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The effects of seeding rates, row spacings, and planting dates on grain sorghum 'Sorghum bicolor (L.) Moench)

Larry Gene Heatherly

To the Graduate Council:

I am submitting herewith a thesis written by Larry Gene Heatherly entitled "The effects of seeding rates, row spacings, and planting dates on grain sorghum 'Sorghum bicolor (L.) Moench)." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agronomy.

Charles R. Graves, Major Professor

We have read this thesis and recommend its acceptance:

Vernon H. Reich, John H. Reynolds

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

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May 15, 1972

To the Graduate Council:

I am submitting herewith a thesis written by Larry Gene Heatherly entitled "The Effects of Seeding Rates, Row Spacings, and Planting Dates on Grain Sorghum (*Sorghum bicolor* (L.) Moench)." 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.

Charles R. Graves
Major Professor

We have read this thesis and recommend its acceptance:

John H Reynolds

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THE EFFECTS OF SEEDING RATES, ROW SPACINGS, AND PLANTING DATES ON GRAIN SORGHUM (*SORGHUM BICOLOR* (L.) MOENCH)

A Thesis

Presented to

the Graduate Council of

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In Partial Fulfillment

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by

Larry Gene Heatherly

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ABSTRACT

The effect of three seeding rates, two plant populations, and two row widths on plant height, grain yield, and bushel weight of grain sorghum (*Sorghum bicolor* (L.) Moench) was studied at Knoxville, Tennessee, in 1970. In 1971, the test was expanded to include an early and late planting at Knoxville, Spring Hill, and Martin using the same treatment levels, with an additional measurement of weight/100 seed.

Narrow rows produced higher grain yields in the 1970 planting and in four of the six 1971 plantings. Differences in yield among seeding rate--population means occurred in three of the six 1971 plantings, with the eight and ten pound seeding rates and the 78,000 plants/acre population level producing yields that were in the higher yielding group in each of the three cases. The first of the two plantings at two of the three locations produced the higher average yields, while the opposite pattern occurred at Spring Hill.

Wide row plants were taller than those in the narrow rows in four of the six 1971 plantings. The differences in plant height between the two plantings at each location followed the same pattern as yield differences. Grain from the wide rows in three of the 1971 plantings had a higher bushel weight than grain from the narrow rows, whereas the opposite row width effect occurred in one of the remaining plantings. Wide rows produced grain with the higher 100 seed weight in only two of the 1971 plantings. Seeding rate--population changes affected bushel weight and 100 seed weight only in isolated cases.

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CHAPTER I

INTRODUCTION

The sudden outbreak of the virulent Race T of southern corn leaf blight (*Helminthosporium maydis*) on corn in 1970, plus the critical shortage of seed corn from hybrids resistant to this blight in 1971, stimulated considerable interest in grain sorghum (*Sorghum bicolor* (L.) Moench) as a replacement feed-grain crop for corn.

Grain sorghum acreage in Tennessee in 1971 increased approximately fourfold over the 1969 and 1970 acreages. Because of this sudden increase in importance of and interest in the crop, in combination with a deficiency of knowledge regarding the most favorable row spacing and seeding rate and the most appropriate planting time for grain sorghum in Tennessee, a preliminary study was initiated in 1970 and a more extensive study was conducted in 1971 to determine the effect of row spacing, seeding rate--population, and planting date on grain sorghum plant height, grain yield, bushel weight, and 100 seed weight.

CHAPTER II

LITERATURE REVIEW

As early as 1920, recommendations for row spacing, seeding rate, and planting date for the culture of grain sorghum were present. Rothgeb (22) concluded from a five year study in Texas that for the best average grain yield, the grain sorghums should be seeded in rows spaced three and one half feet apart at a rate that would give one plant to every 10-12 inches of row (approximately 14,000 plants/acre). He stated that a good time to sow grain sorghum in any locality would be ten days to two weeks later than the average date for planting corn. In 1926, Sieglinger (24) reported that sorghum varieties which tillered profusely produced similar yields of grain in Oklahoma when the distance between plants in the row varied from six to 30 inches. Conversely, varieties which produced few tillers showed progressive reductions in yield for every successive increase in the distance between plants in the row. In 1931, Texas workers (14) reported that plant height at maturity differed little between the planting dates of May 15 and June 15. It was also reported that optimum planting time for maximum grain production varied for different regions of the state. In most cases no reduction in grain yield occurred when the within-row plant spacing was varied from six to 30 inches.

Painter and Leamer (18), using four and nine inch intrarow plant spacings (44,000 and 19,360 plants/acre, respectively), and 36 inch interrow spacing in New Mexico, found that the thicker planting yielded 14-18 bushels/acre more when adequate nitrogen (120 pounds/acre) was present.

In 1955, workers in Kansas (15) reported that grain sorghum yields from 20 inch rows were 26 percent higher than those from 40 inch rows while Arkansas researchers (34) reported similar results the same year, except for a larger percentage increase in yield of the 20 inch over the 40 inch rows. The Kansas experiments showed that 78,000 plants/acre produced the highest grain yield. Row spacing experiments in Arizona (7) found that both 20 inch and 30 inch rows were superior in grain yields to 40 inch rows and for best results the seeding rate should be adjusted to give a plant population of approximately 60,000 plants/acre.

Grimes and Musick (10) found that grain yields declined markedly when the plant population dropped below 40,000-50,000 plants/acre. However, above this range, they found no significant grain yield differences due to varying populations, although a population of near 100,000 plants/acre produced maximum grain yields under optimum irrigation. Yields were significantly reduced as row width increased with an ample moisture supply being present.

In a two year study at Hays, Kansas, Brown and Shrader (5) noted that in the first year, 20 inch rows produced the highest grain yields, and in the second year, the best yields were produced by 40 inch rows. Responses to plant population changes were attributed to the initial soil moisture depth, with populations of 60,000 and 90,000 plants/acre producing the highest grain yields with the deepest level of soil moisture. Porter, Jensen, and Sletten (20) found three year average grain yields from 12, 20, and 30 inch row spacings to be significantly higher than yields from 40 inch rows. Yields from the 12 and 20 inch row spacings were significantly greater than yields produced by either the 30 or 40 inch spacings. Planting rates had little influence on yield and no significant row spacing x planting rate interaction was found in any year or in the three year analysis. The three year average bushel weights (test weight) of grain from each row spacing were significantly different with bushel weight increasing as row width increased. Bushel weight differences among planting rate means were not significant. Significant differences among plant height means were noted for the different row spacings, with the plant height increasing as row width increased, but planting rate had no significant influence on plant height.

Stickler and Laude (28) found that a grain sorghum population of 78,000 plants/acre produced higher grain yields than 52,000 plants/acre. A significant row spacing x plant population interaction existed for grain yield. Grain yields did not differ significantly among row widths at the low population, but at the higher population, significantly higher yields were obtained as row spacing decreased from 40 to ten inches. The 20 inch rows effectively controlled weeds at both populations, whereas wider row widths did not. Plant height was greatest in ten inch rows and decreased with increasing row width in the higher population. They concluded that successful narrow row culture of grain sorghum requires a high plant population.

Talbert and Fletchall (33) found that decreasing the row spacing from 40 to 20 inches resulted in increased grain sorghum yields and decreased weed growth. However, the plant population of the 40 inch rows was only two thirds that of the 20 inch rows, and no attempt was made to separate the effects of increased stand from the effects of decreased row width in this experiment. In an extended study at Manhattan, Kansas (30), plant population and row width effects on grain sorghum were evaluated. For the period 1944-1953, 20 inch rows produced an average of 28 percent more grain than did 40 inch rows. However, the 20 inch row plots had twice the plants of the 40 inch row plots. In 1953 and 1954, average grain yields were higher with a density of 80 square inches/plant (78,000 plants/acre) than with thicker or thinner rates. Grain yields from 40 inch row plots were less than those from 10, 20, or 30 inch row widths. In both years, a significant row width x area/plant interaction occurred, and in 1956, yields were greater in 20 inch and 30 inch row widths than in the 10 inch and 40 inch widths by only six percent. In general, plant height increased as row width decreased and varied little with changes in plant density.

In 1961, Stickler and Pauli (29) reported significant differences in grain yield among planting dates for eight varieties of grain sorghum. Dates of May 20, June 10, and June 30, were used, and the response to planting date was found to be related to the maturity of a variety. It was also noted that grain yield was highly correlated with seed weight (grams/200 seed) in both years of the two year study. Graves, Duck, and McCutchen (9) suggested that response of grain sorghum varieties to close row spacing may be a function of early or late planting.

Burnside and Hanway (6), working in Nebraska, found yields of grain sorghum to be highest in 20 inch rows and lowest in 40 inch rows. In Australia, Phillips and Norman (19), using two years' data, found a significant difference in grain sorghum yields among interrow spacings. The results were reversed for the two years, with 36 inch row widths outyielding 18 and seven inch rows the first year, and the reverse trend occurring in the second year's data. The effect of intrarow spacing was nonsignificant for both years. Also, the first year's data revealed a significant population x row spacing interaction, with the highest plant population (80,000 plants/acre) giving maximum yield at close row spacing, and the low population (20,000 plants/acre) giving maximum yield at the wide row spacing. The second year's interaction, though nonsignificant, displayed the same trend. The yield relationship between populations and row spacing indicated an optimum intrarow plant distance of six to 12 inches.

Researchers in Minnesota (21) reported that as rows narrowed from 40 to ten inches, grain yield increased in a linear fashion. Planting rates of 78,000 and 314,000 seeds/acre were evaluated at each row width and were observed to have no significant effect on grain yield, bushel weight, plant height, or date of heading. Decreases in seed weight occurred with increased plant population. No significant row spacing x plant population interactions were noted, showing that the effects of different row spacings and populations tended to be independent.

Bond, Army, and Lehman (3), using 20 and 40 inch row spacings and two and four pound seeding rates under dryland conditions, found that the higher seeding rate combined with the narrow row spacing was damaging to grain production under limited moisture conditions. Under normal dryland farming conditions, the wider rows produced better grain yields at either the two or four pound seeding rate. At the highest moisture levels, the 20 inch row width produced greater yields.

Brown, Cobb, and Wood (4), working in Georgia, reported that 20 inch rows yielded significantly more grain than 40 inch rows for two consecutive years. However, the narrow rows had the same intrarow spacing as the wider rows, and therefore had twice the population. A third year's data showed no significant yield differences among row widths where the plant population per acre was approximately the same. Bushel weight was greater in the grain produced from the 40 inch rows. In a year of inadequate rainfall, 40 inch rows matured earlier than 20 inch rows, but with adequate moisture, row spacing had no influence on maturity.

Stickler (26), in research involving several locations in Kansas, found 20 inch rows to give a grain yield of seven to 11 percent more than 40 inch widths. He found little or no tendency for yield to vary over a range of stand densities from 60 square inches/plant (104,000 plants/acre) to 720 square inches/plant (9,000 plants/acre). Stickler and Anderson (27), working in Manhattan, Kansas, reported that over a three year period and at a population of 78,000 plants/acre, grain yields from 20 inch rows were 12.6 percent higher than those from 40 inch rows.

A three year study in southeastern Colorado (17) revealed that seeding rates in excess of four pounds of seed/acre generally reduced grain sorghum yields under dryland conditions. Highest yields were obtained from a seeding rate of two pounds/acre when this rate was compared with four and six pounds/acre. Analyses of the data also showed no significant difference in yields from 21 and 42 inch row widths when the same amount of seed per acre was planted at each row width. Plant populations in 42 inch rows were always lower than those in 21 inch rows for comparable seeding rates. Additional observations made during the study showed that 21 inch rows competed better with weeds than did 42 inch rows.

A five year study in eastern and central Kansas (31) showed that grain sorghum grown in 20 inch rows averaged five and two percent less weight/1000 seeds in the eastern and central sections, respectively, than that grown in 40 inch rows. Decreasing stand density in both areas caused a small but consistent increase in seed weight. In both areas of the state, a significant superiority of 20 inch rows over 40 inch rows in grain yield was noted in at least half of the trials, and in no instance were narrow rows significantly inferior to 40 inch rows. The yield superiority of the narrow rows was rather uniform across different stand densities, as little tendency was noted for row width x stand density interaction. The location component of variance accounted for a high percentage of the total variability of grain yield and seed weight in both areas.

Johnson and Harris (13), using seeding rates of two, four, six, eight, 12, and 16 pounds/acre in Georgia, found that grain yield increased significantly for each increment increase in seeding rate through eight pounds/acre. Plant height followed the same pattern as grain yield.

Welch, Burnett, and Eck (37) found that in the presence of sufficient nitrogen, a population of 60,000 plants/acre produced significantly higher grain yields than lower populations of ten, 20, and 40 thousand/acre when grown in 20 inch rows. Higher populations were not used in this study. An additional comparison of 40,000 plants/acre grown in 20 and 40 inch rows showed the narrow rows giving the higher grain yields in both years of the study, though this difference was significant in only one year.

In a three year study (1962-1964), Stickler and Younis (32) found that neither row width nor stand density significantly affected plant height when three experimental lines were used. However, grain yields from 20 inch row widths significantly exceeded those from 40 inch rows by 11 percent. Significant yield differences among stand densities were found in two of the three years. Seed weight decreased with increased stand density and bushel weight decreased as rows narrowed from 40 to 20 inches.

Russell (23) found that mean grain yields decreased significantly as row spacings increased from 20 to 30 to 40 inches. The mean yield from an eight pound seeding rate was significantly lower than that from 12 and 16 pounds/acre. No advantage appeared in using more than 12 pounds of seed/acre. There were no real differences in test weight from the different row spacings or seeding rates. Plant height tended to increase slightly as row width and seeding rate increased, although this increase was not significant.

Atkins, Reich, and Kern (1) found that two year grain yield means for two hybrids were significantly higher (11 percent) and plants were slightly taller when rows were spaced at 30 inches rather than 40 inches apart. One hundred seed weight was significantly lighter with the 30 inch spacing. A within-row plant population of five plants/foot (87,000 plants/acre in 30 inch rows and 65,000 plants/acre in 40 inch rows) produced highest grain yields at each row spacing. Plant height and 100 seed weight were not significantly altered as within-row plant populations were varied. No significant row spacing x plant population interactions occurred for grain yield, plant height, or 100 seed weight.

Data obtained over a two year period in Louisiana (35) showed that increasing the seeding rate from six to 13 pounds/acre did not significantly influence grain yield. Significant yield differences among row spacings were observed, with 21 inch rows being superior to 42 inch rows. No significant row spacing x seeding rate interaction occurred in the two year analysis. A 1971 report from Missouri (12) revealed that when row width was decreased from 35 to seven inches, grain yield increased by 40 percent, and a 17 percent increase in yield occurred when row width decreased from 35 to 21 inches. No increase in yield was realized above a planting rate of eight pounds of seed/acre regardless of row width.

In the majority of the reports reviewed, grain sorghum grown in narrow rows (18-21 inches) significantly outyielded grain sorghum grown in wide rows (36-42 inches). Populations of 60-100 thousand plants/acre generally produced the higher yields, although much of the work showed no difference in yields over a wide population range. Under dryland farming conditions, narrow row culture of grain sorghum was usually found to be damaging to grain production.

CHAPTER III

EXPERIMENTAL PROCEDURE

A preliminary grain sorghum row spacing--seeding rate study was initiated at Knoxville, Tennessee, in 1970, to evaluate seeding rates of 'AKS 614' at two row spacings (42 and 21 inches). AKS 614 is a bird resistant grain sorghum hybrid of medium maturity. The test was seeded on May 6, 1970, on a Sequatchie loam and irrigated when needed. Seeding rates of six, eight, and ten pounds of seed/acre were utilized along with two ten-pound seeding rates which were thinned when the plants reached a height of approximately six inches to give populations of 52,000 and 78,000 plants/acre. Stand counts were made on all treatments at time of thinning (June 8, 1970). The border rows of the fixed population plots were thinned to achieve the same within-row plant population as the harvest rows of the same plots.

A split plot arrangement of treatments was used in a randomized complete block design with four replications. Main plots consisted of the two row widths with the three seeding rates and two plant populations comprising the subplots. The wide row and narrow row plots consisted of four and eight rows, respectively, with each row being 20 feet in length. The two center rows of the wide row plots and the four center rows of the narrow row plots were used to measure grain yield, plant height at maturity, plant population, and heading date (100 percent head exsertion).

Plots were harvested, weather permitting, when the grain moisture content reached 15-18 percent. Heads from each plot were harvested by hand and oven dried to a grain moisture content of seven to nine percent before threshing on an Almaco plot thresher. After the threshed grain had been weighed, a sample from each plot was placed in a plastic bag and a moisture meter was used to determine the moisture content of each sample. Individual samples were cleaned for bushel weight determination, and grain yields and bushel weights were adjusted to 15 percent moisture.

The grain sorghum row spacing--seeding rate study was expanded in 1971 to include two planting dates as separate experiments at Knoxville, Spring Hill, and Martin. AKS 614 was used at all locations. The seeding rates, planting and harvesting procedures, and experimental design were the same as those used in 1970. Thinning, counting, and harvesting dates appear in Table 1. The measurements made in 1971 were identical to those of 1970, with one addition: one hundred seed were selected at random from each plot sample and weighed to determine 100 seed weights. The planting dates and row widths at each location in 1971 are shown in Table 2.

Both plantings at Knoxville in 1971 were seeded on a Sequatchie loam. The first planting at Spring Hill was seeded on a Maury silt loam, level phase, and the second planting was seeded on a Huntington silt loam, local alluvium phase. Both seedings at Martin were planted on a Collins silt loam, level phase. In the spring of 1971, the test area at Knoxville had a pH value of 5.4 and the area at Martin had a value of 6.5. The Spring Hill test location had a pH value of 6.0 in the

Table 1. Dates of Thinning, Counting and Harvesting of Grain Sorghum Row Spacing--Seeding Rate--Planting Date Study at Three Locations in Tennessee in 1971

	Thinning and Counting Date		Harvest Date	
Location	First Planting	Second Planting	First Planting	Second Planting
Knoxville	6-7	6-28	9-9	10-14
Spring Hill	6-10	7-6	9-22	10-21
Martin	6-16	7-7	9-15	10-5

Table 2. Planting Dates and Row Widths Used for Grain Sorghum at Three Locations in Tennessee in 1971

Location	First Planting Date	First Planting Row Widths	Second Planting Date	Second Planting Row Widths
		inches		inches
Knoxville	4-27	40 and 20	6-4	42 and 21
Spring Hill	5-3	40 and 20	6-10	40 and 20
Martin	5-18	38 and 19	6-16	38 and 19

summer of 1971. The Knoxville test area received two tons of agricultural limestone/acre in the fall of 1970 and the Spring Hill and Martin areas received no amendment for pH adjustment. Both planting areas at Knoxville received 35 and 65 pounds of P and K/acre, respectively, prior to the first planting date. Each area received nitrogen prior to its respective seeding date at the rate of 120 pounds/acre. Both planting sites at Spring Hill received 100 pounds/acre of K and 100 pounds of nitrogen/acre prior to the first planting date. The Martin test sites received 110 pounds of nitrogen/acre and applications of P and K at the rates of 30 and 60 pounds/acre, respectively, before the first planting date. All nitrogen applications were applied in the form of ammonium nitrate.

All tests received a preemergence application of Milogard 80W (Propazine) for weed control. The herbicide was applied no later than three days following any planting date at a rate of two pounds of active ingredient/acre. All plantings were hand cultivated when justified. Sevin insecticide was hand sprayed on all plantings for the control of sorghum midge (<u>Contarinia sorghicola</u>) and sorghum webworm (<u>Celama sorghiella</u>).

Analyses of variance were applied to the data from individual experiments at each location, and to the combined experiments across locations for each planting date and across planting dates at each location. All analyses were performed on an IBM 360/65 computer by the Statistical Analysis System programs (2). Treatment means were subjected to the New Duncan's Multiple Range Test (8,11,16). For tests of significance, a probability level of .10 was chosen for all locations and planting dates, unless otherwise stated in the results of this study. Statistical analyses were performed in accordance with the methods outlined in Snedecor and Cochran (25). All possible correlations between variables were obtained.

CHAPTER IV

RESULTS AND DISCUSSION

I. GENERAL OBSERVATIONS

Heading dates for the plots at Knoxville in 1970 were not recorded. In 1971, very little plot to plot variation in heading date was noted at any location. At Knoxville, the first and second plantings exhibited 100 percent head exsertion in the periods July 20-24 and August 15-20, respectively. At Spring Hill, the dates of July 12 and August 7 were recorded as the heading dates for the first and second plantings, respectively. At Martin, the few days prior to July 16 were the days of heading in the first planting, and August 1-3 was the period of heading in the second planting.

At Knoxville in 1970, lodging was quite extensive. The 42 inch and 21 inch rows had 36.5 percent and 4.7 percent lodged plants, respectively, across the three seeding rates and two plant populations. At the wide row spacing, percent lodged plants ranged from 57.5 (78,000 plants/acre) to 13.8 (eight pounds seed/acre). At the narrow row spacing, the plant population levels of 78,000/acre and 52,000/acre were the only seeding rate-population levels exhibiting any lodging (Table 3). In 1971, lodged plants were so seldom seen in any planting that no counts were made.

An interesting observation made during the growing season of each planting in 1971 was that weed infestation of the areas between the narrow

Table 3. Grain Sorghum Lodging Percent at Two Row Widths, Three Seeding Rates, and Two Plant Populations at Knoxville in 1970

Row Width	Seeding Rate--Population	Percent Lodged Plants[a]
42 inches	52,000 plants/acre	33.8
	78,000 plants/acre	57.5
	6 lb. seed/acre	26.2
	8 lb. seed/acre	13.8
	10 lb. seed/acre	51.2
21 inches	52,000 plants/acre	2.5
	78,000 plants/acre	21.2
	6 lb. seed/acre	0.0
	8 lb. seed/acre	0.0
	10 lb. seed/acre	0.0

[a]Average of four replications.

rows was noticeably less than in the areas between the wide rows. The plants of the narrow rows overlapped and shaded the exposed between-row areas much sooner than those of the wide rows. Little or no ground area was visible through the leaf canopy of the narrow row plants, while plants of the wide rows rarely overlapped more than eight inches, leaving numerous unshaded areas in the middles.

Many off-type plants were noticed in each planting at each location. These plants were noticeably taller than the typical AKS 614 plant, and the seed heads were of the closed type, instead of the open type head typical of the AKS 614 hybrid. These off-type heads were not tolerant to bird damage, and in most cases were stripped of seed before harvest. This factor probably contributed to some loss in grain yield, although this loss should have been uniform across all treatments in all plantings, since the seed that was weighed and used for each treatment level came from the same seed source.

II. PRECIPITATION INFORMATION

The 1970 study at Knoxville was irrigated as needed, so rainfall data are not reported here for that year.

In 1971, the amount of rainfall received at each of the three locations for the period April 1--October 31 was below the average for each location (36) (Table 4). At Knoxville, no month was extremely low in rainfall, although May, June, and July were the only months receiving above average precipitation. The only extended period of little or no rainfall occurred in late August and early September. The first and

Table 4. Monthly Precipitation Received During the Period April 1--October 31 at Three Locations in Tennessee in 1971 Along with Average Monthly Precipitation

	Location					
	Knoxville		Spring Hill		Martin	
Month	1971	Average[a]	1971	Average[b]	1971	Average[c]
	inches					
Apr.	4.24	4.90	2.59	6.20	2.52	5.05
May	4.39	3.65	3.45	4.72	4.67	4.10
Jun.	5.86	4.61	1.17	3.24	2.28	5.04
Jul.	5.05	4.76	7.94	3.85	5.34	4.62
Aug.	2.32	4.93	5.84	4.17	8.15	3.64
Sep.	3.25	3.32	1.22	2.82	2.35	4.28
Oct.	2.05	3.22	3.16	3.54	2.89	2.59
Totals	27.16	29.39	25.37	28.54	28.20	29.32

[a]Average of previous five years.

[b]Average of previous seven years.

[c]Average of previous ten years.

second plantings at Knoxville received 18.56 and 17.21 inches of rainfall, respectively, from time of planting to harvest. At Spring Hill, July and August were the only months receiving above average rainfall in the seven month period. Each planting had four periods of eight days or more each when no rainfall was received. The first and second plantings at Spring Hill received 19.43 and 16.80 inches of rainfall, respectively, from time of planting to harvest date.

At Martin, four of the seven months received above average amounts of rainfall. No month was extremely low in rainfall, although April, June, and September received amounts considerably lower than their respective ten year averages. The first and second plantings at Martin received 16.60 and 18.36 inches of rainfall, respectively, from time of planting to harvest date.

Weekly total precipitation for each location in 1971 appears in Table 5.

III. PLANT POPULATION

Plant population differences between row width means at Knoxville in 1970 were not significantly different, while population differences among seeding rate means were significant, with the six pound seeding rate producing the lowest population, and the ten pound rate the highest (Table 6). In 1971, the only case of a significant difference between row width means for population occurred in the second planting at Spring Hill, where the population of the narrow rows was greater than that of the wide rows (Table 7). The 1971 seeding rate means for population in

Table 5. Weekly Total Precipitation for the Period April 1--October 31 at Three Locations in Tennessee in 1971

Week of	Location		
	Knoxville	Spring Hill	Martin
	----------	inches	----------
Apr. 1	2.59	1.34	0.86
Apr. 8	0.01	0.06	0.20
Apr. 15	0.03	0.05	0.33
Apr. 22	1.61	1.14	1.03
Apr. 29	0.04	0.00	0.41
May 6	2.91	1.70	3.76
May 13	0.93	1.30	0.30
May 20	0.51	0.45	0.30
May 27	0.43	0.27	0.31
Jun. 3	0.54	0.34	0.40
Jun. 10	2.15	0.08	0.00
Jun. 17	0.75	0.48	1.10
Jun. 24	1.99	0.00	0.47
Jul. 1	0.19	1.37	0.66
Jul. 8	0.81	0.49	1.02
Jul. 15	1.40	1.19	2.32
Jul. 22	1.58	2.07	1.30
Jul. 29	2.97	3.69	2.26
Aug. 5	0.08	0.98	0.88
Aug. 12	0.14	0.68	0.00
Aug. 19	0.20	2.54	4.00
Aug. 26	0.00	0.77	1.13
Sep. 2	0.15	0.91	0.45
Sep. 9	1.08	0.00	0.00
Sep. 16	1.81	0.12	0.79
Sep. 23	0.21	0.19	1.03
Sep. 30	0.96	0.56	0.95
Oct. 7	0.20	0.00	0.00
Oct. 14	0.67	0.65	0.24
Oct. 21	0.22	1.95	1.70

Table 6. Grain Sorghum Plant Populations Obtained at Two Row Widths and From Three Seeding Rates at Knoxville in 1970

Treatment	Plants/acre[a]
Row Width	
42 inches	76,330 a*
21 inches	74,490 a
Seeding Rate	
6 lb./acre	65,184 a‡
8 lb./acre	80,586 b
10 lb./acre	103,300 c

[a]Average of four replications.

*Values followed by the same letter are not significantly different at the .10 level of probability.

‡Values followed by the same letter are not significantly different at the .10 level of probability.

Table 7. Grain Sorghum Plant Populations Obtained at Two Row Widths Across Three Seeding Rates in Two Plantings at Three Locations in Tennessee in 1971

Row Width	Location Knoxville	Spring Hill	Martin
	plants/acre[a]		
	First Planting		
Narrow	67,643 a*	70,093 a	75,278 a
Wide	70,094 a	70,256 a	72,579 a
	Second Planting		
Narrow	71,531 a	74,307 a	75,846 a
Wide	72,294 a	72,200 b	75,175 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

each planting at each location showed the same pattern as the 1970 data (Table 8). There was no significant row width x seeding rate interaction for plant population in the 1970 planting or in any of the six 1971 plantings, suggesting that populations established from each seeding rate were independent of row width effects.

The average population of the 1970 planting at Knoxville (75,410 plants/acre) was significantly higher than the average population of the 1971 planting (68,868 plants/acre). This may have been due to lower germination of the 1971 seed. A significant year x seeding rate interaction occurred with the eight pound seeding rate in 1971 producing 90.4 percent of the 1970 population from the same rate, while the six and ten pound rates in 1971 produced 81.4 percent and 85.1 percent, respectively, of the 1970 populations from each respective seeding rate. The average wide row population (73,212 plants/acre) was not significantly different from the average narrow row population (71,066 plants/acre) in the two year analysis.

The effect of different locations on plant population was significant in the second planting in which the population at Martin was significantly higher than that at Knoxville or Spring Hill. The first planting displayed the same trend, but the differences were nonsignificant (Table 9). The location component of variance was not involved in any significant interactions in either the early or late planting.

Numerically higher plant populations were obtained in the second planting at each location, but this difference was significant at Spring Hill only (Table 10). Soil temperatures were probably more favorable

Table 8. Grain Sorghum Plant Populations Obtained From Three Seeding Rates Across Two Row Widths in Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate	Location: Knoxville	Spring Hill	Martin
	plants/acre[a]		
	First Planting		
10 lb./acre	87,923 a*	92,333 a	97,795 a
8 lb./acre	72,854 b	74,610 b	78,236 b
6 lb./acre	53,047 c	52,680 c	57,516 c
	Second Planting		
10 lb./acre	94,937 a	97,683 a	99,299 a
8 lb./acre	80,585 b	79,714 b	79,525 b
6 lb./acre	58,572 c	58,030 c	61,686 c

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

Table 9. Grain Sorghum Plant Populations Obtained Across Two Row Widths and Three Seeding Rates at Three Locations in Two Plantings in Tennessee in 1971

Location	Planting: First	Planting: Second
	-------plants/acre[a]-------	
Martin	73,929 a*	75,511 a
Spring Hill	70,175 a	73,254 b
Knoxville	68,868 a	71,913 b

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 10. Grain Sorghum Plant Populations Obtained Across Two Row Widths and Three Seeding Rates in the First and Second Plantings at Knoxville, Spring Hill, and Martin in 1971

Planting	Location: Knoxville	Location: Spring Hill	Location: Martin
	---------------plants/acre[a]---------------		
Second	71,913 a*	73,254 a	75,511 a
First	68,868 a	70,175 b	73,929 a

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

for rapid germination and uniform seedling emergence in the second planting. At Knoxville, a significant planting date x seeding rate interaction occurred. The trend at all locations in 1971 was toward lower populations for each respective seeding rate in the first planting than in the second. At Spring Hill, a significant planting date x row width interaction was noted. The narrow rows of the second planting had a larger number of plants/acre than the second planting wide rows, whereas the wide rows of the first planting had the higher population of the two row widths in the first planting.

IV. PLANT HEIGHT

No significant differences in plant height were found between row width means or among seeding rate--population means in 1970 at Knoxville (Table 11). In 1971, the plants in the wide rows were significantly taller than plants in the narrow rows in the first planting at Martin and in the second planting at each location. The first plantings at Knoxville and Spring Hill showed the same trend, but the differences were nonsignificant (Table 12). Significant differences in plant height among seeding rate--population means occurred in the first and second plantings at Knoxville and in the second planting at Martin, with the 78,000 plants/acre treatment and the ten pound seeding rate producing plants that were in the significantly taller group in each case (Table 13).

The 1970 planting at Knoxville had an average height of 46.98 inches and the 1971 Knoxville first planting had an average height of

Table 11. Grain Sorghum Plant Height Measurements From Two Row Widths, Three Seeding Rates, and Two Plant Populations at Knoxville in 1970

Treatment	Plant Height[a] inches
Row Width	
21 inches	47.25 a*
42 inches	46.80 a
Seeding Rate--Population	
10 lb. seed/acre	47.50 a‡
8 lb. seed/acre	46.00 a
6 lb. seed/acre	46.62 a
52,000 plants/acre	47.38 a
78,000 plants/acre	47.38 a

[a]Average of four replications.

*Values followed by the same letter are not significantly different at the .10 level of probability.

‡Values followed by the same letter are not significantly different at the .10 level of probability.

Table 12. Grain Sorghum Plant Height Measurements From Two Row Widths Across Three Seeding Rates and Two Plant Populations in Two Plantings at Three Locations in Tennessee in 1971

Row Width	Location: Knoxville	Spring Hill	Martin
	---inches[a]---		
	First Planting		
Wide	54.50 a*	38.65 a	57.60 a
Narrow	51.95 a	36.70 a	52.35 b
	Second Planting		
Wide	52.20 a	53.35 a	55.95 a
Narrow	48.20 b	48.70 b	50.20 b

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

Table 13. Grain Sorghum Plant Height Measurements From Three Seeding Rates and Two Plant Populations Across Two Row Widths in Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location: Knoxville	Spring Hill	Martin
	------inches[a]------		
	First Planting		
10 lb. seed/acre	54.50 a*	37.25 a	55.38 a
78,000 plants/acre	54.38 a	38.00 a	55.62 a
8 lb. seed/acre	52.25 b	37.62 a	55.25 a
52,000 plants/acre	51.62 b	37.12 a	54.12 a
6 lb. seed/acre	53.12 ab	38.38 a	54.50 a
	Second Planting		
10 lb. seed/acre	51.12 a	50.88 a	54.12 a
78,000 plants/acre	50.75 ab	51.50 a	53.25 ab
8 lb. seed/acre	50.25 bc	51.12 a	53.50 ab
52,000 plants/acre	49.75 cd	51.38 a	52.25 b
6 lb. seed/acre	49.12 d	50.25 a	52.25 b

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

53.18 inches, a 13.2 percent increase. There were no significant interactions involving the year component of variance.

The first and second plantings at Martin contained the tallest plants when compared with respective plantings at the other locations (Table 14). No significant location x row width or location x seeding rate--population interactions occurred in either the first or second plantings.

At Knoxville and Martin, the first planting produced the taller plants of the two plantings at each respective location, while at Spring Hill, the reverse was true (Table 15). This difference at Spring Hill was probably due to the differences in the Maury and Huntington silt loam soils on which the first and second plantings were seeded, respectively, with the Huntington silt loam having a considerably higher moisture supplying capacity than the Maury silt loam. Although the first planting received approximately 2.5 inches more rainfall in its growing season than the second planting received, the advantages of the second planting site mentioned above probably overruled this. There was a significant planting date x row width interaction at Spring Hill, caused by the tendency for plant height to increase more in the wider rows than in the narrow rows with the later planting time.

In the 1970 planting at Knoxville, plant height was not significantly correlated with plant population or row width. However, individual plantings at the three locations in 1971 showed a significant correlation between plant height and row width. Plant height was not significantly correlated with plant population in any of the six 1971 plantings

Table 14. Grain Sorghum Plant Height Measurements Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in Two Plantings at Knoxville, Spring Hill, and Martin in 1971

Location	Planting Date	
	First	Second
	----------inches[a]----------	
Martin	54.98 a*	53.08 a
Knoxville	53.18 b	50.20 b
Spring Hill	37.68 c	51.02 b

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability

Table 15. Grain Sorghum Plant Height Measurements Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in the First and Second Plantings at Three Locations in Tennessee in 1971

Planting	Location		
	Knoxville	Spring Hill	Martin
	----------------inches[a]----------------		
First	53.18 a*	37.68 b	54.98 a
Second	50.20 b	51.02 a	53.08 b

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

(Table 16). Plant height was negatively correlated with planting date at Knoxville and Martin (r = -0.466 and -0.283, respectively) and positively correlated with planting date at Spring Hill (r = 0.931). These coefficients were significant at the .01 level of probability with 78 degrees of freedom.

V. GRAIN YIELD

In 1970 at Knoxville, seeding rate--population changes did not significantly affect grain yield. Row width means for yield were significantly different, with the narrow rows yielding an average of 117.7 bushels/acre and the wide rows an average of 89.9 bushels/acre, a difference of 27.8 bushels (Table 17). This yield reduction in the wide rows, especially at high populations, was due to lodging before the grain had reached physiological maturity. There was very little lodging in the narrow rows in 1970. In 1971, the narrow rows in the first plantings at Spring Hill and Martin and in the second plantings at Spring Hill and Knoxville produced significantly higher yields than the wide rows. The first planting at Knoxville and the second planting at Martin displayed the same trend, but the differences were nonsignificant (Table 18). This response to close-row spacing was probably due to less competition between plants in the narrow rows than in the wide rows because the plant population of each wide row was approximately twice that of each narrow row with a corresponding seeding rate--population. In addition, the narrow rows tended to shade the between-row areas much sooner in the season and more completely than the wide rows, thus giving

Table 16. Correlation Coefficients (r) Showing Plant Height--Row Width and Plant Height--Population Relationships at Three Locations and Two Planting Dates in Tennessee in 1971

Location	Plant Height--Row Width r	Plant Height--Population r
Knoxville		
First Planting	0.437**	0.210
Second Planting	0.702**	0.221
Spring Hill		
First Planting	0.417**	0.005
Second Planting	0.816**	0.025
Martin		
First Planting	0.833**	0.154
Second Planting	0.876**	0.167

**Significant at the .01 level of probability, with 38 degrees of freedom.

Table 17. Grain Sorghum Yields Obtained From Two Row Widths, Three Seeding Rates, and Two Plant Populations at Knoxville in 1970

Treatment	Grain Yield[a] bushels/acre
Row Width	
21 inches	117.7 a*
42 inches	89.9 b
Seeding Rate--Population	
6 lb. seed/acre	106.3 a‡
52,000 plants/acre	106.0 a
8 lb. seed/acre	105.1 a
10 lb. seed/acre	103.1 a
78,000 plants/acre	98.5 a

[a]Average of four replications.

*Values followed by the same letter are not significantly different at the .10 level of probability.

‡Values followed by the same letter are not significantly different at the .10 level of probability.

Table 18. Grain Sorghum Yields Obtained From Two Row Widths Across Three Seeding Rates and Two Plant Populations in Two Plantings at Three Locations in Tennessee in 1971

Row Width	Location: Knoxville	Spring Hill	Martin
	----------bushels/acre[a]----------		
	First Planting		
Narrow	105.0 a*	91.0 a	122.7 a
Wide	98.4 a	83.6 b	111.7 b
	Second Planting		
Narrow	104.3 a	97.0 a	88.0 a
Wide	90.8 b	90.3 b	83.4 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

better weed control and reducing evaporation. In the second plantings at Knoxville and Spring Hill and in the first planting at Martin, significant differences in yield among seeding rate--population means occurred; however, yields from the eight and ten pound seeding rates and 78,000 plants/acre population level were not significantly different (Table 19). No significant row width x seeding rate--population interactions were found in the 1970 planting or in any of the 1971 plantings.

The 1970 planting and 1971 first planting at Knoxville had average yields of 103.8 and 101.6 bushels/acre, respectively, with the difference being nonsignificant. The two year analysis of the Knoxville data revealed a significant difference in grain yield means between the two row widths, with narrow rows and wide rows yielding 111.3 and 94.1 bushels/acre, respectively, as an average of the three seeding rates and two plant populations. No significant grain yield difference was found among seeding rate--population means over the two year period for the early plantings at Knoxville (Table 20). There was a significant year x row width interaction, with the narrow rows showing a significant yield difference between years, while the wide rows did not (Table 21). A significant row width x seeding rate--population interaction also occurred.

There was a significant difference in grain yield among locations in 1971 in both plantings, with Martin producing the highest yield of the first plantings and the lowest yield of the second plantings (Table 22). Narrow rows produced significantly higher yields of the two row

Table 19. Grain Sorghum Yields Obtained From Three Seeding Rates and Two Plant Populations Across Two Row Widths in Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location: Knoxville	Spring Hill	Martin
	---bushels/acre[a]---		
	First Planting		
10 lb. seed/acre	103.3 a*	89.5 a	121.5 a
78,000 plants/acre	103.7 a	87.1 a	122.7 a
8 lb. seed/acre	99.0 a	91.8 a	117.1 ab
52,000 plants/acre	102.0 a	84.4 a	113.7 bc
6 lb. seed/acre	100.4 a	83.6 a	111.0 c
	Second Planting		
10 lb. seed/acre	104.0 a	92.4 a	87.7 a
78,000 plants/acre	101.9 a	97.0 a	90.4 a
8 lb. seed/acre	99.3 a	96.5 a	84.9 a
52,000 plants/acre	91.9 b	94.8 a	83.1 a
6 lb. seed/acre	90.8 b	87.1 b	82.4 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

Table 20. Two Year Average Grain Sorghum Yields Obtained From Two Row Widths, Three Seeding Rates, and Two Plant Populations in the 1970 Planting and First 1971 Planting at Knoxville

Treatment	Grain Yield bushels/acre
Row Width	
Narrow	111.3 a*
Wide	94.1 b
Seeding Rate--Population	
10 lb. seed/acre	103.2 a‡
78,000 plants/acre	101.1 a
8 lb. seed/acre	102.0 a
52,000 plants/acre	104.0 a
6 lb. seed/acre	103.3 a

*Values followed by the same letter are not significantly different at the .10 level of probability.

‡Values followed by the same letter are not significantly different at the .10 level of probability.

Table 21. Grain Sorghum Yields Obtained From Two Row Widths Across Three Seeding Rates and Two Plant Populations in the 1970 Planting and First 1971 Planting at Knoxville

Year	Row Width	Grain Yield
		bushels/acre[a]
1970	Narrow	117.7 a*
1971	Narrow	105.0 b
1970	Wide	89.9 c
1971	Wide	98.4 bc

[a]Average of four replications.

*Values followed by the same letter are not significantly different at the .10 level of probability.

Table 22. Grain Sorghum Yields Obtained Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in Two Plantings at Knoxville, Spring Hill, and Martin

	Planting	
Location	First	Second
	---------------bushels/acre[a]	--------------
Martin	117.2 a*	85.7 c
Knoxville	101.8 b	97.6 a
Spring Hill	87.3 c	93.5 b

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

widths in both plantings across the three locations (Table 23). Significant differences among seeding rate--population means for yield occurred in both plantings across the three locations, with the eight and ten pound seeding rates and the 78,000 plants/acre population level producing yields that were in the significantly higher yielding group in each case (Table 24). The location component of variance was not involved in any significant interactions in either of the two plantings.

At Martin, the first planting produced a significantly higher average yield than the second, while at Spring Hill, the opposite was true. The same trend occurred at Knoxville as at Martin, but the difference was nonsignificant (Table 25). At Spring Hill, the differences in the Maury soil of the first planting and the Huntington soil of the second planting described earlier probably contributed to the difference in yield of the two plantings. The narrow rows produced the higher yields of the two row widths across the two plantings at each location (Table 26). Significant differences in seeding rate--population means for yield occurred at all locations in the combined analyses, with the ten pound seeding rate and the 78,000 plants/acre population level producing yields that were in the higher yielding group at each location (Table 27). At Knoxville, a significant planting date x seeding rate--population interaction occurred. There were no other significant interactions.

In the 1970 planting at Knoxville, grain yield was significantly correlated with row width ($r = -0.801$) but not with plant population ($r = -0.136$). Individual plantings at the three locations in 1971 showed a significant negative correlation between grain yield and row width in

Table 23. Grain Sorghum Yields Obtained From Two Row Spacings in Two Plantings Across Three Seeding Rates, Two Plant Populations, and Three Locations in Tennessee in 1971

Row Width	Planting First	Planting Second
	---------bushels/acre---------	
Narrow	106.2 a*	96.4 a
Wide	97.9 b	88.2 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 24. Grain Sorghum Yields Obtained From Three Seeding Rates and Two Plant Populations in Two Plantings Across Two Row Widths and Three Locations in Tennessee in 1971

Seeding Rate--Population	Planting First	Planting Second
	---------bushels/acre---------	
10 lb. seed/acre	104.7 a*	94.7 a
78,000 plants/acre	104.5 a	96.4 a
8 lb. seed/acre	102.6 ab	93.6 a
52,000 plants/acre	100.0 bc	89.9 b
6 lb. seed/acre	98.3 c	86.8 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 25. Grain Sorghum Yields Obtained Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in the First and Second Plantings at Three Locations in Tennessee in 1971

Planting	Location		
	Knoxville	Spring Hill	Martin
	---bushels/acre[a]---		
First	101.7 a*	87.3 b	117.2 a
Second	97.6 a	93.5 a	85.7 b

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 26. Grain Sorghum Yields Obtained From Two Row Spacings Across Two Plantings, Three Seeding Rates, and Two Plant Populations at Three Locations in Tennessee in 1971

Row Width	Location		
	Knoxville	Spring Hill	Martin
	---bushels/acre---		
Narrow	104.6 a*	93.9 a	105.4 a
Wide	94.6 b	87.0 b	97.5 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 27. Grain Sorghum Yields Obtained From Three Seeding Rates and Two Plant Populations Across Two Row Widths and Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location		
	Knoxville	Spring Hill	Martin
	bushels/acre		
10 lb. seed/acre	103.6 a*	90.9 ab	104.6 ab
78,000 plants/acre	102.8 a	92.0 ab	106.6 a
8 lb. seed/acre	99.2 ab	94.1 a	101.0 bc
52,000 plants/acre	97.0 b	89.6 b	98.4 cd
6 lb. seed/acre	96.5 b	85.3 c	96.7 d

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

all but one case (Table 28). In the Knoxville 1970-1971 combined analysis, grain yield was found to be significantly correlated with row width (r = -0.647).

In the first planting combined analysis and the second planting combined analysis, grain yield was negatively correlated with row width and positively correlated with plant population. Grain yield was positively correlated with plant height in the first planting and negatively correlated with plant height in the second planting (Table 29).

Correlation coefficients between grain yield and row width, plant population, plant height, and planting date from the combined analyses of the two plantings at each location are shown in Table 30.

VI. BUSHEL WEIGHT

There was no significant difference in bushel weight between row width means or among seeding rate--population means in 1970 at Knoxville (Table 31). In 1971, the wide rows of the first planting at Knoxville and the second plantings at Spring Hill and Martin produced grain with a significantly higher bushel weight, whereas in the first planting at Spring Hill, the opposite was true. The second planting at Knoxville and the first planting at Martin showed the same trend as the first planting at Knoxville and the second plantings at Spring Hill and Martin, but the differences were nonsignificant (Table 32). The only case of a significant effect of seeding rate--population differences on bushel weight occurred in the second planting at Spring Hill, where the grain from the 78,000 plants/acre population level had a bushel weight which

Table 28. Correlation Coefficients (r) Showing Grain Yield--Row Width and Grain Yield--Population Relationships at Three Locations and Two Planting Dates in Tennessee in 1971

Location	Grain Yield-- Row Width r	Grain Yield-- Population r
Knoxville		
First Planting	-0.466**	0.006
Second Planting	-0.533**	0.394*
Spring Hill		
First Planting	-0.399**	0.308*
Second Planting	-0.374*	0.204
Martin		
First Planting	-0.540**	0.532**
Second Planting	-0.249	0.280

*Significant at the .05 level of probability with 38 degrees of freedom.

**Significant at the .01 level of probability with 38 degrees of freedom.

Table 29. Correlation Coefficients (r) Showing Grain Yield--Row Width, Grain Yield--Population, and Grain Yield--Plant Height Relationships in Two Plantings Across Three Locations in Tennessee in 1971

Correlation Between Yield and:	Planting	
	First	Second
Row Width	-0.276**	-0.358**
Population	0.266**	0.230**
Plant Height	0.644**	-0.278**

**Significant at the .01 level of probability with 118 degrees of freedom.

Table 30. Correlation Coefficients (r) Showing Grain Yield--Row Width, Grain Yield--Population, Grain Yield--Plant Height, and Grain Yield--Planting Date Relationships Across Two Plantings at Three Locations in Tennessee in 1971

Correlation Between Yield and:	Location		
	Knoxville	Spring Hill	Martin
Row Width	-0.481**	-0.365**	-0.212
Population	0.226*	0.270*	0.181
Plant Height	0.002	0.234*	0.144
Planting Date	-0.196	0.330**	-0.849**

*Significant at the .05 level of probability with 78 degrees of freedom.

**Significant at the .01 level of probability with 78 degrees of freedom.

Table 31. Grain Sorghum Bushel Weight Measurements of the Grain From Two Row Spacings, Three Seeding Rates, and Two Plant Populations at Knoxville in 1970

Treatment	Bushel Weight
	pounds[a]
Row Width	
Narrow	50.16 a*
Wide	49.63 a
Seeding Rate--Population	
6 lb. seed/acre	51.60 a‡
10 lb. seed/acre	50.06 a
8 lb. seed/acre	47.25 a
78,000 plants/acre	50.44 a
52,000 plants/acre	50.14 a

[a]Average of four replications.

*Values followed by the same letter are not significantly different at the .10 level of probability.

‡Values followed by the same letter are not significantly different at the .10 level of probability.

Table 32. Grain Sorghum Bushel Weight Measurements of the Grain From Two Row Widths Across Three Seeding Rates and Two Plant Populations in Two Plantings at Three Locations in Tennessee in 1971

Row Width	Location: Knoxville	Spring Hill	Martin
	----pounds/bushel[a]----		
	First Planting		
Narrow	61.63 b*	62.68 a	62.37 a
Wide	62.24 a	62.47 b	62.74 a
	Second Planting		
Narrow	59.11 a	59.94 b	63.82 b
Wide	59.33 a	60.82 a	64.08 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

was significantly lower than the bushel weights of the grain from the eight and ten pound seeding rates (Table 33). There were no significant row width x seeding rate--population interactions in the 1970 planting or in any of the 1971 plantings.

In the two year analysis, the 1970 average bushel weight of 49.90 pounds was significantly lower than the 1971 Knoxville first planting average of 61.93 pounds. There were no significant row width or seeding rate--population effects in the two year analysis (Table 34), and the year component of variance was not involved in any significant interactions.

Significant bushel weight differences due to the effects of different locations occurred in both plantings in 1971, with the Knoxville location producing grain with the lowest bushel weight in each respective planting (Table 35). The wide rows in each planting across the three locations produced grain with the higher average bushel weight (Table 36). No significant differences in bushel weights were found among seeding rate--population means in either planting across the three locations (Table 37). There was a significant location x row width interaction for bushel weight in the first planting combined analysis. At Knoxville and Martin, the wide rows produced grain with the higher bushel weight, while at Spring Hill, the bushel weight of grain from the narrow rows was greater.

Significant bushel weight differences due to the effects of different planting time occurred at each location, with the first of the two plantings at Knoxville and Spring Hill producing grain with the higher

Table 33. Grain Sorghum Bushel Weight Measurements of the Grain Obtained From Three Seeding Rates and Two Plant Populations Across Two Row Widths in Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location		
	Knoxville	Spring Hill	Martin
	---------------pounds/bushel[a]---------------		
	First Planting		
6 lb. seed/acre	62.04 a*	62.65 a	62.48 a
8 lb. seed/acre	61.88 a	62.52 a	62.51 a
10 lb. seed/acre	62.21 a	62.48 a	62.60 a
52,000 plants/acre	61.80 a	62.70 a	62.44 a
78,000 plants/acre	61.74 a	62.53 a	62.73 a
	Second Planting		
6 lb. seed/acre	59.20 a	60.41 ab	63.98 a
8 lb. seed/acre	59.55 a	60.77 a	64.03 a
10 lb. seed/acre	59.11 a	60.85 a	63.86 a
52,000 plants/acre	59.12 a	60.11 ab	63.89 a
78,000 plants/acre	59.14 a	59.76 b	64.00 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

Table 34. Two Year Average Grain Sorghum Bushel Weights of the Grain From Two Row Widths, Three Seeding Rates, and Two Plant Populations in the 1970 Planting and First 1971 Planting at Knoxville

Treatment	Bushel Weight pounds
Row Width	
Wide	55.94 a*
Narrow	55.90 a
Seeding Rate--Population	
10 lb. seed/acre	56.14 a‡
78,000 plants/acre	56.09 a
8 lb. seed/acre	54.56 a
52,000 plants/acre	55.97 a
6 lb. seed/acre	56.82 a

*Values followed by the same letter are not significantly different at the .10 level of probability.

‡Values followed by the same letter are not significantly different at the .10 level of probability.

Table 35. Grain Sorghum Bushel Weight Measurements Obtained Across Two Row Widths, Three Seeding Rates and Two Plant Populations in Two Plantings at Knoxville, Spring Hill, and Martin in 1971

Location	Planting First	Planting Second
	--------pounds/bushel[a]---------	
Martin	62.55 a*	63.95 a
Spring Hill	62.58 a	60.38 b
Knoxville	61.93 b	59.22 c

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 36. Grain Sorghum Bushel Weight Measurements Obtained From Two Row Spacings in Two Plantings Across Three Seeding Rates, Two Plant Populations, and Three Locations in Tennessee in 1971

Row Width	Planting First	Planting Second
	--------pounds/bushel---------	
Wide	62.48 a*	61.41 a
Narrow	62.33 b	60.96 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 37. Grain Sorghum Bushel Weight Measurements Obtained From Three Seeding Rates and Two Plant Populations in Two Plantings Across Two Row Spacings and Three Locations in Tennessee in 1971

Seeding Rate--Population	Planting: First	Planting: Second
	---------pounds/bushel---------	
10 lb. seed/acre	62.43 a*	61.27 a
78,000 plants/acre	62.34 a	60.97 a
8 lb. seed/acre	62.30 a	61.45 a
52,000 plants/acre	62.31 a	61.04 a
6 lb. seed/acre	62.39 a	61.19 a

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

bushel weight and the second of the two plantings at Martin producing grain with the higher average bushel weight (Table 38). At Spring Hill and Martin, the wide rows produced grain with the higher average bushel weight of the two row widths across the two plantings at both locations. The trend at Knoxville was the same, though nonsignificant (Table 39). There was no significant difference in bushel weight among seeding rate--population means across the two plantings at any location (Table 40). At Spring Hill, a significant planting date x row width interaction occurred, with the two row widths of the first planting producing grain with no difference in bushel weight, while the wide rows of the second planting yielded grain with the higher bushel weight (Table 41).

Bushel weights from the 1970 planting at Knoxville were not significantly correlated with any other variable. Correlation coefficients between bushel weight and row width, plant population, plant height, and grain yield in the individual plantings in 1971 are given in Table 42. Bushel weight was positively correlated with row width in four of the six plantings. Five of the six plantings showed no significant correlations between bushel weight and grain yield and no planting showed the correlation between bushel weight and population to be significant.

Correlations between bushel weight and the four aforementioned variables from the combined analyses across the three locations for each planting date are presented in Table 43. Bushel weight was negatively correlated with grain yield in the second planting, but no significant relationship was present in the first planting.

Table 38. Grain Sorghum Bushel Weight Measurements Obtained Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in the First and Second Plantings at Three Locations in Tennessee in 1971

Planting	Location Knoxville	Spring Hill	Martin
	pounds/bushel[a]		
First	61.93 a*	62.58 a	62.55 b
Second	59.22 b	60.38 b	63.95 a

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 39. Grain Sorghum Bushel Weight Measurements From Two Row Spacings Across Two Plantings, Three Seeding Rates, and Two Plant Populations at Three Locations in Tennessee in 1971

Row Width	Location Knoxville	Spring Hill	Martin
	pounds/bushel[a]		
Wide	60.79 a*	61.64 a	63.41 a
Narrow	60.37 a	61.31 b	63.10 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 40. Grain Sorghum Bushel Weight Measurements Obtained From Three Seeding Rates and Two Plant Populations Across Two Row Widths and Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location: Knoxville	Spring Hill	Martin
	---pounds/bushel---		
10 lb. seed/acre	60.66 a*	61.67 a	63.23 a
78,000 plants/acre	60.44 a	61.15 a	63.37 a
8 lb. seed/acre	60.71 a	61.65 a	63.27 a
52,000 plants/acre	60.46 a	61.40 a	63.17 a
6 lb. seed/acre	60.62 a	61.53 a	63.23 a

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 41. Grain Sorghum Bushel Weight Measurements Obtained From Two Row Widths Across Three Seeding Rates and Two Plant Populations in Two Plantings at Spring Hill in 1971

Planting	Row Width	Bushel Weight
		pounds/bushel[a]
First	Narrow	62.68 a*
First	Wide	62.47 a
Second	Narrow	59.94 c
Second	Wide	60.82 b

[a]Average of four replications.

*Values followed by the same letter are not significantly different at the .10 level of probability.

Table 42. Correlation Coefficients (r) Between Bushel Weight and Row Width, Plant Population, Plant Height, and Grain Yield at Three Locations and Two Planting Dates in Tennessee in 1971

Location	Correlation Between Bushel Weight and: Row Width	Plant Population	Plant Height	Grain Yield
Knoxville				
First Planting	0.433**	0.068	0.042	-0.643**
Second Planting	0.120	-0.009	-0.034	-0.014
Spring Hill				
First Planting	-0.151	-0.175	-0.455**	0.256
Second Planting	0.466**	0.110	0.488**	-0.143
Martin				
First Planting	0.425**	0.014	0.452**	-0.037
Second Planting	0.397**	-0.067	0.432**	0.178

**Significant at the .01 level of probability with 38 degrees of freedom.

Table 43. Correlation Coefficients (r) Between Bushel Weight and Row Width, Plant Population, Plant Height, and Grain Yield for Two Planting Dates in Tennessee in 1971

Correlation Between Bushel Weight and:	Planting Date	
	First	Second
Row Width	0.186*	0.105
Plant Population	0.007	0.094
Plant Height	-0.182*	0.428**
Grain Yield	-0.060	-0.409**

*Significant at the .05 level of probability with 118 degrees of freedom.

**Significant at the .01 level of probability with 118 degrees of freedom.

In the combined planting date analysis at each location, a high negative correlation existed between bushel weight and planting date at Knoxville and Spring Hill (r = -0.855 and -0.799, respectively), while the correlation at Martin (r = 0.876) was positive. Bushel weight was correlated with grain yield at Spring Hill and Martin (r = 0.330 and -0.849, respectively) but not at Knoxville.

VII. ONE HUNDRED SEED WEIGHT

Measurements for 100 seed weight were not made on the grain from the 1970 planting at Knoxville. In the first plantings at Knoxville and Martin in 1971, the wide rows produced grain with a significantly higher seed weight. This same trend occurred in each of the four remaining plantings, but the differences were nonsignificant (Table 44). There were no significant differences in 100 seed weight due to the effects of seeding rate--population changes in any of the six plantings (Table 45). A significant row width x seeding rate--population interaction for 100 seed weight occurred in the second planting at Spring Hill.

Significant differences in 100 seed weight among locations occurred in both plantings, with the Martin location producing grain with the highest average seed weight across the first plantings and the Martin and Knoxville locations yielding grain with the highest seed weight across the second plantings (Table 46). The wide rows in each planting across the three locations produced grain with the higher average seed weight (Table 47). No significant difference in 100 seed weight occurred among seeding rate--population means in the first planting across the three

Table 44. One Hundred Seed Weights of Grain Sorghum From Two Row Widths Across Three Seeding Rates and Two Plant Populations in Two Plantings at Three Locations in Tennessee in 1971

Row Width	Location Knoxville	Spring Hill	Martin
	----------grams/100 seed[a]----------		
	First Planting		
Narrow	2.05 b*	2.18 a	2.18 b
Wide	2.20 a	2.24 a	2.37 a
	Second Planting		
Narrow	2.60 a	2.27 a	2.53 a
Wide	2.72 a	2.39 a	2.75 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

Table 45. One Hundred Seed Weights of Grain Sorghum From Three Seeding Rates and Two Plant Populations Across Two Row Widths in Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location		
	Knoxville	Spring Hill	Martin
	---------------grams/100 seed[a]-------------		
		First Planting	
6 lb. seed/acre	2.18 a*	2.22 a	2.30 a
8 lb. seed/acre	2.15 a	2.22 a	2.22 a
10 lb. seed/acre	2.10 a	2.21 a	2.30 a
52,000 plants/acre	2.10 a	2.20 a	2.27 a
78,000 plants/acre	2.09 a	2.17 a	2.29 a
		Second Planting	
6 lb. seed/acre	2.72 a	2.35 a	2.70 a
8 lb. seed/acre	2.61 a	2.32 a	2.69 a
10 lb. seed/acre	2.63 a	2.28 a	2.47 a
52,000 plants/acre	2.65 a	2.38 a	2.67 a
78,000 plants/acre	2.70 a	2.31 a	2.67 a

[a]Average of four replications.

*Values in individual columns within each planting followed by the same letter are not significantly different at the .10 level of probability.

Table 46. One Hundred Seed Weights of Grain Sorghum Obtained Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in Two Plantings at Knoxville, Spring Hill, and Martin in 1971

Location	Planting: First	Planting: Second
	grams/100 seed[a]	
Martin	2.28 a*	2.64 a
Spring Hill	2.21 b	2.33 b
Knoxville	2.12 c	2.66 a

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 47. One Hundred Seed Weights of Grain Sorghum From Two Row Spacings in Two Plantings Across Three Seeding Rates, Two Plant Populations, and Three Locations in Tennessee in 1971

Row Width	Planting: First	Planting: Second
	grams/100 seed	
Wide	2.27 a*	2.62 a
Narrow	2.14 b	2.47 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

locations, but in the second planting, the ten pound seeding rate produced grain with a significantly lower seed weight (Table 48). A significant location x row width interaction occurred in the first planting.

The difference in planting dates at each location significantly affected 100 seed weight, with the second planting producing grain with a higher average seed weight in each case (Table 49). The wide rows produced grain with the higher average 100 seed weight across the two plantings at each location (Table 50). Seeding rate--population means across the two plantings for 100 seed weight were not significantly different at any location (Table 51). At Spring Hill, a significant row width x seeding rate interaction occurred, and at Martin, there was a significant planting date x seeding rate interaction.

Correlation coefficients between 100 seed weight and row width, plant population, plant height, grain yield, and bushel weight are shown in Table 52. One hundred seed weight was significantly correlated with row width in five of the six 1971 plantings. In each case, seed weight increased as row width increased. The same trend occurred in the first planting at Spring Hill, although the correlation was nonsignificant. The only case of a significant correlation between 100 seed weight and plant population occurred in the second planting at Martin. Seed weight was significantly correlated with grain yield in both plantings at Knoxville and Martin, but in neither planting at Spring Hill. In the four cases of significance, seed weight decreased as grain yield increased. The correlation between seed weight and bushel weight was significant in the first plantings at each location, but not in the second. The two variables tended to increase together (Table 52).

Table 48. One Hundred Seed Weights of Grain Sorghum From Three Seeding Rates and Two Plant Populations in Two Plantings Across Two Row Spacings and Three Locations in Tennessee in 1971

Seeding Rate-- Population	Planting	
	First	Second
	------grams/100 seed-------	
6 lb. seed/acre	2.23 a*	2.59 a
52,000 plants/acre	2.19 a	2.56 a
78,000 plants/acre	2.18 a	2.56 a
8 lb. seed/acre	2.20 a	2.54 a
10 lb. seed/acre	2.20 a	2.46 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 49. One Hundred Seed Weights of Grain Sorghum Obtained Across Two Row Widths, Three Seeding Rates, and Two Plant Populations in the First and Second Plantings at Three Locations in Tennessee in 1971

Planting	Location		
	Knoxville	Spring Hill	Martin
	-------------grams/100 seed[a]--------------		
Second	2.66 a*	2.33 a	2.64 a
First	2.12 b	2.21 b	2.28 b

[a]Average of four replications.

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 50. One Hundred Seed Weights of Grain Sorghum From Two Row Spacings Across Two Plantings, Three Seeding Rates, and Two Plant Populations at Three Locations in Tennessee in 1971

Row Width	Location Knoxville	Spring Hill	Martin
	grams/100 seed		
Wide	2.46 a*	2.31 a	2.56 a
Narrow	2.32 b	2.22 b	2.36 b

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 51. One Hundred Seed Weights of Grain Sorghum From Three Seeding Rates and Two Plant Populations Across Two Row Widths and Two Plantings at Three Locations in Tennessee in 1971

Seeding Rate--Population	Location Knoxville	Spring Hill	Martin
	grams/100 seed		
6 lb. seed/acre	2.45 a*	2.28 a	2.50 a
8 lb. seed/acre	2.38 a	2.27 a	2.46 a
10 lb. seed/acre	2.36 a	2.25 a	2.38 a
52,000 plants/acre	2.38 a	2.29 a	2.47 a
78,000 plants/acre	2.39 a	2.24 a	2.48 a

*Values in individual columns followed by the same letter are not significantly different at the .10 level of probability.

Table 52. Correlation Coefficients (r) Between 100 Seed Weight and Row Width, Plant Population, Plant Height, Grain Yield, and Bushel Weight at Three Locations and Two Planting Dates in Tennessee in 1971

	Correlation Between 100 Seed Weight and:				
Location	Row Width	Plant Population	Plant Height	Grain Yield	Bushel Weight
Knoxville					
First Planting	0.535**	-0.102	0.130	-0.351*	0.353*
Second Planting	0.363*	-0.131	0.288	-0.550**	0.132
Spring Hill					
First Planting	0.305	-0.092	-0.464**	0.069	0.449**
Second Planting	0.480**	-0.225	0.615**	-0.144	0.196
Martin					
First Planting	0.755**	-0.034	0.687**	-0.343*	0.430*
Second Planting	0.485**	-0.366*	0.411**	-0.498**	0.267

*Significant at the .05 level of probability with 38 degrees of freedom.

**Significant at the .01 level of probability with 38 degrees of freedom.

Correlation coefficients between 100 seed weight and row width and between 100 seed weight and bushel weight were significant in the first planting analysis across the three locations (Table 53). Seed weight was significantly correlated with each of the five variables in Table 53 in the second planting analysis.

In the combined planting date analysis at each location, 100 seed weight was significantly correlated with row width, bushel weight, and planting date at each location. Seed weight was significantly correlated with grain yield at Knoxville and Martin but not at Spring Hill. Seed weight--plant population coefficients were not significant at any location (Table 54).

Table 53. Correlation Coefficients (r) Between 100 Seed Weight and Other Variables at Two Planting Dates in Tennessee in 1971

Correlation Between Seed Weight and:	Planting Date	
	First	Second
Row Width	0.479**	0.327**
Plant Population	-0.009	-0.181*
Plant Height	0.079	0.336**
Grain Yield	0.062	-0.330**
Bushel Weight	0.485**	0.183*

*Significant at the .05 level of probability with 118 degrees of freedom.

** Significant at the .01 level of probability with 118 degrees of freedom.

Table 54. Correlation Coefficients (r) Between 100 Seed Weight and Row Width, Plant Population, Plant Height, Grain Yield, Bushel Weight, and Planting Date at Three Locations in Tennessee in 1971

Correlation Between Seed Weight and:	Location		
	Knoxville	Spring Hill	Martin
Row Width	0.218*	0.352**	0.388**
Plant Population	0.024	-0.103	-0.128
Plant Height	-0.309**	0.495**	0.123
Grain Yield	-0.403**	0.118	-0.762**
Bushel Weight	-0.685**	-0.220*	0.730**
Planting Date	0.868**	0.469**	0.717**

*Significant at the .05 level of probability with 78 degrees of freedom.

**Significant at the .01 level of probability with 78 degrees of freedom.

CHAPTER V

SUMMARY AND CONCLUSIONS

The effect of three seeding rates and two plant populations at two row widths on plant height, grain yield, and bushel weight of grain sorghum (*Sorghum bicolor* (L.) Moench) was studied at Knoxville, Tennessee, in 1970. In 1971, the effect of the three seeding rates and the two plant populations at the two row widths on plant height, grain yield, bushel weight, and 100 seed weight in an early and late planting at Knoxville, Spring Hill, and Martin was evaluated. Grain sorghum was seeded in wide rows (38, 40, or 42 inches) and narrow rows (19, 20, or 21 inches) at the rates of six, eight, and ten pounds of seed/acre, along with two ten-pound seeding rates which were thinned to give populations of 52,000 and 78,000 plants/acre, using a split plot arrangement of treatments. The 1970 Knoxville planting was seeded in early May and the early or first plantings in 1971 were seeded in late April or early May, whereas the late or second plantings in 1971 were seeded in early or mid June.

Plant populations/acre obtained in 1971 ranged from 53,000 to 62,000 for the six pound seeding rate, 73,000 to 81,000 for the eight pound seeding rate, and 88,000 to 99,000 for the ten pound seeding rate. The plant populations from the six and ten pound rates in 1970 at Knoxville were slightly above the range for each respective rate in 1971.

Grain yields from the narrow rows of the 1970 Knoxville planting and four of the six 1971 plantings were significantly greater than wide row yields. This same trend occurred in the two remaining 1971 plantings. The eight and ten pound seeding rates and the 78,000 plants/acre population level produced yields that were significantly higher in three of the six 1971 plantings, and also in each of the two plantings across the three locations. The ten pound seeding rate and the 78,000 plants/acre population level produced yields in the higher yielding group across the two plantings at each location.

The first plantings at Knoxville and Martin produced the higher average yields of the two plantings at each respective location, whereas the second planting at Spring Hill produced the higher yield of the two plantings at that location, possibly due to the differences in the Maury and Huntington silt loam soils on which the first and second plantings were seeded, respectively.

In 1971, wide row plants were taller than those in narrow rows in one of the three first plantings and in each of the three second plantings. Plant height differences among seeding rate--population means occurred in three of the six 1971 plantings. The first plantings at Knoxville and Martin produced the taller plants of the two plantings at each respective location, while the second planting at Spring Hill contained the taller plants of the two plantings at that location, again because of the soil differences of the two planting sites.

Grain from the wide rows in three of the 1971 plantings had a higher average bushel weight than grain from the narrow rows, while wide rows produced grain with the higher average 100 seed weight in two of the 1971 plantings. Bushel weight differences among seeding rate--population means occurred in only one of the six 1971 plantings, whereas seeding rate--population changes did not affect 100 seed weight in any planting. The first of the two plantings at two of the locations produced grain with the higher average bushel weight, whereas the reverse occurred at Martin. The second of the two plantings at each location produced grain with the higher average 100 seed weight. The wide rows produced grain with the higher average bushel weight across the two plantings at two locations and the higher average 100 seed weight across the two plantings at all locations.

A significant positive correlation existed between plant height and row width in each of the six 1971 plantings. A significant negative correlation occurred between grain yield and row width in the 1970 Knoxville planting and in five of the six 1971 plantings. A significant positive correlation between bushel weight and row width existed in four of the six 1971 plantings. One hundred seed weight was positively correlated with row width in five of the six 1971 plantings. Bushel weight and plant height were not correlated with seeding rate--population in any of the six 1971 plantings or in the 1970 planting. Grain yield was positively correlated with seeding rate--population in three of the six 1971 plantings and 100 seed weight was correlated with seeding rate--population in only one of the six plantings in 1971.

Significant correlations between planting date and plant height, bushel weight, and 100 seed weight existed at each location, and grain yield was correlated with planting date at two of the three locations.

One hundred seed weight was significantly correlated with grain yield in four of the six 1971 plantings. Bushel weight and 100 seed weight were positively correlated in the first planting at each location. Bushel weight and 100 seed weight were significantly correlated with plant height in each of the two plantings at Spring Hill and Martin.

For higher yields, the results of this study showed that grain sorghum should be seeded in early or mid May in narrow rows at a seeding rate that will establish 75,000-95,000 plants/acre, and it was found that a seeding rate of eight or ten pounds of seed/acre will establish populations within this desired range. If mechanical cultivation for weed control in the narrow rows poses a problem, then the seeding of grain sorghum in wide rows may necessarily be dictated by this condition. However, with the use of a preemergence herbicide in this study, adequate weed control in the narrow rows was attained at all locations.

If a higher bushel weight or a higher 100 seed weight is the desired characteristic, then grain sorghum should be seeded in wide rows in most cases, with no single optimum seeding rate being determined for either of these two variables in this study. For a higher bushel weight, grain sorghum should be seeded in early or mid May, whereas grain sorghum should be seeded in early or mid June to obtain grain with a higher 100 seed weight.

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APPENDIX

APPENDIX

Table 55. Analyses of Variance for 1970 Grain Sorghum Plant Populations, Plant Heights, Grain Yields, and Bushel Weights at Knoxville

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Plant Populations	
Row Width (RW)	1	33856000	.6064
Error	3	102137965	
Seeding Rate--population (SP)	4	2793853168**	.0001
RW x SP	4	36463604	.5102
Error	24	41227386	
		Plant Heights	
Row Width (RW)	1	1.225	.8252
Error	3	23.092	
Seeding Rate--population (SP)	4	3.338	.2617
RW x SP	4	3.412	.2517
Error	24	2.375	
		Grain Yields	
Row Width (RW)	1	7728.400*	.0218
Error	3	424.382	
Seeding Rate--population (SP)	4	82.072	.3788
RW x SP	4	148.528	.1270
Error	24	74.481	
		Bushel Weights	
Row Width (RW)	1	2.862	.5578
Error	3	3.626	
Seeding Rate--population (SP)	4	20.568	.5164
RW x SP	4	6.069	.9075
Error	24	24.552	

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 56. Analyses of Variance for the Combined 1970-1971 Grain Sorghum Plant Populations, Plant Heights, Grain Yields, and Bushel Weights at Knoxville

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Plant Populations	
Year (Y)	1	855830987*	.0395
Row Width (RW)	1	92039806	.5702
Y x RW	1	1863246	.9029
Error	6	126194442	
Seeding Rate--population (SP)	4	4516177883**	.0001
Y x SP	4	241853729**	.0008
RW x SP	4	5415098	.9666
Y x RW x SP	4	75224198	.1338
Error	48	40658380	
		Plant Heights	
Year (Y)	1	768.800**	.0015
Row Width (RW)	1	22.050	.6408
Y x RW	1	39.200	.2312
Error	6	22.192	
Seeding Rate--population (SP)	4	11.075*	.0105
Y x SP	4	5.175	.1574
RW x SP	4	8.050*	.0412
Y x RW x SP	4	0.450	.9593
Error	48	2.988	
		Grain Yields	
Year (Y)	1	90.844	.5821
Row Width (RW)	1	5914.908**	.0037
Y x RW	1	2248.366*	.0259
Error	6	262.553	
Seeding Rate--population (SP)	4	21.616	.8143
Y x SP	4	91.775	.1721
RW x SP	4	115.285+	.0952
Y x RW x SP	4	74.228	.2650
Error	48	55.039	

Table 56. (continued)

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Bushel Weights	
Year (Y)	1	2897.547**	.0001
Row Width (RW)	1	0.033	.9004
Y x RW	1	6.624	.1253
Error	6	2.113	
Seeding Rate--population (SP)	4	10.932	.5137
Y x SP	4	9.927	.5351
RW x SP	4	4.083	.8584
Y x RW x SP	4	2.298	.9433
Error	48	12.459	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 57. Analyses of Variance for the Grain Sorghum Populations of the First and Second Plantings at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
	Knoxville First Planting		
Row Width (RW)	1	60047052	.5740
Error	3	150250919	
Seeding Rate--population (SP)	4	1964178444**	.0001
RW x SP	4	44175692	.3788
Error	24	40089374	
	Spring Hill First Planting		
Row Width (RW)	1	266996	.8480
Error	3	6764033	
Seeding Rate--population (SP)	4	2361471623**	.0001
RW x SP	4	19364814	.2844
Error	24	14480893	
	Martin First Planting		
Row Width (RW)	1	72875702	.5042
Error	3	125639435	
Seeding Rate--population (SP)	4	2624528963**	.0001
RW x SP	4	40487690	.5886
Error	24	56193035	
	Knoxville Second Planting		
Row Width (RW)	1	5811013	.1508
Error	3	1583547	
Seeding Rate--population (SP)	4	2496415494**	.0001
RW x SP	4	7020570	.8092
Error	24	17623812	
	Spring Hill Second Planting		
Row Width (RW)	1	44398704**	.0006
Error	3	201865	
Seeding Rate--population (SP)	4	2647925385**	.0001
RW x SP	4	45289307	.2355
Error	24	30369988	

Table 57. (continued)

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Martin Second Planting	
Row Width (RW)	1	4497044	.8124
Error	3	72766144	
Seeding Rate--population (SP)	4	2452065708**	.0001
RW x SP	4	15733009	.6856
Error	24	27323124	

**Significant at the .01 level of probability.

Table 58. Analyses of Variance for Grain Sorghum Plant Populations of the First and Second Plantings in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		First Planting	
Location (L)	2	276049395	.1039
Row Width (RW)	1	24482	.9848
L x RW	2	66582634	.5220
Error	9	94218129	
Seeding Rate--population (SP)	4	6909366165**	.0001
L x SP	8	20406432	.8136
RW x SP	4	33906465	.5402
L x RW x SP	8	35060866	.5173
Error	72	36921100	
		Second Planting	
Location (L)	2	132243497*	.0295
Row Width (RW)	1	13539457	.5152
L x RW	2	20583652	.5294
Error	9	24850519	
Seeding Rate--population (SP)	4	7556440715**	.0001
L x SP	8	19982936	.6092
RW x SP	4	43073577	.1549
L x RW x SP	8	12484654	.8548
Error	72	25105641	

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 59. Analyses of Variance for Grain Sorghum Plant Populations at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville	
Planting Date (PD)	1	185382650	.1675
Row Width (RW)	1	51608813	.5545
PD x RW	1	14249252	.6809
Error	6	75917233	
Seeding Rate--population (SP)	4	4353952364**	.0001
PD x SP	4	106641573*	.0106
RW x SP	4	36070886	.3021
PD x RW x SP	4	15125376	.7214
Error	48	28856593	
		Spring Hill	
Planting Date (PD)	1	189623294**	.0007
Row Width (RW)	1	18889848+	.0574
PD x RW	1	25775851*	.0338
Error	6	3482949	
Seeding Rate--population (SP)	4	4973366400**	.0001
PD x SP	4	36030609	.1870
RW x SP	4	10745722	.7534
PD x RW x SP	4	53908399+	.0618
Error	48	22425440	
		Martin	
Planting Date (PD)	1	50049738	.5089
Row Width (RW)	1	56789555	.5173
PD x RW	1	20583191	.6664
Error	6	99202789	
Seeding Rate--population (SP)	4	5066722011**	.0001
PD x SP	4	9872659	.9152
RW x SP	4	51074016	.3130
PD x RW x SP	4	5146683	.9706
Error	48	41758079	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 60. Analyses of Variance for Grain Sorghum Plant Heights of the First and Second Plantings at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville First Planting	
Row Width (RW)	1	60.025	.1914
Error	3	21.292	
Seeding Rate--population (SP)	4	12.912*	.0196
RW x SP	4	5.088	.2592
Error	24	3.600	
		Spring Hill First Planting	
Row Width (RW)	1	38.025	.1181
Error	3	8.092	
Seeding Rate--population (SP)	4	2.162	.5547
RW x SP	4	1.212	.7092
Error	24	2.238	
		Martin First Planting	
Row Width (RW)	1	275.625**	.0050
Error	3	5.625	
Seeding Rate--population (SP)	4	3.212	.2840
RW x SP	4	0.688	.8835
Error	24	2.400	
		Knoxville Second Planting	
Row Width (RW)	1	160.000*	.0127
Error	3	6.067	
Seeding Rate--population (SP)	4	5.038**	.0020
RW x SP	4	0.938	.3709
Error	24	0.838	
		Spring Hill Second Planting	
Row Width (RW)	1	216.225*	.0141
Error	3	8.825	
Seeding Rate--population (SP)	4	1.962	.5624
RW x SP	4	1.538	.5580
Error	24	2.000	

Table 60. (continued)

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
	Martin Second Planting		
Row Width (RW)	1	330.625**	.0009
Error	3	2.092	
Seeding Rate--population (SP)	4	5.350^{+}	.0713
RW x SP	4	2.250	.4088
Error	24	2.167	

$^{+}$Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 61. Analyses of Variance for Grain Sorghum Plant Heights of the First and Second Plantings in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		First Planting	
Location (L)	2	3618.533**	.0001
Row Width (RW)	1	310.408**	.0009
L x RW	2	31.633	.1190
Error	9	11.669	
Seeding Rate--population (SP)	4	10.429**	.0076
L x SP	8	3.929	.1980
RW x SP	4	3.471	.2914
L x RW x SP	8	1.758	.7427
Error	72	2.746	
		Second Planting	
Location (L)	2	87.658**	.0016
Row Width (RW)	1	691.200**	.0001
L x RW	2	7.825	.2997
Error	9	5.661	
Seeding Rate--population (SP)	4	8.742**	.0012
L x SP	8	1.804	.3858
RW x SP	4	1.492	.5262
L x RW x SP	8	1.617	.5324
Error	72	1.668	

**Significant at the .01 level of probability.

Table 62. Analyses of Variance for Grain Sorghum Plant Heights at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville	
Planting Date (PD)	1	177.012*	.0116
Row Width (RW)	1	208.012**	.0083
PD x RW	1	12.012	.6124
Error	6	13.679	
Seeding Rate--population (SP)	4	14.156**	.0005
PD x SP	4	3.794	.1623
RW x SP	4	2.294	.4003
PD x RW x SP	4	3.731	.1687
Error	48	2.219	
		Spring Hill	
Planting Date (PD)	1	3564.450**	.0001
Row Width (RW)	1	217.800**	.0028
PD x RW	1	36.450+	.0816
Error	6	8.458	
Seeding Rate--population (SP)	4	1.019	.7523
PD x SP	4	3.106	.2263
RW x SP	4	0.769	.8349
PD x RW x SP	4	1.981	.5468
Error	48	2.119	
		Martin	
Planting Date (PD)	1	72.200**	.0054
Row Width (RW)	1	605.000**	.0001
PD x RW	1	1.250	.5939
Error	6	3.858	
Seeding Rate--population (SP)	4	7.769*	.0157
PD x SP	4	0.794	.8452
RW x SP	4	1.906	.5116
PD x RW x SP	4	1.031	.7730
Error	48	2.283	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 63. Analyses of Variance for Grain Sorghum Yields of the First and Second Plantings at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville First Planting	
Row Width (RW)	1	434.874	.1287
Error	3	100.724	
Seeding Rate--population (SP)	4	31.320	.5076
RW x SP	4	40.985	.3569
Error	24	35.598	
		Spring Hill First Planting	
Row Width (RW)	1	543.906*	.0241
Error	3	32.039	
Seeding Rate--population (SP)	4	93.509	.2095
RW x SP	4	21.387	.8334
Error	24	58.940	
		Martin First Planting	
Row Width (RW)	1	1222.462*	.0291
Error	3	82.507	
Seeding Rate--population (SP)	4	200.884**	.0066
RW x SP	4	13.551	.8663
Error	24	43.248	
		Knoxville Second Planting	
Row Width (RW)	1	1821.960*	.0181
Error	3	88.000	
Seeding Rate--population (SP)	4	279.712*	.0140
RW x SP	4	65.769	.5283
Error	24	71.715	
		Spring Hill Second Planting	
Row Width (RW)	1	419.192+	.0637
Error	3	51.522	
Seeding Rate--population (SP)	4	129.866*	.0193
RW x SP	4	18.279	.7335
Error	24	36.055	

Table 63. (continued)

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
	Martin Second Planting		
Row Width (RW)	1	215.157	.2683
Error	3	117.089	
Seeding Rate--population (SP)	4	90.198	.1437
RW x SP	4	37.639	.5449
Error	24	47.642	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 64. Analyses of Variance for Grain Sorghum Yields of the First and Second Plantings in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		First Planting	
Location (L)	2	8944.239**	.0001
Row Width (RW)	1	2087.669**	.0007
L x RW	2	56.787	.5144
Error	9	71.757	
Seeding Rate--population (SP)	4	190.090**	.0048
L x SP	8	67.811	.1805
RW x SP	4	28.714	.6492
L x RW x SP	8	23.605	.8428
Error	72	45.928	
		Second Planting	
Location (L)	2	1457.640**	.0012
Row Width (RW)	1	2019.004**	.0012
L x RW	2	218.652	.1313
Error	9	85.537	
Seeding Rate--population (SP)	4	363.326**	.0002
L x SP	8	68.225	.2484
RW x SP	4	88.302	.1574
L x RW x SP	8	16.692	.9546
Error	72	51.804	

**Significant at the .01 probability level.

Table 65. Analyses of Variance for Grain Sorghum Yields at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville	
Planting Date (PD)	1	334.685	.1069
Row Width (RW)	1	2018.543**	.0041
PD x RW	1	238.292	.1615
Error	6	94.362	
Seeding Rate--population (SP)	4	197.218*	.0109
PD x SP	4	113.814+	.0918
RW x SP	4	90.941	.1657
PD x RW x SP	4	15.813	.8798
Error	48	53.656	
		Spring Hill	
Planting Date (PD)	1	781.438**	.0054
Row Width (RW)	1	959.043**	.0035
PD x RW	1	4.054	.7619
Error	6	41.781	
Seeding Rate--population (SP)	4	172.670*	.0115
PD x SP	4	50.704	.3834
RW x SP	4	28.549	.6668
PD x RW x SP	4	11.117	.9166
Error	48	47.497	
		Martin	
Planting Date (PD)	1	19821.067**	.0001
Row Width (RW)	1	1231.665*	.0127
PD x RW	1	205.954	.1995
Error	6	99.798	
Seeding Rate--population (SP)	4	275.368**	.0007
PD x SP	4	15.715	.8464
RW x SP	4	41.920	.5396
PD x RW x SP	4	9.271	.9332
Error	48	45.445	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 66. Analyses of Variance for Grain Sorghum Bushel Weights of the First and Second Plantings at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville First Planting	
Row Width (RW)	1	3.795+	.0856
Error	3	0.600	
Seeding Rate--population (SP)	4	0.291	.5414
RW x SP	4	0.312	.5068
Error	24	0.365	
		Spring Hill First Planting	
Row Width (RW)	1	0.445+	.0594
Error	3	0.052	
Seeding Rate--population (SP)	4	0.069	.9139
RW x SP	4	0.239	.5253
Error	24	0.291	
		Martin First Planting	
Row Width (RW)	1	1.365	.1190
Error	3	0.293	
Seeding Rate--population (SP)	4	0.103	.6008
RW x SP	4	0.290	.1302
Error	24	0.147	
		Knoxville Second Planting	
Row Width (RW)	1	0.484	.6106
Error	3	1.497	
Seeding Rate--population (SP)	4	0.271	.8722
RW x SP	4	0.464	.7236
Error	24	0.890	
		Spring Hill Second Planting	
Row Width (RW)	1	7.621*	.0438
Error	3	0.696	
Seeding Rate--population (SP)	4	1.672+	.0781
RW x SP	4	0.306	.7813
Error	24	0.698	

Table 66. (continued)

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Martin Second Planting	
Row Width (RW)	1	0.686*	.0335
Error	3	0.051	
Seeding Rate--population (SP)	4	0.043	.7338
RW x SP	4	0.080	.5439
Error	24	0.085	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

Table 67. Analyses of Variance for Grain Sorghum Bushel Weights of the First and Second Plantings in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
First Planting			
Location (L)	2	5.317**	.0012
Row Width (RW)	1	2.000*	.0315
L x RW	2	1.803*	.0246
Error	9	0.315	
Seeding Rate--population (SP)	4	0.071	.8993
L x SP	8	0.196	.6644
RW x SP	4	0.228	.5000
L x RW x SP	8	0.307	.3433
Error	72	0.268	
Second Planting			
Location (L)	2	243.186**	.0001
Row Width (RW)	1	6.120*	.0181
L x RW	2	1.336	.2217
Seeding Rate--population (SP)	4	0.878	.1895
L x SP	8	0.554	.5503
RW x SP	4	0.104	.9425
L x RW x SP	8	0.373	.7185
Error	72	0.558	

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 68. Analyses of Variance for Grain Sorghum Bushel Weights at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville	
Planting Date (PD)	1	146.990**	.0001
Row Width (RW)	1	3.494	.1160
PD x RW	1	0.784	.5758
Error	6	1.049	
Seeding Rate--population (SP)	4	0.234	.8281
PD x SP	4	0.328	.7230
RW x SP	4	0.188	.8770
PD x RW x SP	4	0.588	.5480
Error	48	0.628	
		Spring Hill	
Planting Date (PD)	1	96.580**	.0001
Row Width (RW)	1	2.191+	.0506
PD x RW	1	5.875**	.0078
Error	6	0.374	
Seeding Rate--population (SP)	4	0.728	.2242
PD x SP	4	1.012	.1019
RW x SP	4	0.403	.5238
PD x RW x SP	4	0.142	.8841
Error	48	0.494	
		Martin	
Planting Date (PD)	1	39.214**	.0001
Row Width (RW)	1	1.994*	.0144
PD x RW	1	0.058	.5874
Error	6	0.172	
Seeding Rate--population (SP)	4	0.087	.5664
PD x SP	4	0.059	.7299
RW x SP	4	0.210	.1408
PD x RW x SP	4	0.160	.2538
Error	48	0.116	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 69. Analyses of Variance for Grain Sorghum 100 Seed Weights of the First and Second Plantings at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
	Knoxville First Planting		
Row Width (RW)	1	0.2168*	.0396
Error	3	0.0184	
Seeding Rate--population (SP)	4	0.0143	.5620
RW x SP	4	0.0045	.8706
Error	24	0.0145	
	Spring Hill First Planting		
Row Width (RW)	1	0.0394	.1964
Error	3	0.0144	
Seeding Rate--population (SP)	4	0.0030	.7137
RW x SP	4	0.0078	.2753
Error	24	0.0057	
	Martin First Planting		
Row Width (RW)	1	0.3245**	.0021
Error	3	0.0037	
Seeding Rate--population (SP)	4	0.0071	.2894
RW x SP	4	0.0099	.1547
Error	24	0.0054	
	Knoxville Second Planting		
Row Width (RW)	1	0.1473	.1805
Error	3	0.0488	
Seeding Rate--population (SP)	4	0.0169	.3343
RW x SP	4	0.0197	.2607
Error	24	0.0140	
	Spring Hill Second Planting		
Row Width (RW)	1	0.1428	.1099
Error	3	0.0284	
Seeding Rate--population (SP)	4	0.0103	.4166
RW x SP	4	0.0248+	.0706
Error	24	0.0100	

Table 69. (continued)

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
	Martin Second Planting		
Row Width (RW)	1	0.4597	.1042
Error	3	0.0868	
Seeding Rate--population (SP)	4	0.0710	.1127
RW x SP	4	0.0140	.7989
Error	24	0.0339	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 70. Analyses of Variance for Grain Sorghum 100 Seed Weights of the First and Second Plantings in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		First Planting	
Location (L)	2	0.2282**	.0009
Row Width (RW)	1	0.5074**	.0003
L x RW	2	0.0367+	
Error	9	0.0122	
Seeding Rate--population (SP)	4	0.0077	.5278
L x SP	8	0.0084	.5419
RW x SP	4	0.0093	.3687
L x RW x SP	8	0.0064	.6496
Error	72	0.0085	
		Second Planting	
Location (L)	2	1.3895**	.0004
Row Width (RW)	1	0.6908**	.0063
L x RW	2	0.0294	.6053
Error	9	0.0547	
Seeding Rate--population (SP)	4	0.0574*	.0246
L x SP	8	0.0203	.4059
RW x SP	4	0.0253	.2747
L x RW x SP	8	0.0166	.5546
Error	72	0.0193	

+Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

Table 71. Analyses of Variance for Grain Sorghum 100 Seed Weights at Knoxville, Spring Hill, and Martin in 1971

Source of Variation	Degrees of Freedom	Mean Squares	Probability of a Larger F Value
		Knoxville	
Planting Date (PD)	1	5.7331**	.0001
Row Width (RW)	1	0.3607*	.0168
PD x RW	1	0.0034	.7588
Error	6	0.0336	
Seeding Rate--population (SP)	4	0.0194	.2613
PD x SP	4	0.0117	.5194
RW x SP	4	0.0161	.3536
PD x RW x SP	4	0.0080	.6931
Error	48	0.0143	
		Spring Hill	
Planting Date (PD)	1	0.2949*	.0101
Row Width (RW)	1	0.1661*	.0310
PD x RW	1	0.0161	.5774
Error	6	0.0214	
Seeding Rate--population (SP)	4	0.0067	.5008
PD x SP	4	0.0066	.5085
RW x SP	4	0.0272*	.0146
PD x RW x SP	4	0.0053	.6132
Error	48	0.0079	
		Martin	
Planting Date (PD)	1	2.6598**	.0006
Row Width (RW)	1	0.7783**	.0065
PD x RW	1	0.0059	.7293
Error	6	0.0453	
Seeding Rate--population (SP)	4	0.0302	.2050
PD x SP	4	0.0478^{+}	.0593
RW x SP	4	0.0219	.3604
PD x RW x SP	4	0.0020	.9790
Error	48	0.0196	

$^{+}$Significant at the .10 level of probability.

*Significant at the .05 level of probability.

**Significant at the .01 level of probability.

VITA

Larry Gene Heatherly was born in Union City, Tennessee, on September 17, 1946. He attended schools in Obion County, Tennessee, and was graduated from Obion County Central High School in 1964. The following September, he entered the University of Tennessee at Martin and in June, 1968, he received the Bachelor of Science degree in General Agriculture. In September, 1968, he entered the Graduate School of the University of Tennessee at Knoxville as a graduate research assistant.

In March, 1969, he was inducted into the United States Army and was honorably discharged in October, 1970, having served 14 months in Vietnam. In January, 1971, he again entered the Graduate School of the University of Tennessee at Knoxville as a graduate research assistant and received the Master of Science degree in Agronomy in June, 1972.

He is married to the former Emily Joyce Wrenn of Greenfield, Tennessee.