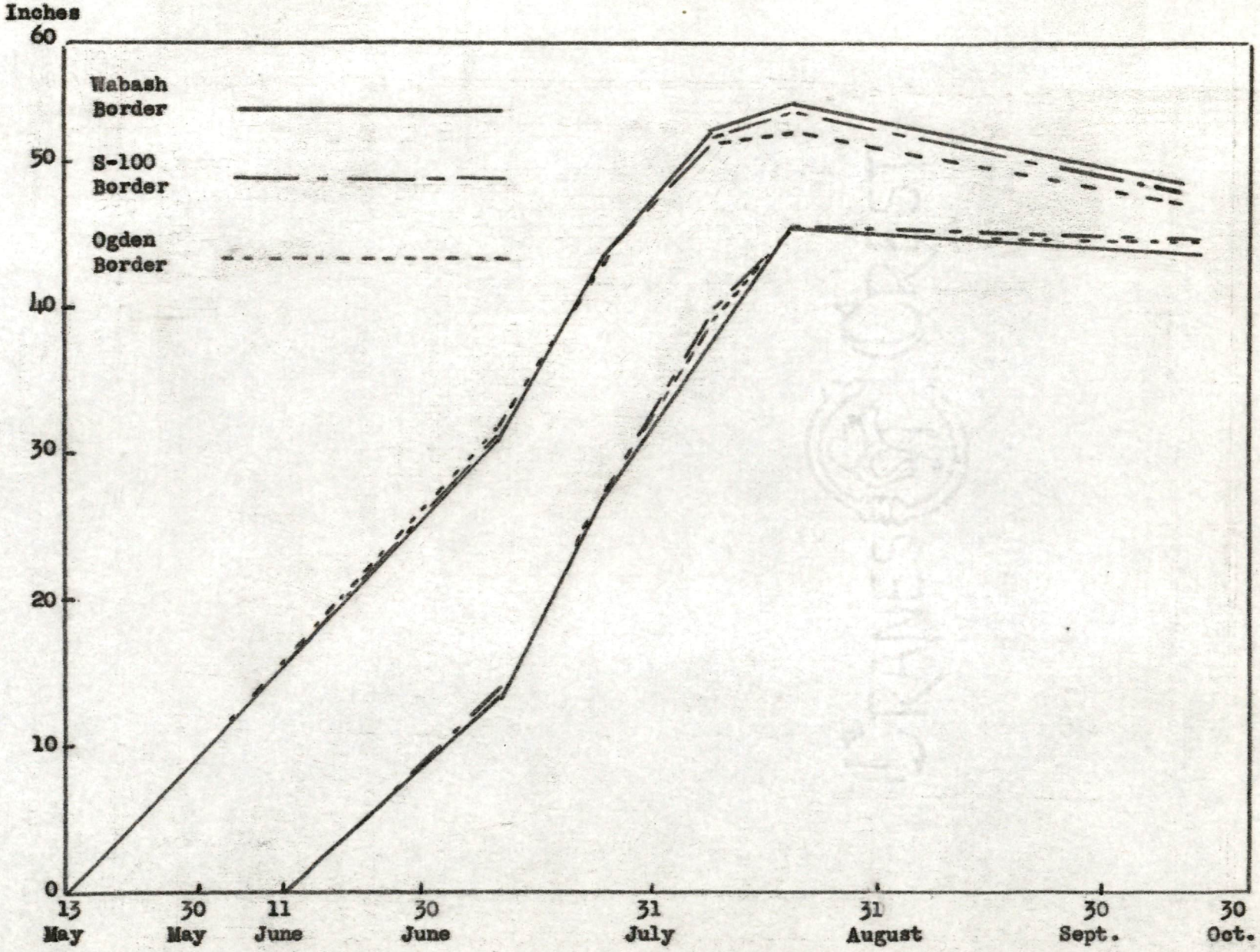


Figure 13. Growth curves for early and late planted Ogden.

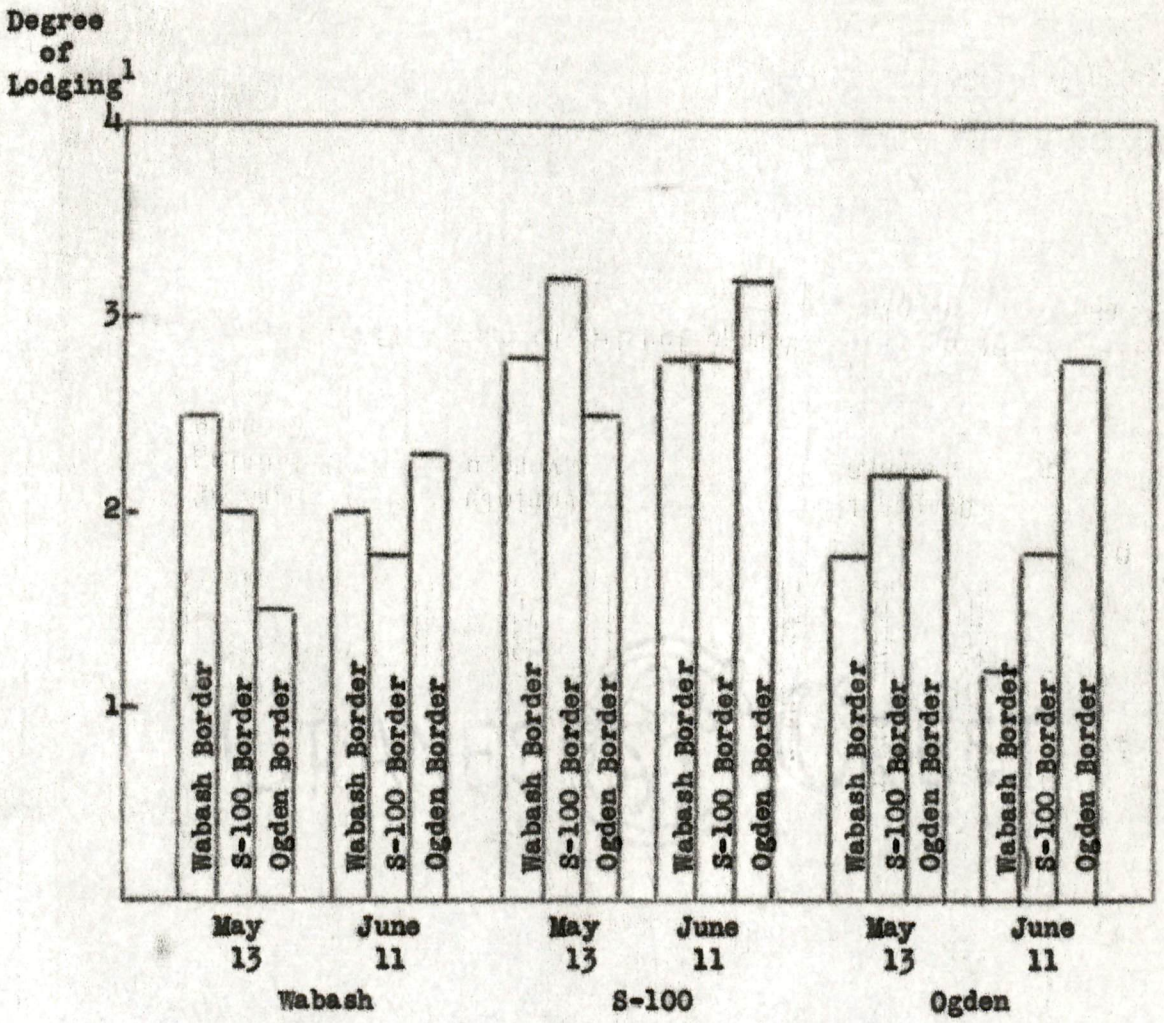


Figure 14. Average lodging of varieties for two dates of planting and when bordered by three different varieties.

1. (1) little or no lodging, (2) some lodging, (3) considerable lodging, (4) lodged heavily.

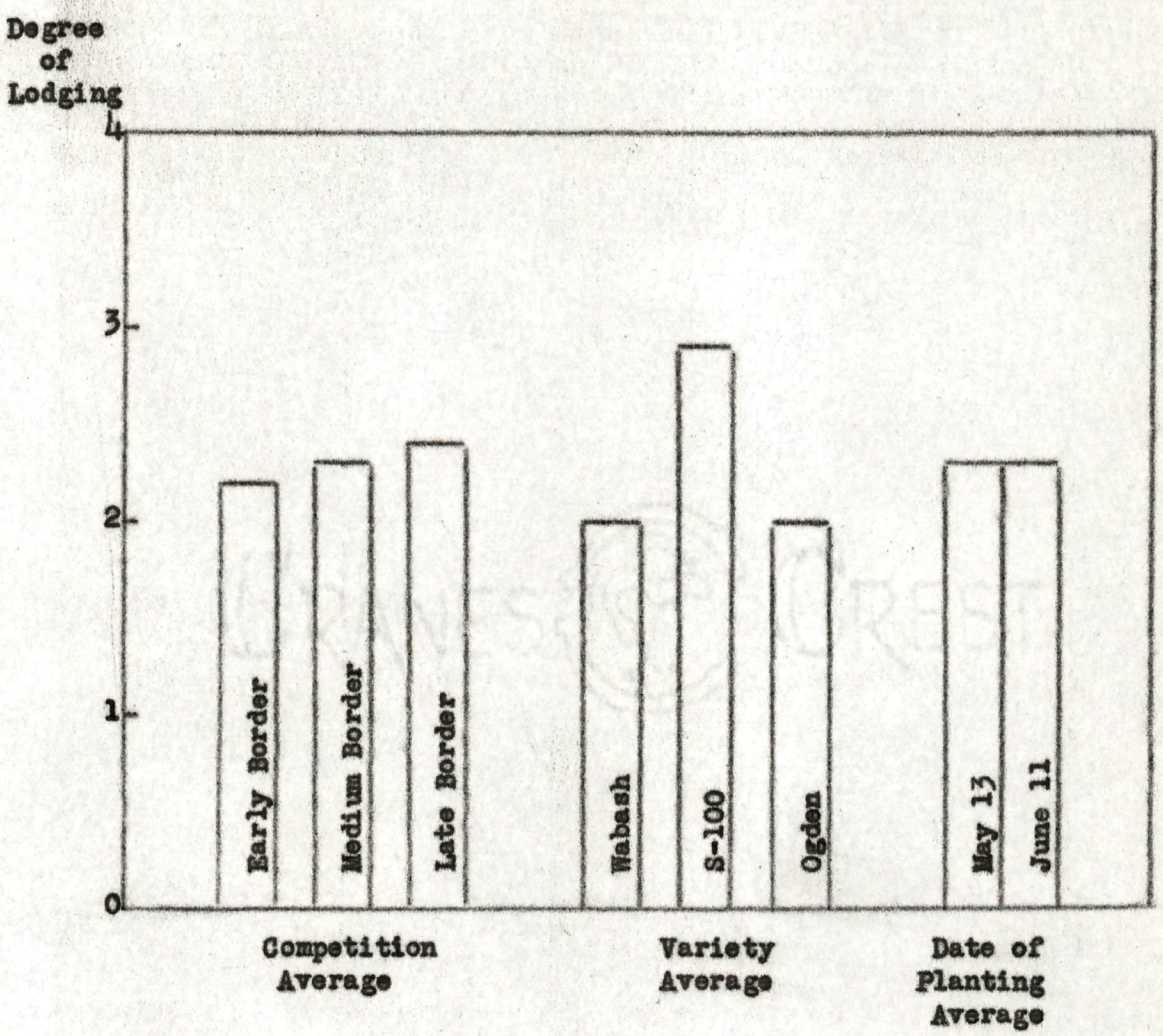


Figure 15. Average lodging by competition, varieties, and dates of planting.

good in six rows, and fair in two rows. These two varieties showed the highest quality. S-100 quality graded good in 22 rows and fair in two rows.

CHAPTER V

DISCUSSION AND CONCLUSIONS

Discussion

Soybean varieties vary in their ability to compete for nutrients and moisture with other soybean varieties. Competing ability was directly related to the length of the growing period. The late maturing variety depressed the yields of all other varieties planted in competition to it. The medium maturing variety offered more competition than the early maturing variety.

Date of planting did not alter this effect, although the differences were not as apparent in the later planting.

Competition was evident only in yields and in the number of beans in 500 pods. Competition did not affect the number of ovules in 500 pods. This indicates that the effects of competition become evident late in the growing period of the plants, between the time when ovules are set in the pods and maturity.

Date of planting affected the yields of all varieties. There was a substantially lower yield from the late planting.

Henson and Carr[1] reported that the early maturing varieties exhibited the most striking response to time of planting. They

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[1] P. R. Henson and R. B. Carr, "Soybean Varieties and Time of Planting Experiments," Mississippi State College Agricultural Experiment Station, Circular 140, March 1948.

reported that yields of the early maturing varieties were significantly and progressively reduced by late May and mid-June plantings. A similar effect was noticed at Knoxville, but the yields of all varieties tested were reduced in the late planting with little difference among varieties. The late planting of Wabash at Knoxville yielded 82.8 percent of the yield of the May 13 planting. The June 11 planting of the medium maturing S-100 yielded 86.6 percent of the May 13 planting, and the yield of the late maturing Ogden in the June 11 planting was 83.4 percent of the yield of the May 13 planting.

Feaster[2] reported that his investigations indicated that maximum yields were obtained from planting a full season variety as early in the spring as feasible. At Knoxville the May 13 planting of the Ogden and S-100 varieties resulted in higher yields than the earliest maturing variety planted at the same time.

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[2] G. V. Feaster, "Effect of Planting Time on Maturity, Yield, and Quality of Soybeans in Southeast Missouri," University of Missouri, Agricultural Experiment Station Bulletin 514, 1948.

Conclusions

Competition for nutrients, moisture and space between soybean varieties with different maturity dates affected yields of the test rows. Late maturing varieties offered more competition than either medium or early maturing varieties, and medium maturing varieties offered more competition than early maturing varieties.

The effect of competition became evident during the late stage of bean development, and did not influence the rate of growth nor the number of ovules per pod.

In planning varietal experiments with soybeans, varieties should appear with border rows of the same or a similar variety in order to eliminate an experimental bias due to competition.

BIBLIOGRAPHY

BIBLIOGRAPHY

Arny, A. C. "Border Effect and Ways of Avoiding It," Journal of the American Society of Agronomy, 14:266-278, 1922.

Brown, B. A. "Plot Competition with Potatoes," Journal of the American Society of Agronomy, 14:257-258, 1922.

Christidis, B. G. "Competition Between Cotton Varieties, A Reply," Journal of the American Society of Agronomy, 29:703-705, 1937.

Christidis, B. G. "Intervarietal Competition in Yield Trials With Cotton," Journal of Agricultural Science, 25:229-237, 1935.

Feaster, C. V. "Effect of Planting Time on Maturity, Yield, and Quality of Soybeans in Southeast Missouri," University of Missouri, Agricultural Experiment Station Bulletin 514, 1948.

Garber, R. J., and Odland, T. E. "Influence of Adjacent Rows of Soybeans on One Another," Journal of the American Society of Agronomy, 18:605-607, 1926.

Henson, P. R., and Carr, R. B. "Soybean Varieties and Time of Planting Experiments," Mississippi State College Agricultural Experiment Station, Circular 140, March 1948.

Immer, F. R. "Varietal Competition As a Factor in Yield Trials with Sugar Beets," Journal of the American Society of Agronomy, 26:259-261, 1934.

Probst, A. H. "Border Effect in Soybean Nursery Plots," Journal of the American Society of Agronomy, 35:662-666, 1943.

Quinby, J. R., Killough, D. T., and Stansel, R. N. "Competition Between Cotton Varieties in Adjacent Rows," Journal of the American Society of Agronomy, 29:269-279, 1937.

APPENDIX

APPENDIX A

YIELD IN POUNDS PER PLOT OF THRESHED BEANS FOR THREE VARIETIES AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11	Mean Both Date
Wabash	Wabash	2.11	1.70	2.17	1.76	2.01	1.40	1.83	1.67	2.03	1.63	1.83
Wabash	S-100	1.87	1.85	2.04	1.69	2.15	1.69	1.66	1.24	1.93	1.62	1.77
Wabash	Ogden	1.78	1.65	1.81	1.66	1.92	1.24	1.50	1.39	1.75	1.48	1.62
S-100	Wabash	2.44	1.97	2.38	1.88	2.34	1.68	2.29	1.97	2.36	1.88	2.12
S-100	S-100	2.35	2.19	2.19	1.63	2.19	1.89	1.94	1.74	2.17	1.86	2.02
S-100	Ogden	2.09	1.94	1.90	1.84	2.06	2.10	1.71	1.60	1.94	1.87	1.90
Ogden	Wabash	2.49	2.08	2.52	1.70	2.63	1.81	2.19	1.97	2.46	1.89	2.17
Ogden	S-100	2.14	1.87	2.25	1.93	2.07	1.91	2.20	1.92	2.16	1.91	2.04
Ogden	Ogden	2.17	1.71	1.73	1.64	1.73	1.69	1.79	1.39	1.86	1.61	1.73

ANALYSIS OF VARIANCE

Variation due to	Degrees Freedom	Variance	F Calc.
Total	71		
Treatment	2	0.5195	28.39**
Replication	3	0.1828	9.99**
T x R (Error A)	6	0.0183	---
Variety	2	0.0183	23.90**
Date of Planting	1	1.8850	85.29**
Treatment x Variety	4	0.0394	1.78
Treatment x Date of Planting	2	0.1300	5.88**
Variety x Date of Planting	2	0.0074	0.33
Error B	49	0.0221	---

** Highly significant.

APPENDIX B

WEIGHT IN GRAMS PER 100 BEANS OF A SAMPLE TAKEN FROM THE THRESHED YIELD OF EACH PLOT FOR THREE VARIETIES AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11	Mean Both Date
Wabash	Wabash	12.7	12.8	12.6	12.3	12.6	12.9	13.0	13.2	12.7	12.8	12.8
Wabash	S-100	13.9	13.7	13.0	13.0	13.9	12.9	14.8	12.8	13.9	13.1	13.5
Wabash	Ogden	11.7	12.8	13.8	14.2	12.4	12.3	14.6	13.2	13.1	13.1	13.1
S-100	Wabash	13.5	13.9	14.7	14.3	13.6	13.9	15.4	14.7	14.3	14.2	14.2
S-100	S-100	13.8	13.7	14.2	14.8	12.9	13.3	12.8	14.0	13.4	13.9	13.7
S-100	Ogden	13.7	13.7	13.2	14.4	14.0	12.9	14.0	13.7	13.7	13.7	13.7
Ogden	Wabash	14.2	12.4	14.0	12.2	14.6	12.8	15.8	12.8	14.6	12.6	13.6
Ogden	S-100	13.8	14.1	14.3	13.5	14.0	14.2	15.4	13.7	14.4	13.9	14.1
Ogden	Ogden	14.4	13.0	14.6	14.4	13.2	13.4	13.6	13.8	13.9	13.6	13.8

ANALYSIS OF VARIANCE

Variation due to	Degrees Freedom	Variance	F Calc.
Total	71	0.679	
Treatment	2	0.43	0.74
Replication	3	1.54	2.66
T x R (Error A)	6	0.58	----
Variety	2	4.28	10.70**
Date of planting	1	2.35	0.59
Treatment x Variety	4	1.02	2.55*
Treatment x Date of Planting	2	0.57	1.42
Variety x Date of Planting	2	1.85	4.62*
Error B	49	.40	----

* Significant.
** Highly significant.

APPENDIX C

NUMBER OF OVULES IN 500 PODS TAKEN FROM A SAMPLE FROM EACH PLOT OF THREE VARIETIES AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11	Mean Both Date
Wabash	Wabash	1368	1352	1389	1338	1341	1361	1380	1320	1369	1343	1356
Wabash	S-100	1390	1354	1371	1330	1350	1346	1362	1339	1368	1342	1355
Wabash	Ogden	1369	1327	1347	1308	1347	1325	1312	1344	1344	1326	1335
S-100	Wabash	1256	1291	1257	1251	1233	1251	1256	1283	1250	1269	1260
S-100	S-100	1263	1263	1250	1258	1224	1278	1229	1278	1242	1269	1255
S-100	Ogden	1262	1259	1261	1243	1259	1270	1261	1257	1261	1257	1259
Ogden	Wabash	1161	1139	1167	1120	1093	1145	1180	1152	1150	1139	1145
Ogden	S-100	1179	1166	1149	1145	1110	1118	1148	1192	1146	1155	1151
Ogden	Ogden	1230	1136	1129	1143	1197	1133	1126	1195	1170	1152	1161

ANALYSIS OF VARIANCE

Variation due to	Degrees Freedom	Variance	F Calc.
Total	71		
Treatment	2	32.6	0.07
Replication	3	1,623.2	3.67
T x R (Error A)	6	442.8	-----
Variety	2	232,229.2	480.21**
Date of Planting	1	533.5	1.10
Treatment x Variety	4	861.5	1.78
Treatment x Date of Planting	2	430.1	0.89
Variety x Date of Planting	2	2,149.8	4.45*
Error B	49	483.6	-----

* Significant.
** Highly significant.

APPENDIX D

NUMBER OF BEANS IN 500 PODS TAKEN FROM A SAMPLE FROM EACH PLOT OF THREE VARIETIES AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11	Mean Both Date
Wabash	Wabash	1070	1089	1133	1125	1103	1158	1134	1122	1110	1124	1117
Wabash	S-100	1012	1057	1125	1072	977	1046	931	1003	1011	1046	1028
Wabash	Ogden	1020	1043	1012	982	1058	1067	795	956	971	1012	992
S-100	Wabash	1033	1179	1057	1174	1014	1141	1079	1165	1046	1165	1105
S-100	S-100	1067	1144	1055	1127	973	1156	984	1196	1020	1156	1088
S-100	Ogden	924	1107	985	1112	1014	1190	980	1154	976	1141	1058
Ogden	Wabash	967	867	1010	913	942	963	995	896	978	910	944
Ogden	S-100	947	894	933	889	889	851	923	859	923	873	898
Ogden	Ogden	966	903	912	830	960	889	848	923	922	861	891

ANALYSIS OF VARIANCE

Variation due to	Degrees Freedom	Variance	F Calc.
Total	71		
Treatment	2	35,130.3	6.65*
Replication	3	2,889.4	0.55
T x R (Error A)	6	5,279.8	----
Variety	2	197,007.8	107.36**
Date of Planting	1	24,017.0	13.09**
Treatment x Variety	4	4,567.3	2.49
Treatment x Date of Planting	2	1,163.0	0.63
Variety x Date of Planting	2	59,994.1	32.69**
Error B	49	1,835.1	----

* Significant.
** Highly significant.

APPENDIX E

AVERAGE DATE OF BLOSSOMING FOR EACH PLOT OF THREE VARIETIES AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11
Wabash	Wabash	7/4	7/23	7/4	7/25	7/4	7/22	7/4	7/25	7/4	7/24
Wabash	S-100	7/4	7/23	7/4	7/25	7/4	7/22	7/4	7/22	7/4	7/23
Wabash	Ogden	7/4	7/23	7/4	7/23	7/4	7/22	7/4	7/24	7/4	7/23
S-100	Wabash	7/11	7/29	7/11	7/29	7/11	7/22	7/11	7/30	7/11	7/28
S-100	S-100	7/12	7/29	7/11	7/29	7/11	7/25	7/11	7/27	7/11	7/28
S-100	Ogden	7/11	8/1	7/11	7/29	7/11	7/26	7/11	7/27	7/11	7/28
Ogden	Wabash	7/27	8/9	7/26	8/12	7/29	8/10	7/26	8/14	7/27	8/11
Ogden	S-100	7/26	8/9	7/26	8/11	7/26	8/9	7/27	8/10	7/26	8/10
Ogden	Ogden	7/29	8/13	7/25	8/12	7/26	8/9	7/26	8/9	7/28	8/11

APPENDIX F

MATURITY DATE FOR EACH PLOT OF THREE VARIETIES AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1		Repl. 2		Repl. 3		Repl. 4		Mean	
		May 13	June 11	May 13	June 11	May 13	June 11	May 13	June 11	May 13	June 11
Wabash	Wabash	9/11	9/19	9/11	9/19	9/11	9/19	9/11	9/19	9/11	9/19
Wabash	S-100	9/11	9/19	9/11	9/19	9/11	9/19	9/11	9/19	9/11	9/19
Wabash	Ogden	9/11	9/19	9/14	9/19	9/11	9/19	9/11	9/19	9/12	9/19
S-100	Wabash	9/25	10/3	9/25	10/3	9/25	10/3	9/25	10/3	9/25	10/3
S-100	S-100	9/25	10/3	9/25	10/3	9/25	10/3	9/25	10/3	9/25	10/3
S-100	Ogden	9/25	10/3	9/25	10/3	9/25	10/3	9/25	10/3	9/25	10/3
Ogden	Wabash	10/11	10/15	10/11	10/14	10/11	10/14	10/12	10/14	10/11	10/14
Ogden	S-100	10/11	10/15	10/11	10/14	10/11	10/14	10/10	10/14	10/11	10/14
Ogden	Ogden	10/11	10/15	10/11	10/14	10/11	10/14	10/10	10/14	10/11	10/14

APPENDIX G

LODGING DATA FOR THREE VARIETIES OF SOYBEANS AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11	Mean Both Dates
Wabash	Wabash	2	3	3	2	2	1	3	2	2.5	2.0	2.3
Wabash	S-100	2	2	2	2	3	2	1	1	2.0	1.8	1.9
Wabash	Ogden	2	3	2	3	1	1	1	2	1.5	2.3	1.9
S-100	Wabash	3	4	3	3	2	2	3	2	2.8	2.8	2.8
S-100	S-100	3	3	4	3	3	4	3	1	3.2	2.8	3.0
S-100	Ogden	3	4	3	4	2	3	2	2	2.5	3.2	2.9
Ogden	Wabash	2	1	2	1	2	1	1	2	1.8	1.2	1.5
Ogden	S-100	3	2	2	2	3	2	1	1	2.2	1.8	2.0
Ogden	Ogden	1	3	3	4	3	2	2	2	2.2	2.8	2.5

Legend - (1) little or no lodging
(2) some lodging
(3) considerable lodging
(4) lodged heavily

APPENDIX H

SEED QUALITY TAKEN FROM A SAMPLE OF THE THRESHED YIELD OF EACH PLOT FOR THREE VARIETIES OF SOYBEANS AT TWO DATES OF PLANTING AND WHEN BORDERED BY THREE DIFFERENT VARIETIES

Variety	Competing Variety	Repl. 1 May 13	Repl. 1 June 11	Repl. 2 May 13	Repl. 2 June 11	Repl. 3 May 13	Repl. 3 June 11	Repl. 4 May 13	Repl. 4 June 11	Mean May 13	Mean June 11	Mean Both Dates
Wabash	Wabash	1	1	1	1	2	1	2	1	1.5	1.0	1.2
Wabash	S-100	1	1	3	1	2	1	3	1	2.2	1.0	1.6
Wabash	Ogden	1	1	2	2	2	1	3	1	2.0	1.2	1.6
S-100	Wabash	2	2	2	2	2	2	3	2	2.2	2.0	2.1
S-100	S-100	2	3	2	2	2	2	2	2	2.0	2.2	2.1
S-100	Ogden	2	2	2	2	2	2	2	2	2.0	2.0	2.0
Ogden	Wabash	1	1	1	1	1	1	1	1	1.0	1.0	1.0
Ogden	S-100	1	1	1	1	1	1	1	1	1.0	1.0	1.0
Ogden	Ogden	1	1	1	1	1	1	1	1	1.0	1.0	1.0

Legend - (1) very good
(2) good
(3) fair
(4) poor
(5) very poor