A CULTURAL STUDY OF GUAR INVOLVING THREE VARIETIES,

THREE-ROW SPACINGS AND THREE RATES OF PLANTING

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# INTRODUCTION

Guar, a drought hardy summer annual legume, has received considerable promotion in the Southwest by General Mills, Inc., Special Commodities Division. The processors are interested in guar because of the high gum content of the seed. However, guar serves other purposes for area farmers. Farmers sell guar seed, feed the rolled seed to cattle, cut the plants for forage, or use it as a green manure crop. Growers claim that the deep taproot penetrates the soil to permit air and moisture free access in the soil.

Currently, most of the guar is planted with cotton and grain sorghum equipment, and some with the grain drill, but the latter usually produces discouraging results. The guar seed is harvested with a grain combine. The seeding rates presently used in Oklahoma are not based on research data.

The average state yield in 1958 and 1959 was estimated by General Mills fieldmen at approximately 500 pounds per acre. The variety Groehler, in tests on the Sandy Land Research Station near Mangum, Oklahoma has yielded as high as 1900 pounds per acre. Low seed yield is an important problem in determining the economic feasibility of establishing guar as a cash crop. The seeding rates and row widths presently used by Oklahoma growers apparently have not given high yields.

The purpose of this test was to study the effects of three row

spacings, and three rates of planting, on the yield of seed, forage, and protein content and other agronomic characteristics of three varieties of guar.

## LITERATURE REVIEW

The simplest and best cultural practice under irrigation in Arizona seems to be to drill from 12 to 16 pounds of guar seed per acre in 12 or 14 inch rows, on a firm seedbed with a shallow mulch, according to Matlock and Aelpi (7). They stated that the seed should be planted only deep enough to place it in firm, moist soil, which is usually 1.5 to 2 inches deep.

Studies in India (5) indicate that 2.5 inches is the optimum depth of planting guar in loam soil.

Irrigated tests in Arizona were conducted by Matlock and Aelpi (7) using the Mesa variety with rows spaced from 7 to 36 inches apart. They found that higher mean yields for the Mesa variety were obtained from 7-inch and 12-inch spacings than those from 24 to 36. On a thresher run basis the 12-inch rows yielded 1587 and the 36-inch rows 876 pounds of seed per acre. However, these results were considered to be inconclusive.

Esser (4) states that guar should not be broadcast because the competition for moisture reduces plant growth.

According to Wester (9) the distance of the spacing of plants in the Philippines should be governed by the climate and fertility of the soil. With favorable growing conditions the wider spacings should be used. He recommended that guar should be spaced 45 to 55 centimeters

or approximately 18 to 25 inches between rows and drilled thinly.

Kelly, Wilcox, and McClellan (6), from research conducted in Hawaii, reported that a guar variety planted in rows 5 feet apart and from 2 to 6 inches spacings in the row produced yields ranging from 1.25 to 2.75 tons of air dried forage per acre, and seed yields ranging from 1,190 to 2,610 pounds per acre.

Rate of seeding studies by Brooks (1) indicated that planting with an ordinary tractor planter, equipped with grain sorghum plates, gave good stands without thinning. Brooks (2) reported that guar can be broadcast but that it does best as a row crop.

Brooks and Harvey (3) conducted an experiment in 1943 using three different methods of planting guar. They used 36-inch rows, with plants spaced 4 inches apart; 36-inch rows with 12-inch spacings of the plants in the row; and broadcast at 25 pounds per acre. Even though the plant populations were different, mean yields did not differ greatly ranging from 615 pounds per acre for the 4-inch spacings and 36-inch rows, to 744 pounds per acre for the broadcast. They concluded that the guar plant apparently has the ability to adapt itself to a wide range of spacings. They received the highest yields from the broadcast plots but this lacked the advantage of cultivation. Planting in rows offered the advantage of weed control which was necessary under good moisture conditions.

Esser (4) reported that the planting rate should be 5 to 6 pounds per acre in rows.

Satisfactory results were obtained under irrigated conditions in Arizona using 15 to 18 pounds per acre of Mesa guar planted on a good seedbed with good quality seed (7). No seeding rate test had been

conducted using Texsel or a Fine Branching selection. Since the seed of Texsel were smaller than those of Mesa, Matlock and Aelpi (7) used only 12 to 14 pounds per acre. They used 15 to 18 pounds per acre for the Fine Branching selection with satisfactory results even though the seed were slightly larger than those of Mesa. For green manuring they recommended higher rates but not to exceed 20 to 25 pounds of small seed and 25 to 30 pounds for large seed.

Jones[1] conducted a test using guar at the rate of 4 viable seed per foot in both 21 and 42 inch rows. His data showed that the 42-inch rows produced 174.21 pounds more protein per acre and the protein content of the forage was 2.09% higher than the 21 inch rows. There were significant differences at the 5% level in the percentage of forage and pounds of protein per acre. The 42-inch rows produced 245 pounds of dry matter more than did the 21-inch rows. However, this was not significant at the 5% level.

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[1]Bill C. Jones. "A Forage and Protein Yield Study of Sorghum Grown Alone and in Combination with Four Summer Legumes, Guar, Cowpeas, Mungbeans, and Soybeans". (Unpubl. M.S. Thesis Oklahoma State University, 1959), p. 9.

## MATERIALS AND METHODS

This study involved three varieties, three row spacings and three planting rates for guar, Cyamopsis tetragonoloba (L) Taub. The study was conducted during 1959 on a Vanoss very fine sandy loam soil on the Agronomy Research Station near Perkins, Oklahoma.

A randomized block design, interpreted as a $3^3$ factorial with four replications, was used. Each replication consisted of three ranges and each range consisted of nine four-row plots. The ranges were each 25 feet long and a blank space of 25 feet was left between ranges to facilitate cultivation.

The varieties used were Groehler, Texsel and a Plant Introduction 164801. Each of the three varieties differed in habit of growth. Groehler has basal branches arising near the base of the plant. Texsel is primarily non-branching or erect since the variety has very few or no branches. P.I. 164801 has a branching habit with the branches arising along the plant.

The row widths were 20, 30, and 40 inches between rows. The planting rates were three, six, and nine seed per foot of row.

The final seedbed was prepared using a spring tooth harrow followed by a spike tooth harrow immediately before planting. Guide rows were marked using a hand row marker.

The seed was planted flat in the furrows formed by the marker. Four row plots were used. The two outside rows were border rows and the inner two rows were for seed and forage yield.

A modified hand planter was used to plant the seed. It consisted of hand dropping the seed through a funnel welded to a piece of pipe.

The seed was planted thick in all plots and after complete emergence, the plants were hand thinned to the appropriate number of plants per foot. The seed was inoculated and treated with Arasan before planting.

The first planting was made May 30 and 31. The test was replanted on June 30 and July 2. Replanting was necessary because excessive rainfall resulted in a poor stand caused by seedling diseases.

The pre-emergence spray, Eptam, was applied to the second planting on July 3. The material was applied at 40 pounds pressure and at the rate of four pounds per acre in 20 gallons of water. A power take off sprayer mounted on a tractor was used.

Heavy rains continued in July and Alternaria Leaf Spot became severe on the guar plants. A fungicide, Dithane Z-78, was applied on July 23 at the rate of 2 pounds per acre. To control this disease the fungicide was applied using a knapsack sprayer.

Soil samples from the test area were analyzed by personnel of the Agronomy soil testing laboratory. Results were as follows:

| Field Area | pH | Available Phos. lbs./A. | % OM. | Exchangeable K. lbs./A. |
|---|---|---|---|---|
| A | 5.6 | 29 | 0.860 | 304 |
| B | 5.6 | 24 | 0.777 | 240 |
| C | 5.4 | 19 | 0.749 | 284 |

These analyses indicate that the test area was a moderately acid soil low in phosphorus and organic matter. The potassium content was adequate.

A small one row tractor was used to cultivate the 30-and 40-inch rows. A garden "Chore-master" was used to cultivate the 20-inch rows.

Forage yields were taken September 11 on the second row from the left in each treatment. The plants were cut approximately two inches above the ground and weighed. A sample of the green forage was obtained and weighed and then placed in a drying oven for 48 hours at 140° F. Oven-dry weights were used to obtain the percentage of dry matter.

The dried samples for each treatment in replications I and II were ground with a Wiley Mill. The nitrogen content of each sample was determined by the Kjeldahl method. These were corrected to percent protein using 6.25 as a conversion factor.

The seed yields were obtained by pulling the stalks from 16 feet of the third row from the left in each plot. The plants were threshed with a nursery thresher. The plots were harvested for seed about two weeks after frost.

Seed and forage yields were calculated using an equal area for each individual plot.

The statistical analysis was calculated as outlined in Snedecor (8).

## RESULTS AND DISCUSSION

Mean seed and forage yields in this study were lower than those obtained in variety tests containing Groehler, Texsel and P. I. 164801 planted 30 days earlier. The mean seed yield for the 40-inch rows in this study were 31, 36, and 30 percent lower respectively than those of Texsel, Groehler and P. I. 164801 in the variety test located nearby. In the present study the pounds of seed, forage and protein per acre were calculated and expressed on the basis of each plot being equal in size.

A summary of agronomic data is shown in Appendix Table I.

### The Effect of Row Spacing

Seed: The mean seed yield for the 20-, 30-, and 40-inch row spacings were 642, 540, and 421 pounds, respectively. Groehler mean seed yields were 670, 646, and 475 pounds, respectively for the 20-, 30-, and 40-inch rows. Though the mean seed yields of Texsel and P. I. 164801 were slightly lower than Groehler, the row spacing yields produced the same pattern as Groehler (Figure I). The 20-inch row spacings produced a higher mean seed yield than the wider spacings.

A different breakdown of the analysis of variance showed that each variety at the three-row spacings had a linear relationship.

The analysis of variance indicated that row spacings differed significantly at the 1% level (Table I). The coefficient of variation was 20.58 percent.

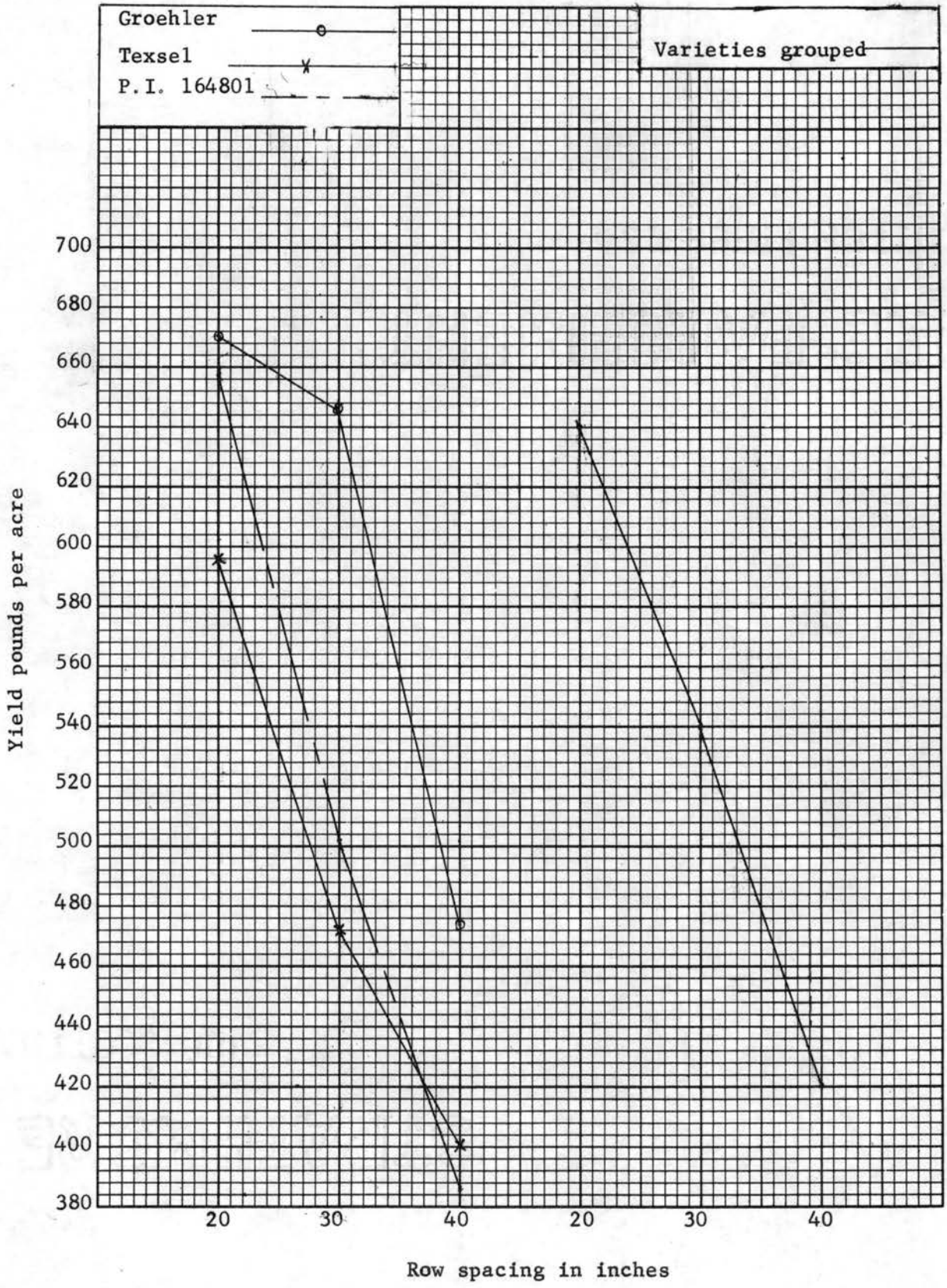


Figure 1. Graphic presentation of the mean seed yield for each of three guar varieties at each of three row spacings obtained in the guar cultural study, 1959.

TABLE I

ANALYSES OF VARIANCE FOR SEED, FORAGE, AND PROTEIN YIELDS OBTAINED IN THE GUAR CULTURAL PRACTICE STUDY ON THE PERKINS AGRONOMY RESEARCH STATION, 1959

| Source of Variation | DF | Mean Squares Seed | DF | Forage | DF | Protein |
|---|---|---|---|---|---|---|
| Total | 107 | | 104 | | 53 | |
| Replications | 3 | 9341.636 | 3 | 32480.93 | 1 | 6430.36 |
| Treatments | 26 | 13311.49 | 26 | 220739.23 | 26 | 2781.05 |
| Varieties (V) | 2 | 28396.41 ** | 2 | 144359.85 | 2 | 2784.65 |
| Rates (R) | 2 | 1210.25 | 2 | 66693.20 | 2 | 176.63 |
| Spacing (S) | 2 | 109904.21 ** | 2 | 2042208.00** | 2 | 22089.50** |
| VxR | 4 | 661.67 | 4 | 28615.00 | 4 | 242.60 |
| VxS | 4 | 4495.50 | 4 | 93625.55 | 4 | 1430.55 |
| RxS | 4 | 4326.01 | 4 | 62577.18 | 4 | 812.10 |
| VxRxS | 8 | 3643.02 | 8 | 61678.30 | 8 | 1533.10 |
| Error | 78 | 3022.75 | 75 | 60971.08 | 26 | 1012.88 |
| C. V.% | | 20.58 | | 21.78 | | 15.38 |

** Indicates Significance at 1% Level.

Forage: Forage yields for the three missing plots were calculated. The missing plots occurred in three different replications for three different varieties. It was considered impractical to remove the bias in the sum of squares. Had this bias been removed, the significance level might be lowered slightly to some place between the 5% and 1% level of significance.

The amount of dry forage per acre ranged from 2762 to 1808 pounds per acre. The mean yields were 2676 pounds for the 20-inch spacings, 2261 pounds for the 30-inch spacings and 1808 for the 40-inch row spacings. The mean forage yields for each variety were highest for the 20-inch spacings and lowest for the 40-inch spacings.

In a different breakdown of the data, the forage yields showed a linear relationship presented graphically in Figure II.

The mean forage yields for the respective 20-, 30-, and 40-inch row spacings were 3333, 2458, and 1813 for Groehler, 2530, 2058, and 1856 for Texsel, and 2754, 2269, and 1755 pounds per acre for P.I. 164801.

The analysis of variance indicated a significant difference among the row spacings at the 1% level (Table I). The coefficient of variation was 21.78 percent.

Protein: The protein content of the forage was determined for samples from each of two replications. The analysis of variance for protein is shown in Table I. Mean protein yields were 467, 439, and 334 pounds per acre for the 20-, 30-, and 40-inch rows, respectively.

A further breakdown of the data indicated that the protein yields for Texsel and P.I. 164801 were linear, but the Groehler yields were quadratic. A graphic presentation is shown in Figure III. This possibly can be explained by the larger number of branches at the 30-inch row spacings for Groehler (Figure IV).

The difference in the amount of protein per acre among the row


Figure 2. Graphic presentation of mean forage yield for each of three guar varieties at each of three row spacings obtained in the guar cultural study, 1959.

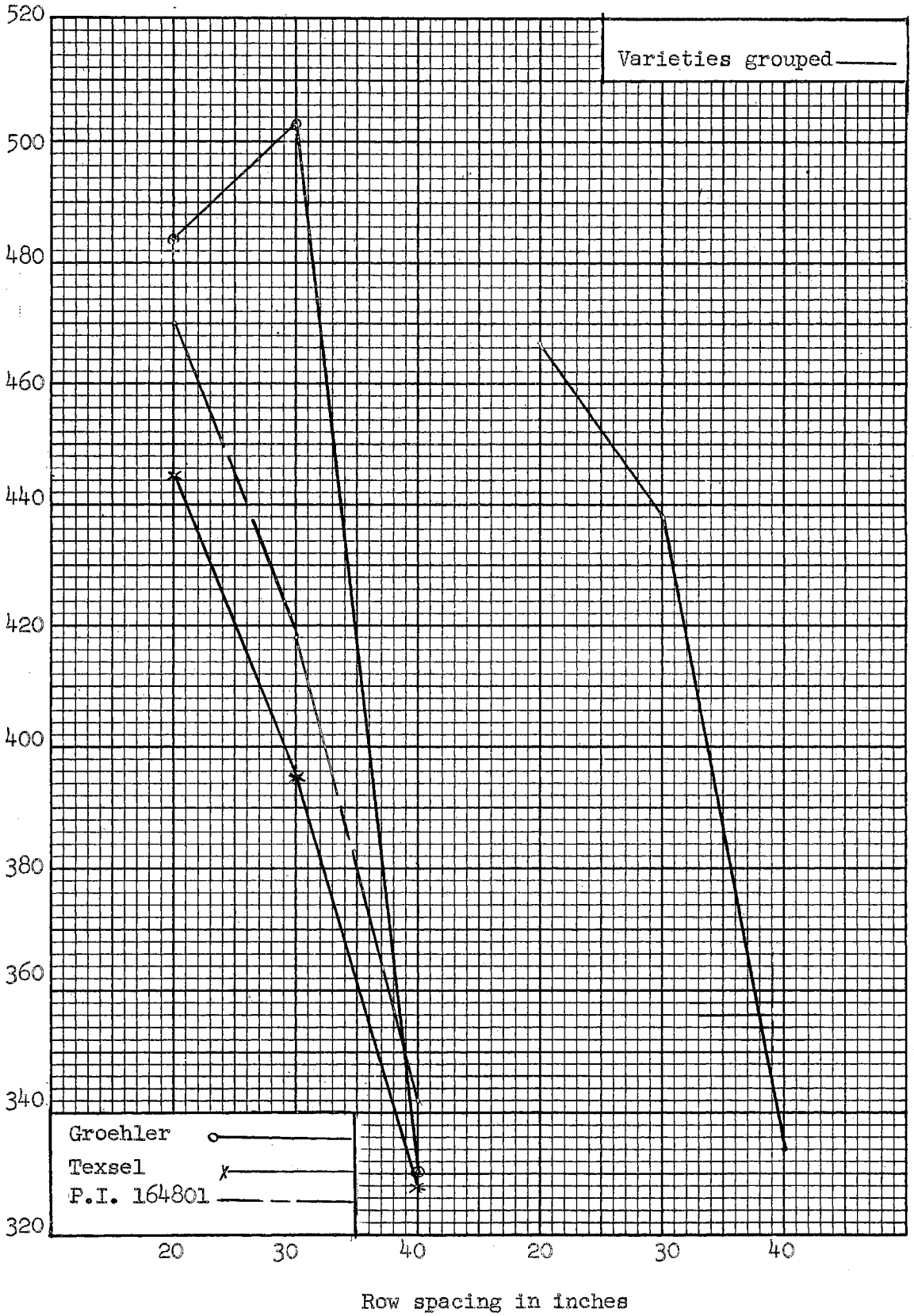


Figure 3. Graphic presentation of the mean protein yield for each of three guar varieties at each of three row spacings obtained in the guar cultural study, 1959.

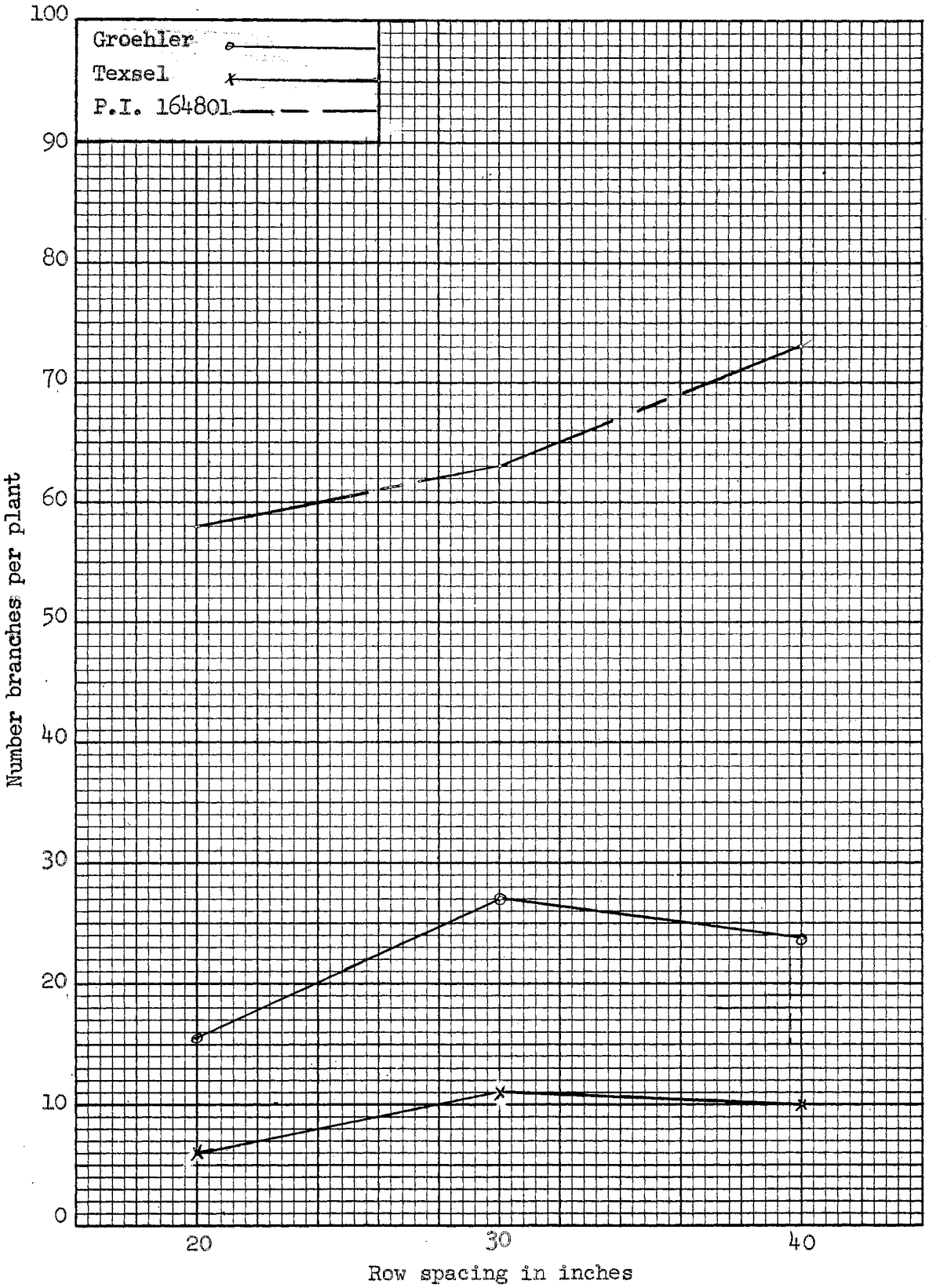


Figure 4. Graphic presentation of the mean number of branches per plant in four feet of row for each of three guar varieties at each of three row spacings on the guar cultural study, 1959.

TABLE II

ANALYSES OF VARIANCE FOR OTHER AGRONOMIC CHARACTERS OBTAINED IN THE GUAR CULTURAL PRACTICE STUDY ON THE PERKINS AGRONOMY RESEARCH STATION, 1959

| Source of Variation | DF | Mean Squares: Number of Branches | Protein Percent | DF | Plant Height | Stem Diameter | DF | Branch Length |
|---|---|---|---|---|---|---|---|---|
| Total | 53 | | | 215 | | | 107 | |
| Between Experimental Units | | | | 107 | 27.35 | | | |
| Replications | 1 | 96.00 | 0.66 | 3 | 119.33 | 3.08 | 3 | 93.35 |
| Treatments | 26 | 1267.08 | 0.10 | 26 | 55.35 | 2.65 | 26 | 33.90 |
| Varieties (V) | 2 | 11864.35** | | 2 | 306.50** | | 2 | |
| Rates (R) | 2 | 267.18 | | 2 | 37.00 | | 2 | |
| Spacings (S) | 2 | 202.46 | | 2 | 218.00** | | 2 | |
| VxS | 4 | 67.19 | | 4 | 8.50 | | 4 | |
| VxR | 4 | 85.46 | | 4 | 24.00 | | 4 | |
| RxS | 4 | 102.96 | | 4 | 28.25 | | 4 | |
| VxRxS | 8 | 157.21 | | 8 | 9.10 | | 8 | |
| Experimental Error | 26 | 113.08 | 0.06 | 78 | 14.47 | 1.83 | 78 | 35.12 |
| Sampling Error | | | | 108 | 4.92 | 0.08 | | |
| C. V.% | | 32.40 | 8.66 | | 14.64 | 18.61 | | 36.29 |

** Indicates Significance at 1% Level.

spacings resulted from differences among the dry forage yields since the variances for the percentage of protein did not differ significantly (Table II). The coefficient of variation was 8.66 percent.

## Variety Effects

Seed: The total mean seed yields were 598, 516, and 490 pounds per acre, respectively, for Groehler, P.I. 164801 and Texsel. The mean square among varieties showed a significant difference at the 1% level (Table I).

Forage: The total mean dry forage per acre ranged from 2423 pounds for Groehler to 2037 pounds per acre for Texsel. The variety forage yields did not indicate a significant difference (Table I).

Protein: The total mean protein yield per acre was highest for Groehler which produced 440, followed by P.I. 164801 at 410 and Texsel at 390 pounds per acre. These yields followed the same pattern as the forage yields. The variance for protein yields among the varieties did not indicate a significant difference (Table I).

## Seeding Rate Effects

Seed: The seeding rate of 3 plants per foot produced the highest seed yield for Groehler and P.I. 164801. The mean seed yields for Groehler were 622, 575, and 595 pounds per acre, respectively, for the rates of 3, 6, and 9 plants per foot. Mean seed yields for P.I. 164801 were 529, 500, and 521 pounds per acre for the respective rates of 3, 6, and 9 plants per foot. Texsel had mean seed yields of 491, 498, and 481 pounds per acre for the three respective rates. The mean squares for rates did not indicate a significance with respect to seed yields (Table I).

Forage: Though forage yields among seeding rates indicated no significant

difference, it is interesting to note that the rate of 6 plants per foot gave the highest mean forage yield for each of the three varieties (Table I). At the rate of 6 plants per foot, the mean forage yields were 2586, 2343, and 2199 pounds of dry matter per acre, respectively, for Groehler, P.I. 164801 and Texsel.

Protein: The mean protein per acre for Texsel and P.I. 164801 was highest for 6 plants per foot. Groehler produced 27 pounds per acre more at the rate of 3 plants per foot than at 6 plants per foot. Texsel produced 400, Groehler produced 428, and P.I. 164801 produced 423 pounds per acre of protein at the rate of 6 plants per foot. Groehler at 3 plants per foot averaged 455 pounds of protein. There was no significant difference among the seeding rates for protein yield indicated by the analysis of variance (Table I).

## Other Agronomic Characters

Number of Branches: The number of branches were counted on plants in four feet of row area in each of two replications. The mean number of branches for the four feet were 22 for Groehler, 18 for Texsel and 65 for P.I. 164801. There was a significant difference among the varieties with respect to the number of branches (Table II). This is expected since the varieties used in this study had different growth habits (Figure IV). The coefficient of variation was 32.40.

Plant Height: Significant differences among the variety means and among the row spacing means were indicated for plant height (Table II). The mean heights for Groehler, Texsel and P.I. 164801 were 26, 28, and 24 inches, respectively. The mean heights for the 20-, 30-, and 40-inch row spacings were 24, 27, and 27 inches, respectively. The variance for seeding rate indicated very little effect on plant height in this experiment.

Stem Diameter: Stem diameter was measured in millimeters at the ground level of the plant. The stem diameter varied from 8.50 to 6.23 millimeters. No significant difference among the treatment means was indicated in this study (Table II).

Branch Length: The length of branches of the plants in a 4-foot section of row were measured for two replications of each treatment. There was no significant difference among the treatment means (Table II). However, branch length measurements varied from 21.19 to 8.31 inches.

Plans were to determine the seed quality score for the seed from each plot. However, no differences could be ascertained with respect to seed quality. Each plot produced seed that was rather dark in color, probably as a result of high rainfall during maturity and disease.

High rainfall probably contributed to the favorable yields obtained at the 20-inch row spacing and seasons with less rainfall probably would produce different results (Appendix Table II).

It is possible that a row spacing of less than 20 inches may produce higher yields though growers in the Southwest report discouraging results from drilled plantings.

As shown in Appendix Table I, the mortality rate is increased at the higher planting rates. Perhaps an accurate metering device should be used to obtain the various rates rather than attempting to thin the stands for a specific rate.

Various amounts of rabbit grazing were observed on July 15, mostly in the area of replication IV. The plants made excellent recovery and the grazed areas were indistinguishable at harvest.

Seedling diseases were very apparent in the area of replication I. As fertility requirements of guar are not known, it is suggested that future studies be conducted on more fertile soil than was used for this study.

## SUMMARY AND CONCLUSIONS

A study involving three guar varieties, three-row spacing and three rates of planting, was conducted at the Agronomy Research Station near Perkins, Oklahoma during 1959.

The objectives of this test were to study the effects of row spacing, variety and rate of planting on certain agronomic characters of guar.

A randomized block design interpreted as a $3^3$ factorial was used. The test was planted June 30 and July 2, and harvested for forage yield in September and seed yield in November, 1959. The yield of seed, forage and protein per acre was determined, with each plot consisting of an equal area.

In this experiment the characters of variety, row spacing and rate of planting performed as independent characters. There was no interaction and rate of planting yields were not significant in the test. Row spacing seemed to be the most important character followed by variety. In most instances, the 20-inch row spacing, the variety Groehler, and the rate of 6 plants per foot, gave the highest yield. Guar plants seem to have the ability to adapt to a fairly large range of spacings within the row. Moisture conditions may have influenced this. In 1959, the rainfall from June 30 to November 16 was 29.72 inches at Perkins. Since this amount was high, the test

must be repeated for more conclusive results. Lower seed and forage yields and shorter plants than normally expected were probably the result of the late date of planting.

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# APPENDIX

# APPENDIX TABLE I

MEAN NUMBER OF PLANTS HARVESTED, MEAN SEED, FORAGE, AND PROTEIN YIELD, MEAN PLANT HEIGHT, STEM DIAMETER, MEAN NUMBER OF BRANCHES PER PLANT AND MEAN BRANCH LENGTH

| VARIETY AND ROW SPACING (INS.) | RATE SEED/FT. | MEAN PLANTS HARVESTED/FT. | MEAN YIELD IN POUNDS PER ACRE | | | MEAN PLANT HEIGHT (INS) | STEM DIAMETER (MM) | MEAN NUMBER BRANCHES PER PLANT | MEAN BRANCH LENGTH (INS.) |
|---|---|---|---|---|---|---|---|---|---|
| | | | SEED | DRY MATTER | PROTEIN | | | | |
| GROEHLER | | | | | | | | | |
| 20 | 3 | 3.5 | 653 | 2931 | 520 | 22.8 | 6.7 | 1.3 | 14.9 |
| 30 | 3 | 3.4 | 754 | 2603 | 520 | 29.4 | 7.6 | 1.9 | 19.4 |
| 40 | 3 | 3.3 | 458 | 1534 | 324 | 23.0 | 7.9 | 1.9 | 16.8 |
| 20 | 6 | 4.7 | 638 | 3171 | 448 | 24.6 | 6.5 | 0.9 | 14.4 |
| 30 | 6 | 5.2 | 629 | 2614 | 520 | 27.5 | 7.6 | 0.9 | 15.1 |
| 40 | 6 | 5.3 | 458 | 1972 | 346 | 27.4 | 7.5 | 0.9 | 18.4 |
| 20 | 9 | 6.3 | 720 | 2899 | 487 | 23.0 | 6.3 | 0.2 | 16.7 |
| 30 | 9 | 6.9 | 556 | 2156 | 472 | 25.1 | 7.7 | 1.4 | 13.5 |
| 40 | 9 | 7.0 | 510 | 1832 | 321 | 26.4 | 7.0 | 0.6 | 15.4 |
| TEXSEL | | | | | | | | | |
| 20 | 3 | 3.5 | 637 | 2706 | 479 | 27.3 | 7.8 | 0.7 | 13.1 |
| 30 | 3 | 3.4 | 441 | 1917 | 376 | 30.1 | 8.5 | 0.7 | 17.6 |
| 40 | 3 | 3.0 | 394 | 1642 | 289 | 30.0 | 8.2 | 0.7 | 22.1 |
| 20 | 6 | 5.1 | 560 | 2402 | 448 | 26.1 | 7.2 | 0.2 | 16.1 |
| 30 | 6 | 4.9 | 539 | 2124 | 362 | 30.1 | 7.5 | 0.6 | 15.5 |
| 40 | 6 | 4.8 | 394 | 2071 | 390 | 26.8 | 8.0 | 0.3 | 21.2 |
| 20 | 9 | 6.3 | 593 | 2482 | 410 | 24.6 | 7.0 | 0.1 | 8.3 |
| 30 | 9 | 6.5 | 440 | 2134 | 448 | 26.5 | 7.7 | 0.4 | 19.8 |
| 40 | 9 | 6.4 | 409 | 1856 | 310 | 29.1 | 8.1 | 0.5 | 16.4 |
| P.I. 164801 | | | | | | | | | |
| 20 | 3 | 3.3 | 622 | 2690 | 484 | 20.3 | 6.2 | 4.0 | 14.3 |
| 30 | 3 | 3.1 | 546 | 2167 | 354 | 23.5 | 6.9 | 4.6 | 16.8 |
| 40 | 3 | 3.2 | 418 | 1619 | 357 | 26.0 | 7.6 | 5.0 | 18.1 |
| 20 | 6 | 4.5 | 705 | 3091 | 500 | 24.4 | 6.4 | 1.7 | 14.1 |
| 30 | 6 | 4.4 | 484 | 2309 | 486 | 24.5 | 6.2 | 2.8 | 13.4 |
| 40 | 6 | 5.0 | 310 | 1634 | 284 | 24.8 | 7.3 | 3.4 | 15.3 |
| 20 | 9 | 6.8 | 649 | 2482 | 429 | 22.5 | 6.7 | 3.2 | 16.8 |
| 30 | 9 | 6.6 | 475 | 2330 | 413 | 23.9 | 7.2 | 2.0 | 16.0 |
| 40 | 9 | 6.9 | 438 | 1939 | 365 | 25.3 | 6.8 | 2.4 | 15.8 |

## APPENDIX TABLE II

### RAINFALL AT PERKINS, OKLAHOMA
### JANUARY 1, 1959 TO DECEMBER 30, 1959

| | |
|---|---|
| January 1-10 | .01 |
| January 11-20 | .12 |
| January 21-30 | Tr |
| January 31, February 9 | .50 |
| February 10-19 | - |
| February 20-March 1 | .55 |
| March 2-11 | .08 |
| March 12-21 | 1.53 |
| March 22-31 | .88 |
| April 1-10 | .83 |
| April 11-20 | - |
| May 1-10 | 3.05 |
| May 11-20 | .07 |
| May 21-30 | 2.73 |
| May 31-June 9 | 1.33 |
| June 10-19 | .73 |
| June 20-29 | 4.03 |
| June 30-July 9 | 1.21 |
| July 10-19 | 2.85 |
| July 20-29 | 4.92 |
| July 30-August 8 | .82 |
| August 9-18 | .01 |
| August 19-28 | .19 |
| August 29-September 7 | 3.72 |
| September 8-17 | .13 |
| September 18-27 | 3.02 |
| September 28-October 7 | 10.53 |
| October 8-17 | 1.15 |
| October 18-27 | - |
| October 28-November 6 | 1.17 |
| November 7-16 | - |
| November 17-26 | - |
| November 27-December 6 | - |
| December 7-16 | .43 |
| December 17-26 | 1.66 |
| December 27-31 | .03 |
| TOTAL | 54.86 |

VITA

Curtis Williams

Candidate for the Degree of

Master of Science

Thesis: A CULTURAL STUDY OF GUAR INVOLVING THREE VARIETIES, THREE ROW SPACINGS AND THREE RATES OF PLANTING.

Major Field: Agronomy (Field Crops)

Biographical:

Personal Data: Born January 17, 1937 at Route one, Tupelo, Oklahoma, the son of Charley H. and Willie Mae Williams.

Education: Attended elementary school at Rocky Point, Hamilton and Lula. Graduated from Lula High School, May, 1955. Undergraduate work at Murray State School of Agriculture, Tishomingo, Oklahoma, 1955-1957; Oklahoma State University 1957-1959. Graduate study at Oklahoma State University 1959-1960.

Experience: Born and reared on a farm; employed by Coal County ASC; USDA, AMS Division; and Agronomy Department at Oklahoma State University, 1959-1960.

Member of: Agronomy Club, Phi Kappa Phi, Alpha Zeta, Omicron Delta Kappa, and Phi Theta Kappa.

Date of Final Examination: August, 1960.