RESPONSE OF PEARL MILLET TO KANSAS GRAIN SORGHUM ENVIRONMENTS

by

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Introduction

Pearl millet, *Pennisetum americanum* (L).Leeke, is a robust, annual bunchgrass that is grown on more than 20 million hectares in the world (5). It originated in the Sahel zone of West Africa (10) and is particularly adapted to conditions of nutrient-poor soils and low rainfall. Being tall and vigrous, with execptional grain and fodder yielding potential, it falls in the same category, and can be utilized more-or-less interchangeably with corn, *Zea mays* (L.), and sorghum, *Sorghum bicolor* (L.), when adapted (11). In comparison to corn and sorghum, pearl millet is considered more efficient in its utilization of moisture and appears to have a higher level of heat tolerance than does sorghum or corn (10).

Pearl millet has been grown in the south eastern United States primarily as a forage crop. Breeding programs have been established in Kansas to develop hybrids adapted for grain production in the semi-arid regions of the central Great Plains.

The objectives of this study was to compare yield and yield components of pearl millet to grain sorghum. Using a linear regression compare the response of pearl millet to Kansas grain sorghum environments.

Literature Review

Pearl millet growth and development is very similar to that of grain sorghum. The development of pearl millet may be divided into three major development phases (8): the vegetative phase (GS1), the panicle development phase (GS2) and the grain filling period (GS3).

The vegetative phase starts at emergence and continues through panicle (floral) initation of the main stem. During this phase the plant establishes both primary and adventitious roots, along with initiation of all leaves. The apical meristem remains at or below the soil surface with little or no internode elonga tion. During this phase tiller buds are formed, leaf primordia initiated and several tillers may emerge. Floral or panicle iniation is marked by the elongation of the apical dome and the formation of a constriction at the base of the apex (9).

During panicle development phase, all remaining leaves are fully expanded, with senescence of some of the earliest leaves at the base of the plant. Stem elongation occurs at the base of the stem with tiller emergence and developmemt. Dry-matter accumulation takes place in roots, leaves, and stem. Distinct morphological and developmental changes during this phase include: development of spikelets, florets, glumes, stigmas, and anthers, and finally stigma emergence (flowering) and pollination (8).

Mashingaidze and Muchena (9) showed that at the panicle development phase floret sterility in millet hybrids could be induced by low temperatures. Cool treatment during booting stage

delayed anther emergence and also led to the emergence of thin, shrivelled, indehiscent or empty anthers (9). Low temperatures at anthesis led to early withering of styles, but receptivity of the stigmas was not affected. Futhermore, high correlations were observed between floret and pollen sterility. It was concluded that the main cause of floret sterility in the hybrids used, was a lack of floret fertilization (9). Crictical temperatures observed ranged from 13 to 16 C, with varietal differences to cool injury being observed.

The final growth phase, grain filling, begins with fertilization of florets in the panicle of the main shoot. Senescence of lower leaves continues with only 2-3 upper leaves remaining at maturity. The increase in total plant dry-weight during this period is largely in the grain, however, there is some accumulation in the later formed tillers. The end of grain filling phase, occuring about 20-25 days after flowering, is marked by the development of a small dark layer of tissue in the hilar region of the grain (8).

In the United States pearl millet has been grown most extensively as a forage crop. The major forage breeding research has been conducted at the Coastal Plain Experiment Station at Tiftion, Georgia. It was here that Glenn W. Burton, principal geneticist, first discovered cytoplasmic male sterility in pearl millet (12). This cytoplasmic male sterility was discovered in 1956 and incorporated into Tift 23, an excellent maintainer (5). Tift 23 has excellent agronomic characteristics and combining ability, it is also one of the four inbreds used in production of

"Gahi-1" (3). Gahi-1 has produced up to 50% more forage than previous millets, starts faster, and competes better with weeds (12).

Two other cytoplasm sources A_2 and A_3 were later discovered and Tift 239 became an excellent maintainer for the A_2 source (5). Tift 239 carrying the recessive d_2 gene for dwarfness was also used for development of Tift 23D$_2$A$_1$ and Tift 23D$_2$B$_1$ (12). The d_2 gene pair was transferred through a series of back crosses.

Tift 23DAE was developed by substituting Tift 23DBE for Tift 23DB as a sterile maintainer for Tift 23DA (4). This substitution was carried out through enough generations to make Tift 23DAE near isogenic with Tift 23DBE (4). Tift 23DAE and Tift 23DBE carry the e_1 gene for photoperiod insensitivity (4). Under favorable growing conditions Tift 23DBE will flower in 45-55 days regardless of planting date.

Pearl millet cytoplasmic male sterility as a reciprocal maintainer restorer relationship is rather unusual among cytoplasmic sterility systems (10). This relationship consists of two male sterile systems A_1 and A_2, with maintainer lines consisting of Ms_1 and Ms_2. The B_1 gene will maintain fertiltity to A_1 and restore fertility to A_2. The B_2 gene will maintain fertility to A_2 and restore fertility to A_1. This relationship is shown in Figure 1 (12).

Figure 1. Pearl millet cytoplasmic male sterility reciprocal maintainer restorer relationship.

Male sterile	Maintainer
Tift 23DA (A_1)	Tift 23DB $\xrightarrow{\text{Restorer}}$ 239DA (A_2)
Tift 239DA (A_2)	Tift 239DA $\xrightarrow{\text{Restorer}}$ 23DA (A_1)

In 1977 the above mentioned inbred lines were used in a Kansas Pearl Millet breeding program to select adapted lines for the central great plains. These inbreds were used to introduce early maturity, increased seed size, dwarfness, and B_1, B_2 male fertility maintainer of the A_1 and A_2 cytoplasmic male-sterility systems. Of the 56 introduced plant materials used, nearly all lines had maturity requirements that limited their production in the day lengths, temperatures, and precipitations of the northern latitudes of Kansas (14).

Performance testing of selected F_1 hybrids produced in 1978 showed a range in yields from less than 1000 to 5090 kg/ha (13). Sorghum checks produced yields of 13770 to 8200 kg/ha (13). Sorghum required from 56 to 77 days to reach half-bloom while the millets ranged from 51 to over 70 days (13). Highest millet grain yields were obtained from plants flowering in less than 60 days and from some flowering at about 68 to 70 days (13).

Yield evaluations of pearl millet hybrids were conducted at six locations in 1979. At each location ten F_1 millet hybrids, five open pollinated populations of pearl millet, and three

commercial sorghum hybrids were used. At all locations except Manhattan, pearl millet yields were not significantly different from grain sorghum yields (13).

To evaluate the millet hybrids over environments, a genotype by environment analysis was needed. Two methods reviewed included: Finlay and Wilkinson (7); "The analysis of adaptation in a plant-breeding programme," and Eberhart and Russell (6), "Stability parameters for comparing varieties."

Both methods use a linear regression where each variety mean is regressed on the mean of all varieties at each environmental site. The regression coefficient along with mean yield for each variety are used as parameters of comparison.

Finlay and Wilkinson (7) used this regression analysis for comparing the adaptation of 277 barley varieties at seven environmental locations. Their interpetation of an adapted variety was based on its regression coefficient and mean yield. If the regression coefficients equalled 1.0 this indicated average stability (7). When this was associated with a high mean yield, varieties have general adaptability to all environmants. When associated with low mean yields, varieties are poorly adapted to all environments. Regression values increasing above 1.0 describe varieties with below average stability or sensitive to environmental changes. These varieties were said to be specifically adapted to high-yielding environments. Varieties with a regression coefficient below 1.0, have an above average stability or little response to changing environments. These were said to be adapted to low-yielding environments.

Eberhart and Russell (6) also used this type of analysis for setting up stability parameters for comparing varieties, with the model:

$$Y_{ij} = \mu_i + \beta_i I_j + \delta_{ij}$$

where:

Y_{ij} = the variety mean of the i variety at the j environment.

μ_i = the i variety mean overall environments.

β_i = the regression coefficient that measures the response of the i variety to varying environments.

I_j = environmental index which is obtained as the mean of all varieties at the j environment minus the grand mean.

δ_{ij} = the deviation from regression of the i variety at the j environment.

The parameters used for comparisons included: mean yield, regression coefficient, and deviations from regresssion. Their model provided a means of partitioning the genotype by environment interaction into two parts: the variation due to the response of each variety to varying environmental indexes (sum of squares due to regression), and the unexplainable deviations from the regression on the environmental index (10). Their definition of a stable variety was one with a high mean yield, regression coefficient equal to one ($B_i = 1$) and the deviation from regression as small as possible.

These two type of genotype by environment analysis are used

for comparing varieties within a species and the environmental index used is the mean of all the varieties at a location. This type of analysis did not meet our objective of comparing millet to sorghum in the sorghum environments of Kansas. To meet this objective we used the same form of linear regression analysis, however, the environmental index used was the sorghum mean yield at each environment. The parameters used for comparison were the regression coeficients and the mean yields. This type of analysis no longer measures the stability of the millet hybrids, but their response in a sorghum environment.

MATERIALS and METHODS

Six dryland locations throughout Kansas were used in 1980 (Table 1). At each location the experimental design was a randomized complete block, replicated three times. Each plot consisted of two rows 76 cm in width by 7.6 m long, with the exception at Hays where the row width was 91 cm. Planting depth was approximatly 4-6 cm depending upon depth and amount of soil moisture. All locations were planted at 16 seeds per meter of row.

Experimental material consisted of five pearl millet hybrids developed at Tifton, Georgia by Dr. Glen W. Burton (Research Geneticist USDA,SEA) 23 pearl millet hybrids developed at Fort Hays Branch Experiment Station, by W.D. Stegmeier, and three commericial sorghum hybrids (Table 2).

Planting was done with a two-row cone planter with the exception of Hays where a four row cone planter was used. In 1981 seven locations were used (Table 1). Due to poor stand establishment and weed problems the Garden City location was abandoned. Six commericial sorghum hybrids and twenty four pearl millet hybrids were used with six coming from Tifton, Georgia and 18 from Hays Branch Experiment Station, Kansas (Table 3). The experimental design, size of plots, and planting methods were as in 1980.

In 1982 an additional site at Hutchinson was added to those used in 1981 (Table 1). No sites were abandoned, however, due to a wet spring and emergence problems Tribune had to be replanted.

Table 1. Specific Location Data.

Year	Location	Planting Date	Soil Type
1980	Manhattan (Ashland)	May 25	Haynie Very Fine Sandy Loam, Mollic, Udifluvent, Coarse-silty, Mixed Calcareous Mesic.
1980	Garden City	June 4	Manter Fine Sandy Loam, Underrelating. Aridic Argiustoll, Coarse-loamy, Mixed, Mesic.
1980	Hays	June 6	Crete Silty Clay Loam, thin surface variant. Pachic Argiustoll, Fine, Montmorillonitic, Mesic.
1980	Minneola	June 4	Harney Silt Loam, 0-1%. Typic Argiustoll, Fine, Montomorillonitic, Mesic.
1980	St. John	May 29	Naron Fine Sandy Loam. Udic Argiustoll, Fine-loamy, Mixed, Thermic.
1980	Tribune	June 10	Ulysses silt loam-0.61% slopes buried soil phase, Aridic Haplustolls fine silty, mixed mesic.
1981	Manhattan (Ashland Dry.)	June 1	Haynie Very Fine Sandy Loam, Mollic, Udifluvent, Coarse-silty, Mixed Calcareous Mesic.
1981	Manhattan (Ashland Irr.)	June 1	Haynie Very Fine Sandy Loam, Mollic, Udifluvent, Coarse-silty, Mixed Calcareous Mesic.
1981	Garden City	June 4	Manter Fine Sandy Loam, Undulating. Aridic Argiustoll, Coarse-loamy, Mixed Mesic.
1981	Hays	June 2	Harney Silt Loam, 0-1% Typic Argiustoll, Fine, Montmorillonitic, Mesic.
1981	Minneola	June 3	Harney Silt Loam, 0-1% Typic Arguistoll, Fine, Montmorillonitic, Mesic.
1981	St. John	June 2	Naron Fine Sandy Loam. Udic Arguistoll, Fine-loamy, Mixed, Thermic.
1981	Tribune	June 10	Ulysses Silt Loam - 0 to 1% slopes buried soil phase, Aridic Haplustolls, fine silty, mixed mesic.
1982	Manhattan (Ashland Dry.)	June 11	Eudora Silt Loam. Coarse-silty, mixed, mesic, Fluventic, Hapludolls.
1982	Manhattan (Ashland Irr.)	June 5	Haynie Very Fine Sandy Loam. Mollic Udifluvent, Coarse-silty, Mixed Calcareous Mesic.
1982	Garden City	May 31	Manter Fine Sandy Loam, Undulating. Aridic Arguistoll, Coarse-loamy, Mixed, Mesic.

Table 1. (continued).

Year	Location	Planting Date	Soil Type
1982	Hays	June 21	Crete Silty Clay Loam, thin surface variant. Pachic Argiustoll, Fine, Montmorillonitic, Mesic.
1982	Hutchinson	June 9	Clark-Ost Complex. Typic Calciustoll, Fine-loamy, Mixed, thermic.
1982	Minneola	June 1	Harney Silt Loam, 0-1%. Typic Arguistoll, Fine-loamy Mixed, Thermic.
1982	St. John	June 1	Farnum Fine Sandy Loam. Pachic Argiusstoll, Fine-loamy, Mixed, Thermic.
1982	Tribune	June 14 replanted on the 29	Ulysses silt loam, 0 to 1% slopes, buried soil phase, Aridic Haplustolls, fine silty, mixed mesic.

The same pearl millet and sorghum hybrids were used as in 1981 (Table 3). Plots were increased from two rows to four rows, and seeding rates were increased to 18 seeds per meter of row. With the exception of Hays and Tribune, plots were planted with a two row vacumn pick-up seeder designed for experimental plot work. Hays and Tribune were planted as in 1980 and 1981.

Weed control was obtained by an application of Propazine (2.52 kg/ha (AI)) at planting, post application of 2,4-D (0.56 kg/ha (AI)) if needed, and by cultivation. Granular Furdan 10G (Carbofuran) was used at planting (1.12 kg/ha (AI)) for early control of chinch bugs. Later infestations were controlled with either Sevin or with liquid Furdan.

Observations recorded (not all taken at all locations) included: half-bloom dates, plants/ha, heads harvested/ha, heads/plant, yield (kg/ha), seed weight (g/1000 seeds) and seed/head. Seed set ratings were recorded for each plot in 1981 and 1982. These scores were based upon a score from 1-10 where, 1 = no seed set and 10 = 100% seed set. Scores were recorded by Dr. R.L. Vanderlip in 1981 and by N.B. Christensen in 1982, W.D. Stegmeier recorded the scores at Hays for both years. As seen in the results and discussion these scores were subjected to differences in location, years and by recorder.

All data were analyzed using Statistical Analysis Systems. Data were analyzed across entries at each location. Anova tables were obtained and mean comparisons were made using an LSD value calculated at the .05% level. Correlation coefficients for the millet hybrids were calculated between yield and the yield components at each location and across locations for 1981 and

1982.

To compare the production of pearl millet in a grain sorghum environment the pearl millet hybrid yields were regressed on the sorghum means at each location, for each year and for 1981 and 1982 combined. Regression coefficients and mean yields were used to measure the response of millet in a sorghum environment.

Table 2. Pearl millet hybrid pedigrees and sorghum hybrids used, 1980.

Sorghums

Entry No.	Identification	Maturity Rating
1	ACCO 1014	Early
2	Pioneer 8324	Medium
3	DeKalb F67	Late

Millets — Fort Hays, Kansas Origin

Entry No.	Identification (Female/Male)
4	79-2208 x 79-4140
5	79-2208 x 78-7024
6	79-2201 x 79-4104
7	79-2201 x 78-7024
8	79-2017 x 79-4104
9	79-2017 x 78-7024
10	79-2159 x 78-7024
11	79-2221 x 78-7024
12	79-2221 x 79-4104
13	79-2216 x 78-7024
14	79-2216 x 79-4104
15	79-2161 x 78-7024
16	79-2161 x 79-4104
17	79-2157 x 78-7024
18	79-2157 x 79-4104
19	79-2148 x 79-4104
20	79-2148 x 78-7024
21	79-2059 x 79-4104
22	79-2059 x 78-7024
23	79-2055 x 79-4140
24	79-2055 x 78-7024
25	79-2042 x 79-4104
26	79-2042 x 78-7024

Millets — Tifton, Georgia Origin

Entry No.	Identification
27	Tift 1 23DAE x 653+653
28	Tift 2 23DAE x 656+653
29	Tift 3 23DAE x 756+756
30	Tift 8 (23DAE x 756) + 656+653
31	Tift 9 23DAE x R83D28

Millets — Bulk Population

Entry No.	Identification
32	Senegal Bulk

Table 3. Pearl millet hybrid pedigrees and sorghum hybrids used during 1981 and 1982.

Sorghums

Entry No.	Identification	Maturity Rating
1	ACCO 1014	Early
2	Funk G-611	Early
3	Golden Acres T-E Y-45	Early
4	Asgrow Corral	Early
5	Pioneer 8324	Medium
6	DeKalb F-67	Late

Millets[1/] Fort Hays, Kansas Origins

Entry No.	Identification (Female/male)
7	80-2113 x 78-7024
8	79-2081 x 78-7024
9	79-2094 x 78-7024
10	79-2150 x 78-7024
11	23-DAE x 78-7024
12	78-2224 x 78-7024
13	80-2113 x 78-7088
14	79-2081 x 78-7088
15	79-2094 x 78-7088
16	79-2150 x 78-7088
17	80-2113 x 79-1137
18	79-2081 x 79-1137
19	80-2203 x 79-1137
20	79-2150 x 79-1137
21	79-2059 x 79-4104
22	79-2081 x 79-4104
23	79-2094 x 79-4104
24	79-2150 x 79-4105

Millets Tifton, Georgia Origin

Entry No.	Identification (Female/male)
25	23DAE x 756 + 10% 756
26	23DAE x 656 + 10% 653
27	23DAE x 28R830
28	23DA x 28R83D
29	23DAE x 64 (756 x RMP)
30	23DAE x 655 (756 x B39)

1/ Pedigrees of Fort Hays female lines are as follows:

79-2059: Tift $23D_2A_1$//*9 Tift $23D_2B_1$/*2 PI185642
79-2081: Tift $23D_2A_1$//*10 Tift $23D_2B_1$/*2 PI185642
79-2094: Tift $23D_2A_1$//*7 Tift $23D_2B_1$/*2 PI185642
79-2150: Tift $23D_2A_1$//*11 Tift $23D_2B_1$/*2 PI185642
78-2224: Tift $23D_2A_1$//*8 Tift $23D_2B_1$/*2 PI185642
78-7001: Tift $23D_2A_1$ E

Male Pedigrees are:

78-7024: Tift $239D_2B_2$/*4 Serere 3A
78-7088: Tift $239D_2B_2$/*4 Serere 3A
79-1137: PI295126/Tift $23D_2B_1$//PI185642/Tift $23D_2B_1$
79-4104: PI287049/Tift $239D_2B_2$//PI287049/PI185642

Results and Discussion

Ashland 1980

Temperatures for Manhattan were above normal for June, July and August with average temperatures of 25.7 C, 31.0 C and 28.8 C, respectively (Table A-1 Appendix A). Seventy-four days of this three month period had temperatures exceeding 32.5 C. Seasonal precipitation was well below normal. Total precipitation was 50% of normal with only 32.1 cm being recorded.

There was no significant difference in yields between sorghum and millet (millet 1967 kg/ha and sorghum 2469 kg/ha, Table 4).

Plant populations for sorghum were significantly greater than millet. Nonetheless, millet had significantly more heads harvested than sorghum. Millet had an average population of 91720 plants/ha, produced 2.42 heads/plant, and 196000 heads/ha were harvested. Sorghum population averaged 166240 plants/ha, produced 0.98 heads/plant, and 161000 heads/ha were harvested. There was a significant negative correlation between plant population and heads/plant among millet hybrids (Table B-1 Appendix B).

Sorghum was later in maturity than millet, averaging 62.0 days and 52.8 days to reach half-bloom, respectively. Millet ranged from 57.0 to 50.3 days. Yield was not related to maturity in pearl millet.

Below optimum growing conditions had a larger effect on the seed size of sorghum than on that of millet. Sorghum averaged 13.02 g/th well below that reported during more normal

Table 4 . Hybrid Performance at Ashland, Manhattan, 1980.

Entry Number	Hybrid	Plants/ha th.	Heads/ha th.	Heads/ plant	Yield (kg/ha)	Seed Weight g/th.	Seeds/ head	Days to half-bloom
1	ACCO 1014	167.9	146.5	.89	2049	13.1	985	53.6
2	Pioneer 8324	156.4	167.9	1.07	3082	12.3	1496	64.3
3	DeKalb F67	174.3	170.9	.98	2274	13.6	978	68.0
4	79-2208 x 79-4140	131.3	219.2	1.69	1573	9.5	759	52.3
5	79-2208 x 78-7024	108.3	302.2	2.84	2591	10.0	835	53.0
6	79-2201 x 79-4104	116.9	197.4	1.72	2079	10.2	968	53.0
7	79-2201 x 78-7024	94.0	195.3	2.36	2027	11.6	895	51.3
8	79-2017 x 79-4104	100.4	176.1	1.77	1796	10.8	929	55.0
9	79-2017 x 78-7024	98.3	190.4	1.96	1625	12.3	700	52.6
10	79-2156 x 78-7024	116.9	151.3	1.29	1474	10.8	907	52.6
11	79-2221 x 78-7024	101.9	200.0	1.98	1639	10.6	773	50.3
12	79-2221 x 79-4104	86.8	169.6	1.98	2289	10.6	1274	55.3
13	79-2216 x 78-7024	70.3	170.9	2.57	1079	10.1	619	51.3
14	79-2216 x 79-4104	86.8	156.7	1.84	2549	10.6	1494	55.3
15	79-2161 x 78-7024	99.7	197.0	2.02	827	11.2	371	51.6
16	79-2161 x 79-4104	83.9	168.5	2.05	2471	10.6	1387	52.6
17	79-2157 x 78-7024	86.1	167.4	1.97	2300	11.1	1223	51.6
18	79-2157 x 79-4104	94.7	147.4	1.57	1799	11.6	931	55.3
19	79-2148 x 79-4104	84.6	205.1	2.44	3412	10.4	1545	53.0
20	79-2148 x 78-7024	115.5	155.7	1.35	2281	11.2	1312	51.0
21	79-2059 x 79-4104	114.8	204.4	1.81	2455	10.4	1152	53.0
22	79-2059 x 78-7024	83.9	195.7	2.45	1735	11.3	755	51.3
23	79-2055 x 79-4140	95.8	204.1	2.13	2558	9.5	1318	53.0
24	79-2055 x 78-7024	111.2	220.0	2.02	2338	10.6	971	51.0
25	79-2042 x 79-4104	96.8	158.7	1.67	1903	10.7	1096	51.6
26	79-2042 x 78-7024	63.8	122.6	1.93	1661	13.0	1102	52.3
27	Tift 9 23DAE x R83D28	37.3	246.4	6.34	1806	5.0	1505	57.0
28	Tift 1 23DAE x 653+653	86.1	1695	2.05	1871	8.7	1273	53.6
29	Tift 2 23DAE x 656+653	65.3	293.7	4.46	2874	9.4	1090	53.3
30	Tift 3 23DAE x 756+756	38.7	241.9	7.04	1115	7.3	656	52.0
31	Tift 8 (23DAE x 756) x 656+653	102.6	288.7	2.82	1801	9.3	701	52.6
32	Senegal Bulk	87.5	175.7	2.08	1320	8.8	849	55.3
LSD (.05)		27.6	61.6	1.39	NS	1.8	567	2.1
C.V.		17.11	19.5	37.18	39.54	10.58	33.96	2.35

conditions. Millet was significantly less than sorghum averaging 10.82 g/th. Significant correlations indicated a negative relationship between seed weight and heads/plant.

There was no significant difference between sorghum and millet for seeds/head. Sorghum ranged from 1496 to 978 seeds, averaging 1153. Millet averaged 1010 with a range of 1545 to 371 seeds/head.

St John 1980

Precipitation was only 44% of normal. Total rainfall recorded was 21.01 cm with only 0.99 cm occuring in July (Table A-5 Appendix A). Temperatures for June, July and August were above normal with average maximum temperatures of 33.9 C, 39.1 C, and 35.5 C, respectively.

These extreme temperatures and periods of drought lowered the yields. Sorghum averaged 1466 kg/ha and millet averaged 1537 kg/ha (Table 5). These environmental conditions delayed the maturity of sorghum from the usual 60-70 days to 75-90 days. The three sorghums reguired 99.0, 90.3, and 75.33 days to half-bloom. Millet was not affected to such an extent, the average days to half-bloom was 54.8 days ranging from 60.3 to 51.3 days.

Millet exhibited its profound tillering ability by having a significantly lower plant population and a significantly greater number of heads harvested. Millet produced 4.07 heads/plant compared to the single head/plant produced by sorghum. Sorghum had an average plant population of 138730 plant/ha and 134240 heads harvested. Millet averaged 379660 heads/ha with a

Table 5 . Hybrid Performance at St. John in 1980.

Entry Number	Hybrid	Plants/ha th.	Heads/ha th.	Heads/ Plant	Yield (kg/ha)	Seed weight g/th.	Seeds/ head	Days to half-bloom
1	ACCO 1014	138.5	144.8	1.08	831	18.40	339	75.3
2	Pioneer 8324	160.0	143.9	.91	1592	16.00	692	90.3
3	DeKalb F67	117.6	113.9	.99	1975	17.60	1022	99.0
4	79-2208 x 79-4140	123.4	421.0	3.52	1283	8.73	360	57.0
5	79-2208 x 78-7024	108.3	403.1	3.72	1310	8.33	392	52.3
6	79-2201 x 79-4104	109.0	396.2	3.80	1457	9.63	384	55.3
7	79-2201 x 78-7024	92.5	467.1	4.94	1587	9.32	399	53.3
8	79-2017 x 79-4104	116.9	304.8	2.77	1331	9.50	465	58.0
9	79-2017 x 78-7024	105.4	345.1	5.16	1740	9.56	335	55.0
10	79-2156 x 78-7024	120.5	293.1	2.48	1222	8.60	489	53.6
11	79-2221 x 78-7024	89.7	340.9	3.71	1459	8.25	530	55.3
12	79-2221 x 79-4104	105.4	305.7	2.85	1268	9.01	478	56.3
13	79-2216 x 78-7024	65.3	405.7	6.14	1565	8.43	455	53.0
14	79-2216 x 79-4104	114.8	416.6	3.56	1816	9.03	529	56.0
15	79-2161 x 78-7024	99.7	431.8	4.25	1540	8.93	422	52.3
16	79-2161 x 79-4104	97.5	452.3	4.65	1731	9.96	395	52.6
17	79-2157 x 78-7024	87.5	444.1	5.13	1681	9.10	441	54.3
18	79-2157 x 79-4104	109.0	360.5	3.28	1751	8.52	555	58.6
19	79-2148 x 79-4104	127.0	372.5	2.91	1353	9.60	406	53.3
20	79-2148 x 78-7024	127.0	493.1	3.86	1944	8.46	479	52.6
21	79-2059 x 79-4104	91.1	377.5	4.20	1649	9.24	465	58.3
22	79-2059 x 78-7024	92.5	436.6	4.60	1779	10.03	425	54.0
23	79-2055 x 79-4140	123.4	400.9	3.27	1458	8.50	434	58.0
24	79-2055 x 78-7024	101.1	377.5	3.73	1140	8.93	341	53.3
25	79-2042 x 79-4104	114.8	384.9	3.37	1542	9.24	434	53.0
26	79-2042 x 78-7024	76.7	322.4	4.30	1586	9.40	515	51.3
27	Tift 9 23DAE x R83D28	34.6	284.8	9.07	1702	6.00	1013	60.3
28	Tift 1 23DAE x 653+653	101.9	297.0	2.86	1371	8.68	568	52.6
29	Tift 2 23DAE x 656+653	81.8	378.3	5.28	1685	7.70	602	53.3
30	Tift 3 23DAE x 756+756	48.0	220.0	4.70	1399	7.56	843	57.3
31	Tift 8 (23DAE x 756) x 656+653	159.3	370.1	2.44	1307	8.23	433	53.0
32	Senegal Bulk	86.1	305.3	3.55	1917	8.43	747	57.3
	LSD (.05)	34.9	157.7	2.17	NS	1.64	207	3.7
	C.V.	20.60	27.08	35.18	24.53	10.58	25.07	3.88

population of 100390 plants/ha. Millet had a significant negative correlation between plant population and heads per plant (Table B-1 Appendix B).

Although millet had greater tillering ability it had far fewer seeds/head and smaller seed weights when compared to the other locations. Millet averaged 488 seeds/head and a seed weight of 8.72 g/th. Sorghum was significantly greater for both seeds/head and seed weights averaging 684 seeds and 17.33 g/th, respectively.

Minneola 1980

Temperatures were above normal with 72 days of June, July, and August having temperatures exceeding 32.5 C. Average temperatures for these months were 26.0 C, 31.0 C, and 28.4 C, respectively. Seasonal precipitation was 91% of normal with 34.04 cm total. There was only 10.31 cm of rainfall for July and August, the two hottest months (Table A-4 Appendix A).

Sorghum yields were significantly greater than millet, averaging 3240 and 2239 kg/ha, respectively (Table 6). Five millet hybrids were not significantly different from the sorghum average.

Sorghum had a significantly longer maturity rating on a crop average. Sorghum averaged 57.0 days and millet averaged 55.0 days to half-bloom.

There were 156380 heads/ha harvested for millet and 106480 heads/ha harvested for sorghum. Millet, significantly greater than sorghum, ranged from 197600 to 108260 heads/ha. Sorghum

Table 6. Hybrid Performance at Minneola in 1980.

Entry Number	Hybrid	Heads/ha th.	Yield (kg/ha)	Seed weight g/th.	Seeds/ head	Days to half-bloom
1	ACCO 1014	105.6	2559	19.37	1251	57.0
2	Pioneer 8324	111.3	3729	20.26	1682	57.0
3	DeKalb F67	102.2	3433	17.60	1914	----
4	79-2208 x 79-4140	163.0	1379	11.20	740	51.3
5	79-2208 x 78-7024	197.6	1827	11.10	853	49.6
6	79-2201 x 79-4104	141.3	2120	11.14	1334	58.3
7	79-2201 x 78-7024	139.6	2460	12.28	1400	54.0
8	79-2017 x 79-4104	142.2	1667	11.40	976	60.3
9	79-2017 x 78-7024	149.5	2703	12.80	1397	56.6
10	79-2156 x 78-7024	143.5	2638	11.56	1612	55.6
11	79-2221 x 78-7024	131.3	2035	12.40	1254	51.3
12	79-2221 x 79-4104	157.0	2443	11.76	1324	53.3
13	79-2216 x 78-7024	134.3	2343	11.96	1468	55.6
14	79-2216 x 79-4104	169.3	2820	14.63	1165	57.0
15	79-2161 x 78-7024	159.0	2955	11.66	1646	52.6
16	79-2161 x 79-4104	155.2	2482	12.10	1375	55.0
17	79-2157 x 78-7024	136.1	2595	11.68	1631	56.0
18	79-2157 x 79-4104	156.5	2112	11.70	1163	59.0
19	79-2148 x 79-4104	166.5	2518	10.96	1375	56.0
20	79-2148 x 78-7024	155.7	2635	11.40	1487	51.0
21	79-2059 x 78-4104	178.5	2449	11.70	1170	58.3
22	79-2059 x 78-7024	124.3	2257	12.40	1433	54.6
23	79-2055 x 79-4140	177.0	2314	10.13	1281	56.6
24	79-2055 x 78-7024	158.3	2125	11.16	1225	54.3
25	79-2042 x 79-4104	167.0	2191	12.13	1084	56.0
26	79-2042 x 78-7024	108.2	1883	12.66	1459	52.0
27	Tift 9 23DAE x R83D28	-----	-----	-----	----	----
28	Tift 1 23DAE x 653+653	147.8	1659	9.41	1175	59.0
29	Tift 2 23DAE x 656+653	197.0	2472	9.78	1280	56.6
30	Tift 3 23DAE x 756+756	179.8	1421	7.86	991	54.3
31	Tift 8 (23DAE x 756) x 656+653	185.7	1942	10.12	1033	52.6
32	Senegal Bulk	-----	----	-----	----	----
	LSD (.05)	49.4	798	1.90	387	3.4
	C.V.	19.98	20.13	9.53	18.14	4.37

ranged from 111340 to 102200 heads/ha.

Seed weights for sorghum averaged 19.08 g/th, significantly greater than millet, 11.45 g/th. Significant correlations indicated the increase in millet yields could be related to increase in seed size (Table B-1 Appendix B).

An increase in millet yields could also be related to seeds/head. Millet averaged 1271 seeds/head, ranging from 1646 to 740 seeds/head. Sorghum averaged 1615 seeds/head, significantly greater than millet.

Hays 1980

Growing conditions were adversly affected by high temperatures and low rainfall. July had temperatures above 32.5 C every day with an average maximum temperature of 39.5 C. During this month there was only 1.82 cm of rainfall. The average temperatures for June and August were 24.8 C and 26.4 C, respectively. Total precipitation for the 6 month growing season was 30.83 cm, 65% of normal.

Sorghum yields averaged 2886 kg/ha (Table 7), ranging from 3339 to 2566 kg/ha. This was significantly greater than the millet average of 1682 kg/ha. Millet ranged from 2474 to 1053 kg/ha and the 22 lowest yielding millet hybrids were not significantly different.

Millet had significantly more heads/ha harvested, ranging from 260130 to 146510 head/ha with an average of 182420 head/ha. The three sorghum hybrids had values of 98580, 91600, and 81270

Table 7 . Hybrid Performance at Hays in 1980.

Entry Number	Hybrid	Heads/ha th.	Yield (kg/ha)	Seed weight g/th.	Seeds/ head
1	ACCO 1014	91.6	2674	26.34	1116
2	Pioneer 8324	81.2	3339	22.13	1858
3	DeKalb F67	98.5	2566	22.54	1118
4	79-2208 x 79-4140	200.3	1053	8.80	592
5	79-2208 x 78-7024	217.1	1897	9.04	972
6	79-2201 x 79-4104	149.3	1247	9.64	861
7	79-2201 x 78-7024	161.9	1746	10.40	1026
8	79-2017 x 79-4104	164.7	1316	9.05	900
9	79-2017 x 79-7024	203.7	1588	8.97	882
10	79-2156 x 78-7024	199.2	2409	8.86	1295
11	79-2221 x 78-7024	157.5	1704	9.23	1138
12	79-2221 x 79-4104	178.4	1630	9.66	952
13	79-2216 x 78-7024	160.6	1467	8.91	1022
14	79-2216 x 79-4104	168.1	1516	9.37	967
15	79-2161 x 78-7024	173.9	1571	9.37	936
16	79-2161 x 79-4104	79.6	1955	9.17	1185
17	79-2157 x 78-7024	158.0	1568	8.45	1182
18	79-2157 x 79-4104	146.5	1300	8.09	1038
19	79-2148 x 79-4104	177.0	1889	10.06	1055
20	79-2148 x 78-7024	159.0	1673	8.43	1247
21	79-2059 x 79-4104	161.8	1771	10.00	1061
22	79-2059 x 78-7024	163.8	1725	10.07	1054
23	79-2055 x 79-4140	182.6	1384	8.90	866
24	79-2055 x 78-7024	172.8	1603	8.50	1094
25	79-2042 x 79-4104	187.0	1733	11.15	831
26	79-2042 x 78-7024	185.5	2131	10.72	1058
27	Tift 9 23DAE x R83D28	-----	----	-----	----
28	Tift 1 23DAE x 653+653	206.1	2195	7.97	1381
29	Tift 2 23DAE x 656+653	260.1	2474	8.59	1106
30	Tift 3 23DAE x 756+756	252.8	1416	6.72	874
31	Tift 8 (23DAE x 756) x 656+653	206.3	1726	9.01	863
32	Senegal Bulk	-----	----	----	----
LSD (.05)		48.2	845	.91	358
C.V.		19.74	33.45	1.67	24.22

heads/ha, averaging 89750 heads/ha.

Seed weights of millet were low when compared to other locations. They averaged 9.11 g/th, ranging from 11.15 to 6.72 g/th. Sorghum seed weights were among the highest compared to other locations,averaging 23.77 g/th.

Sorghum had significantly more seeds/head, averaging 1386 seeds. Millet averaged 1016 seeds/head ranging from 1381 to 592 seed/head. There was a significant relationship between yield and seeds/head.

Garden City 1980

Again there were above average temperatures from June through September, along with below normal precipitation. Rainfall totaled 31.59 cm for the entire growing season, 6.5 cm below normal (Table A-2 Appendix A). Poor distribution throughout June, July, and August added to the poor growing conditions. Average temperatures for June, July, and August were 23.8 C, 28.0 C and 25.2 C, respectively.

Sorghum significantly out yielded millet on an average basis, however, sorghums average was increased by the large yield of Pioneer 8324. The three sorghum hybrid yields were, 2375, 955, and 687 kg/ha (Table 8). The millet averaged 812 kg/ha ranging from 1176 to 391 kg/ha.

The low yields could be attributed to the low number of heads/ha harvested. There was no significant difference in heads/ha on a crop average basis. Millet averaged 99950, ranging from 136130 to 65670 heads/ha. Sorghum averaged 97550 with a

Table 8 . Hybrid Performance at Garden City in 1980.

Entry Number	Hybrid	Heads/ha th.	Yield (kg/ha)	Seed weight g/th.	Seeds/ head
1	ACCO 1014	85.4	955	19.12	568
2	Pioneer 8324	114.5	2375	14.73	1779
3	DeKalb F67	92.6	687	15.76	470
4	79-2208 x 79-4140	82.2	697	10.04	811
5	79-2208 x 78-7024	106.1	843	9.36	661
6	79-2201 x 79-4104	94.8	1081	10.36	1107
7	79-2201 x 78-7024	120.9	885	9.73	756
8	79-2017 x 79-4104	90.9	880	10.96	858
9	79-2017 x 78-7024	74.8	1176	11.40	1381
10	79-2156 x 78-7024	108.5	1073	9.30	1116
11	79-2221 x 78-7024	75.2	1000	10.66	1215
12	79-2221 x 79-4104	76.5	648	9.83	861
13	79-2216 x 78-7024	98.0	720	9.90	702
14	79-2216 x 79-4104	126.5	543	10.73	514
15	79-2161 x 78-7024	100.0	710	9.30	868
16	79-2161 x 79-4104	79.5	1071	11.83	1054
17	79-2157 x 78-7024	110.3	1159	11.60	1000
18	79-2157 x 79-4104	111.3	1073	10.06	977
19	79-2148 x 79-4104	107.8	935	10.16	861
20	79-2148 x 78-7024	97.8	637	8.90	887
21	79-2059 x 79-4104	111.1	563	9.93	519
22	79-2059 x 78-7024	71.7	950	10.73	1216
23	79-2055 x 79-4140	91.3	630	10.83	712
24	79-2055 x 78-7024	131.0	987	10.03	814
25	79-2042 x 79-4104	107.4	685	10.66	620
26	79-2042 x 78-7024	133.3	682	10.53	516
27	Tift 9 23DAE x R83D28	-----	----	-----	----
28	Tift 1 23DAE x 653+653	65.6	472	8.93	804
29	Tift 2 23DAE x 656+653	136.1	838	9.40	670
30	Tift 3 23DAE x 756+756	65.6	604	7.10	1204
31	Tift 8 (23DAE x 756) x 656+653	123.9	391	8.93	346
32	Senegal Bulk	-----	----	-----	----
LSD (.05)		68.8	558	2.28	582
C.V.		42.25	39.51	13.07	41.32

range of 114580 to 85460.

Seed weights among sorghum were more adversely reduced by the poor environment than those of millet. Sorghum averaged 16.54 g/th, well below the weights of these hybrids at other locations. Millet averaged 10.0 g/th ranging from 11.83 to 7.10 g/th. Georgia millets were among the smallest averaging 8.57 g/th.

Seed number/head between the crops were not significantly different and were the lowest averages among the 1980 locations. Sorghum averaged 939 seed/head and millet averaged 854. Millet ranged from 1381 to 346 and sorghum ranged from 1779 to 470 seeds/head.

Tribune 1980

Growing conditions at Tribune were not as harsh as at the other locations. Precipitation for the six month growing season totaled 41.72 cm, 8.43 cm above normal (Table A-6 Appendix A). Average maximum temperatures for June, July, and August were 31.3 C, 36.9 C, and 33.1 C, respectively.

Yields at Tribune were indicative of the good growing conditions, having the higest yields of all 1980 locations. Sorghum averaged 4560 kg/ha (Table 9), significantly greater than millet average of 3868 kg/ha. Only five millet hybrids yielded significantly less than the sorghum average.

Millet had an average of 273000 head/ha harvested. Millet ranged between 426000 and 125000 heads/ha. Only one sorghum hybrid was recorded and it had 165000 heads/ha harvested.

Sorghum seed weight was significantly greater than that of

millet. Sorghum averaged 19.14 and millet 10.46 g/th. Millet ranged from 12.50 to 7.56 g/th. There was no apparent relation ship between seed weight and yield in millet.

Seed number/head was also the highest among locations for the millet hybrids. Millet averaged 1142 seed/head, ranging from 2829 to 744 seeds/head. Acco 1014 was the only sorghum recorded and it had 1195 seeds/head.

Table 9. Hybrid Performance at Tribune in 1980.

Entry Number	Hybrid	Heads/ha th.	Yield (kg/ha)	Seed weight g/th.	Seeds/ head
1	ACCO 1014	165.2	4541	23.34	1195
2	Pioneer 8324	-----	5575	18.58	----
3	DeKalb F67	-----	3565	15.50	----
4	79-2208 x 79-4140	396.1	2973	10.04	744
5	79-2208 x 78-7024	291.3	3514	10.23	1382
6	79-2201 x 79-4104	177.4	2922	11.50	1432
7	79-2201 x 78-7024	277.9	3844	10.24	1372
8	79-2017 x 79-4104	228.3	2965	10.67	1143
9	79-2017 x 78-7024	321.6	3910	10.63	1174
10	79-2156 x 78-7024	301.5	4908	10.50	1562
11	79-2221 x 78-7024	259.9	3957	10.26	1520
12	79-2221 x 79-4104	282.7	5210	10.36	1735
13	79-2216 x 78-7024	232.5	3542	10.40	1430
14	79-2216 x 79-4104	278.3	3633	10.80	1215
15	79-2161 x 78-7024	284.0	3541	10.40	1280
16	79-2161 x 79-4104	239.6	3684	10.10	1522
17	79-2157 x 78-7024	144.3	3742	10.20	2829
18	79-2157 x 79-4104	290.0	4150	10.43	1378
19	79-2148 x 79-4104	345.7	5423	10.43	1514
20	79-2148 x 78-7024	268.9	4161	10.20	1524
21	79-2059 x 79-4104	261.4	4414	10.40	1634
22	79-2059 x 78-7024	262.8	4580	12.50	1394
23	79-2055 x 79-4140	298.0	4737	10.43	1508
24	79-2055 x 78-7024	280.0	3782	10.10	1343
25	79-2042 x 79-4104	318.3	4646	11.80	1259
26	79-2042 x 78-7024	255.5	4554	12.43	1445
27	Tift 9 23DAE x R83D28	-----	----	-----	----
28	Tift 1 23DAE x 653+653	159.2	2260	9.70	1463
29	Tift 2 23DAE x 656+653	125.9	1244	9.34	1119
30	Tift 3 23DAE x 756+756	382.0	4437	7.56	1606
31	Tift 8 (23DAE x 756) x 656+653	426.6	3707	10.36	868
32	Senegal Bulk	-----	----	-----	----
LSD (.05)		113.9	1528	1.21	525
C.V.		27.69	23.77	6.54	22.76

Manhattan (Ashland) Dryland 1981

Temperatures for Manhattan were above normal for April, but were nearly normal for the remainder of the year (Table A-7 ,Apendix A). Average maximum temperature for the three month period, June through August, was 30.3 C, with only 27 days having temperatures 32.5 C or higher.

Precipitation was above normal from May through July, with 64.88 cm total for the entire six month growing season. This was 101% of normal and was uniformly distributed throughout the growing season.

Average sorghum yield was second highest of all locations, 7790 kg/ha (Table 10). It ranged from 8710 kg/ha to 6321 kg/ha. The sorghum average was significantly greater than all pearl millet hybrid means, with the exception of hybrid 29. The pearl millet hybrids ranged from 5864 kg/ha to 1595 kg/ha, with an average of 3797 kg/ha.

Sorghum reached half-bloom from 54 to 60 days, with pearl millet ranging from 48 to 59 days. There was a parental group difference among the pearl millet hybrids. The average with the male parents 78-7024 and 78-7088 were significantly less than all other parental group averages. There, however,was no significant relationship between maturity and yield.

Millet hybrids developed at Georgia had the highest number of heads harvested with heads being produced by both tillers and branched tillers. Millet hybrids averaged 364583 heads /ha, ranging from 757000 to 266000. Sorgum hybrids ranged from

Table 10. Hybrid Performance at Ashland Dryland, Manhattan in 1981.

Entry Number	Hybrid	Days to half bloom	Heads/ ha, th.	Yield, (kg/ha)	Seed wt. g/th	Seeds/ head
1	ACCO 1014	54.3	128.2	6321	28.7	1718
2	Funk G-611	60.0	132.0	7731	27.5	2104
3	Golden Acres T-E Y45	60.3	138.3	8434	26.9	2272
4	Asgrow Corral	58.3	154.1	7573	25.0	1977
5	Pioneer 8324	59.3	128.2	8710	24.3	2837
6	DeKalb F67	----	141.1	7973	25.2	2259
7	80-2113 x 78-7024	51.0	343.3	2219	11.0	482
8	79-2081 x 78-7024	49.0	288.7	1595	11.4	592
9	79-2094 x 78-7024	49.3	375.8	2649	11.2	640
10	79-2150 x 78-7024	48.3	268.9	2514	11.4	969
11	23DAE x 78-7024	48.3	312.4	3553	9.2	1239
12	78-2224 x 78-7024	48.7	302.4	2665	12.1	749
13	80-2113 x 78-7088	49.0	334.4	4271	12.8	1033
14	79-2081 x 78-7088	49.3	357.9	3957	12.5	901
15	79-2094 x 78-7088	48.3	474.3	4173	12.9	731
16	79-2150 x 78-7088	48.7	293.5	5070	11.2	1546
17	80-2113 x 79-1137	52.3	311.0	5147	11.5	1442
18	79-2081 x 79-1137	53.7	336.8	3947	14.5	914
19	80-2203 x 79-1137	51.3	401.1	5227	10.5	1238
20	79-2150 x 79-1137	51.7	350.0	4913	10.6	1379
21	79-2059 x 79-4104	52.0	341.1	3668	10.8	975
22	79-2081 x 79-4104	52.7	358.3	4400	12.0	1038
23	79-2094 x 79-4104	53.3	371.7	3080	11.3	757
24	79-2150 x 79-4104	51.7	273.7	4416	11.1	1451
25	23 DAE x 756 + 10% 756	50.0	266.5	2521	7.9	1176
26	23 DAE x 656 + 10% 653	48.7	757.3	5367	10.7	781
27	23 DAE x 28R83D	59.7	495.6	4695	6.0	1582
28	23 DA x 28R83D	----	290.9	1870	6.1	1114
29	23 DAE x 64 (756 x RMP)	50.7	363.1	5864	7.9	2149
30	23 DAE x 655 (756 x B39)	50.3	481.5	3378	7.4	950
LSD (.05)		2.2	185.6	1649	2.5	466
C.V.		2.55	35.55	21.93	11.27	21.93

154000 to 128000 and had an average of 137000 heads/ha.

Seed weight ranged from 28.6 g/th to 24.2 g/th for sorghum, and 14.5 g/th to 5.7 g/th for pearl millet. Millet hybrids developed at Georgia were the smallest averaging 7.6 g/th. Millet hybrids developed at Kansas averaged 11.5 g/th, significantly greater than the Georgia millets.

Sorghum hybrids had significantly more seeds/head than pearl millet, averaging 2194 and 1076 seeds/head, respectively. There was a significant positive correlation between seeds/head and yield (Table B-2 Appendix B). Pearl millet also had a significant negative correlation between seed weight and seeds/head.

The biggest deterrent to the yield of pearl millet was floral sterility. Based on a rating scale of 0 to 10,where 0 = no seed set and 10 = 100% seed set, Millet hybrids had an average rating of 4.18 (Table 16). The low seed set rating could be attributed to cool evenings recorded on 28 and 29 July. Mashingaidze and Muchena (9) reported floral sterility could be induced by temperatures ranging from 13-16 C.

Manhattan (Ashland) Irrigated 1981

Average sorghum yield was highest of all locations (8152 kg/ha). Hybrids ranged from 9362 kg/ha to 5808 kg.ha (Table 11). Millet average was significantly less, 3484 kg/ha, with a range of 5506 kg/ha to 1760 kg/ha.

Days to half-bloom ranged from 50.0 to 59.0 days for sorghum and 48.0 to 52.6 days for millet. There were significant parental differences in maturity among millet hybrids. Male parental groups 78-7024 and 78-7088 were significantly earlier than other parental groups Due to a large variance in the yields, there was no significant relationship between maturity and yield among the millet hybrids.

Millet hybrids had significantly more heads harvested than sorghum hybrids. They averaged 293000 head/ha with the Georgia millets having the greatest number. Sorghum hybrids averaged 156000 with no significant differences among sorghum hybrids.

The variance for seed/head was so large, that no significant difference could be detected among sorghum or millet hybrids. Sorghum averaged 2005 seeds/head and millet averaged 1531 seeds/head.

Seed weight of the sorghum was significantly higher than millet ranging from 28.2 g/th to 25.1 g/th.seeds. Millet hybrids ranged from 13.2 to 6.1 g/th seeds. The Georgia millet hybrids were the smallest with an average of 6.1 g/th. Due to the large variance in yield among entries no significant relationship between seed weight and yield could be detected.

Table 11. Hybrid Performance at Ashland.Irrigated, Manhattan in 1981.

Entry Number	Hybrid	Days to half bloom	Heads/ ha th.	Yield (kg/ha)	Seed wt. g/th	Seeds/ head
1	ACCO 1014	51.7	139.2	5808	26.6	1612
2	Funk G-611	59.0	152.1	8625	28.3	2012
3	Golden Acres T-E Y45	57.7	173.7	7907	25.1	1831
4	Asgrow Corral	55.3	154.5	8608	26.4	2166
5	Pioneer 8324	55.3	147.4	8603	25.7	2349
6	DeKalb F67	50.0	176.1	9362	26.5	2068
7	80-2113 x 78-7024	49.7	116.7	2510	10.6	3730
8	79-2081 x 78-7024	49.7	157.1	2336	11.0	1353
9	79-2094 x 78-7024	49.0	182.6	1761	10.8	1034
10	79-2150 x 78-7024	48.3	198.1	2640	11.7	1140
11	23DAE x 78-7024	50.0	297.1	3257	10.1	1104
12	78-2224 x 78-7024	48.0	285.1	2150	10.6	701
13	80-2113 x 78-7088	49.0	315.3	5506	11.6	1584
14	79-2081 x 78-7088	48.7	310.5	3840	12.3	1122
15	79-2094 x 78-7088	49.0	383.4	3815	13.3	742
16	79-2150 x 78-7088	48.0	188.0	4270	11.6	1959
17	80-2113 x 79-1137	51.7	292.3	3226	11.5	937
18	79-2081 x 79-1137	51.7	340.6	3168	11.3	935
19	80-2203 x 79-1137	52.7	405.2	3990	10.6	952
20	79-2150 x 79-1137	51.0	267.0	4629	10.5	1658
21	79-2059 x 79-4104	51.0	339.1	4792	11.8	1211
22	79-2081 x 79-4104	50.3	291.8	4097	11.9	1159
23	79-2094 x 79-4104	52.0	279.7	2426	11.0	2340
24	79-2150 x 79-4104	50.3	275.6	4141	10.9	1526
25	23 DAE x 756 + 10% 756	50.7	455.0	3280	8.3	1010
26	23 DAE x 656 + 10% 653	49.0	345.9	3106	10.7	819
27	23 DAE x 28R83D	58.3	420.0	3919	6.1	1565
28	23 DA x 28R83D	50.0	262.7	2901	7.3	1643
29	23 DAE x 64 (756 x RMP)	51.0	310.0	3708	7.7	5035
30	23 DAE x 655 (756 x B39)	51.3	327.2	4154	8.4	5035
LSD (.05)		2.7	181.0	2094	1.4	2589
C.V.		3.33	41.56	28.97	6.2	97.29

Sterility ratings for the pearl millet hybrids averaged 5.69 and ranged from 8.0 to 3.0. Two cool evenings the latter part of July could have contributed to the floral sterility.

Hays 1981

The climate at Hays was marked by above average rainfall during April and May (Table A-8 Apendex A). Total precipitaion for the six month growing season was 43.89 cm, 3.55 cm below normal. The largest departure from normal occured in June, with a total of 2.94 cm, 8.38 cm below normal. Temperature varied only slightly from normal, with average temperatures of 24.0 C, 25.7 C, and 24.0 C, for June, July, and August, respectively. Less than 50% of the days in this 3 month period had temperatures above 32 C.

Average yield of the millet hybrids were highest of all locations averaging of 4041 kg/ha (Table 12). The hybrids ranged from 5019 kg/ha to 1156 kg/ha. Although yields were relatively high compared to the other locations, millet yielded significantly less than sorghum. Sorghum averaged 5763 kg/ha, ranging from 6623 kg/ha to 4236 kg/ha.

Average days to half-bloom for millet was 60.97, ranging from 53.0 to 87.0 days. There also were significant differences among parental groups of Kansas millet hybrids. Sorghum averaged 60.5 days. The Georgia millets had the longest maturity averaging 63.4 days. This was significantly different from both the Kansas millets and sorghum hybrids. Millet male parental

Table 12. Hybrid Performance at Hays in 1981.

Entry Number	Hybrid	Days to half bloom	Heads/ ha th.	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head
1	ACCO 1014	54.3	71.9	4236	27.4	2160
2	Funk G-611	62.8	107.6	6623	27.7	2226
3	Golden Acres T-E Y45	59.3	111.5	5224	25.6	2077
4	Asgrow Corral	58.3	101.3	5933	23.0	2553
5	Pioneer 8324	61.5	81.9	6474	21.4	3707
6	DeKalb F67	67.0	95.9	6087	24.7	2585
7	80-2113 x 78-7024	59.0	219.2	4289	12.4	1596
8	79-2081 x 78-7024	58.8	207.5	4045	12.4	1578
9	79-2094 x 78-7024	59.0	235.7	4133	11.9	1477
10	79-2150 x 78-7024	57.5	194.6	4454	10.5	2180
11	23DAE x 78-7024	58.5	221.2	4174	9.5	2002
12	78-2224 x 78-7024	53.3	204.5	4325	11.7	1818
13	80-2113 x 78-7088	60.8	184.7	4461	12.1	2009
14	79-2081 x 78-7088	58.8	220.0	4425	11.3	1785
15	79-2094 x 78-7088	57.0	287.7	4956	13.6	1279
16	79-2150 x 78-7088	57.5	206.6	5019	10.8	2264
17	80-2113 x 79-1137	63.0	230.5	4316	10.7	1929
18	79-2081 x 79-1137	63.0	218.2	4162	10.5	1831
19	80-2203 x 79-1137	62.8	277.7	4614	10.9	1546
20	79-2150 x 79-1137	61.5	195.5	4130	9.1	2341
21	79-2059 x 79-4104	62.3	228.7	3985	11.0	1598
22	79-2081 x 79-4104	63.0	219.8	3983	11.0	1713
23	79-2094 x 79-4104	62.8	376.7	4136	11.8	1102
24	79-2150 x 79-4104	61.0	225.6	4541	11.5	1759
25	23 DAE x 756 + 10% 756	53.8	371.3	2547	7.9	873
26	23 DAE x 656 + 10% 653	61.3	232.0	4167	10.1	2227
27	23 DAE x 28R83D	64.5	363.8	3384	6.5	1460
28	23 DA x 28R83D	83.3	214.8	1156	5.6	971
29	23 DAE x 64 (756 x RMP)	59.0	317.9	4019	7.5	1723
30	23 DAE x 655 (756 x B39)	55.8	318.1	3585	11.9	1148
LSD (.05)		1.8	67.6	892	2.4	621
C.V.		2.08	22.08	14.47	12.58	23.72

groups 79-1137 and 79-4104 were significantly later than the other two parental groups. Significant correlations (Table B-2 Appendex B) showed that the earlier hybrids had the highest yields.

Sorghum averaged 95056 heads/ha harvested. This was significantly less than the millet hybrids which averaged 248893 heads/ha harvested. The Georgia hybrids had the greatest number of heads harvested ranging from 376740 to 214830 heads/ha.

The low yield among the Georgia hybrids could be related to the significantly smaller seed weight. They had an average seed weight of 7.75 g/th seeds. The Kansas hybrids ranged from 13.50 g/th seeds to 9.50 g/th seeds. A significant correlation of 0.552 showed yields increased with an increase in seed weight. Sorghum hybrids had the largest seed weight with an average of 24.94 g/th seeds.

Average seeds/head for the sorghum hybrids were 2551 seeds, ranging from 3707 to 2077. This was significantly greater than millet which averaged 1675 seeds. The highest yielding millet hybrids had the greatest number of seeds.

Seed set rating for Hays was the highest for all locations. Millet hybrids on the whole averaged 8.15. This high seed set could be related to yield, in that Hays had both the highest seed set rating and yield of all locations.

Of all locations Hays also had the greatest amount of pearl millet production surrounding the yield trials. Mashingaidze and Muchena (9) reported the main cause of floral sterility was the destruction of pollen induced by cool temperatures during boot stage and not a lack of receptiveness of the stigmas. This

increased concentration of pollen in the air around the experimental plots could account for the increase in seed set.

Minneola 1981

Minneola trials were planted in very moist conditions with above normal rainfall occuring throughout May (Table A-9 Appendix A). Precipitation totaled 47.00 cm for the six month growing season (April - September). Monthly average temperature did not deviate from normal to a great extent. Maximum average temperatures for June, July, and August were 33.0 C, 34.3 C, and 32.1 C, respectively.

Sorghum averaged 5491 kg/ha and ranged from 6032 kg/ha to 4150 kg/ha (Table 13). This was significantly greater than the millet average (2834 kg/ha), ranging from 3964 kg/ha to 502 kg/ha. All pearl millet hybrids were significantly less than the sorghum average.

Average number of days to half-bloom for sorghum was 60.4 days and for millet 58.4 days. There were parental group differences among the millet hybrids. Male parental groups 79-1137 and 79-4104 had averages of 60.6 and 60.0 days, respectively. These averages were significantly larger than the other millet hybrid groups, but not significantly different from the sorghum average.

Plant populations for the two crops were not significantly different. Sorghum averaged 69240 plants/ha and millet averaged

Table 13. Hybrid Performance at Minneola in 1981.

Entry Number	Hybrid	Days to half bloom	Plants/ ha, th.	Heads/ ha, th.	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Heads/ plant
1	ACCO 1014	55.7	68.2	104.8	4150	22.5	1792	1.60
2	Funk G-611	63.0	48.8	104.8	5755	22.8	2518	2.70
3	Golden Acres T-E Y45	58.3	68.2	134.4	5808	23.1	1938	3.70
4	Asgrow Corral	58.7	86.8	120.6	6032	23.5	2242	1.57
5	Pioneer 8324	61.7	89.7	119.1	5508	18.5	2546	1.39
6	DeKalb F67	65.0	53.8	104.3	5695	21.0	2667	2.48
7	80-2113 x 78-7024	59.7	57.4	173.2	2726	11.8	1340	3.23
8	79-2081 x 78-7024	57.7	89.7	191.4	2676	12.1	1169	2.20
9	79-2094 x 78-7024	59.3	51.7	165.8	2537	11.3	1874	3.20
10	79-2150 x 78-7024	57.3	56.0	171.8	2574	11.8	1300	3.14
11	23DAE x 78-7024	54.3	63.9	172.2	2814	10.8	1562	2.70
12	78-2224 x 78-7024	55.7	56.0	191.4	2452	11.3	1142	3.47
13	80-2113 x 78-7088	59.0	70.3	166.0	3473	14.3	1510	2.58
14	79-2081 x 78-7088	56.0	74.6	148.8	3222	14.2	1542	2.02
15	79-2094 x 78-7088	53.0	61.7	246.4	2530	14.1	789	4.04
16	79-2150 x 78-7088	57.7	66.0	165.1	3964	11.1	2217	2.76
17	80-2113 x 79-1137	62.3	72.5	161.2	3510	11.7	1871	2.26
18	79-2081 x 79-1137	60.7	39.5	161.2	3167	10.7	1843	4.46
19	80-2203 x 79-1137	59.3	73.9	177.0	2761	11.9	1290	2.75
20	79-2150 x 79-1137	59.7	75.4	178.0	3590	10.3	1972	2.41
21	79-2059 x 79-4104	59.0	71.0	173.2	3077	12.6	1410	2.64
22	79-2081 x 79-4104	60.3	63.2	217.7	3185	10.9	1350	3.79
23	79-2094 x 79-4104	62.3	71.8	174.1	2543	12.7	1211	2.53
24	79-2150 x 79-4104	58.3	70.3	169.8	3992	11.5	1896	2.53
25	23 DAE x 656 + 10% 756	54.7	38.8	329.1	2050	8.4	737	9.44
26	23 DAE x 656 + 10% 653	55.3	70.3	193.8	2419	10.8	1170	2.76
27	23 DAE x 28R83D	63.0	38.8	237.3	3044	5.6	2389	5.99
28	23 DA x 28R83D	61.2	56.0	151.7	503	4.7	787	2.86
29	23 DAE x 64 (756 x RMP)	56.3	56.7	279.6	3470	8.0	1565	5.41
30	23 DAE x 655 (756 x B39)	55.3	27.3	189.9	2061	7.7	1463	7.58
LSD (.05)		2.1	NS	77.9	918	2.3	706	2.61
C.V.		2.22	34.14	27.11	16.68	10.77	26.39	47.89

61350 plants/ha.

Although plant population was not significantly different, there was a significant difference in the number of heads harvested among hybrids. Millet hybrids averaged 191060 heads/ha, significantly greater than the sorghum average of 114650 heads/ha. Millet hybrids developed at Georgia were among the top ranging from 329143 to 151650 heads/ha. There was no apparent relationship between heads harvested and yield.

The grouping among hybrids for heads/plant was about the same as heads/ha harvested. The Georgia millets had the highest with a high of 9.43 heads/plant. Sorghum averaged 2.24 heads/plant and millet averaged 3.60. The significant correlation coefficient of -0.64 for plant population vs heads/plant indicated the increased tillering ability in millet among low populations.

Average seed weight for sorghum was significantly greater than that of millet averaging 21.90 g/th and 10.84 g/th, respectively. The Georgia hybrids had the lowest seed weight ranging from 10.80 g/th to 4.73 g/th. The 78-7088 male parental group had significantly greater average seed weight than all other parental groups.

Sorghum average for seeds/head was significantly greater than that of millet, 2283 and 1474 seeds/head, respectively. With the large variance among the millet hybrids there wasn't a significant relationship between seed weight and seeds/head.

The seed set rating for the millet hybrids was 4.52. There were three cool evenings on the 7, 8, and 9 of August that had temperatures approaching the critical temperatue level reported

by Mashingaidze and Muchena (9). This could account for the low seed set scores of some of the later maturing hybrids.

St.John 1981

The environment for 1981 had above normal precipitation with normal temperatures. Precipitation for the growing season was 114% of normal with 148% of normal for May through July (Table A-10 AppendixA). Precipitation for the three month period was uniformly distributed making for excellent conditions for stand establishment. Temperatures for the growing seaseon were slightly above normal with an average maximum temperature of 29.3 C.

There were no significant differences among hybrids for yield (Table 14). The yields ranged from 3294 kg/ha to 1263 kg/ha. The sorghum averaged 2442 kg/ha and the millets averaged 2032 kg/ha.

Low yields for both sorghum and millet could be attributed to poor ferility and low stand establishment. The yield trials had symptoms of "sand burn" or Atrazine damage.

Days to half-bloom that were recorded for the millet hybrids, ranged from 47.3 to 50.3 days. Average days to half-bloom was 48.8.

Plants/ha for the sorghum averaged 98000 with a range of 115000 to 80000. Pearl millet hybrids ranged from 68000 to 9320 with an average of 31750. All pearl millet hybrids were

Table 14 . Hybrid Performance at St. John in 1981.

Entry Number	Hybrid	Days to half bloom	Plants/ ha th.	Heads/ ha, th.	Heads/ plant	Yield (kg/ha)	Seeds/ head	Seed wt.
1	ACCO 1014	49.4	80.4	95.2	1.19	1744	770	25.2
2	Funk G-611	----	96.2	105.7	1.16	2574	1028	23.6
3	Golden Acres T-E Y45	----	101.9	90.0	.94	1927	1056	20.8
4	Asgrow Corral	----	111.2	137.8	1.27	2190	595	27.3
5	Pioneer 8324	----	115.5	121.0	1.05	3297	1293	20.7
6	DeKalb F67	----	85.4	78.5	.94	2924	1620	22.8
7	80-2113 x 78-7024	49.2	25.8	119.6	6.11	2396	1593	12.4
8	79-2081 x 78-7024	49.0	40.2	137.8	3.90	1890	1295	10.8
9	79-2094 x 78-7024	48.7	10.8	199.0	16.11	1748	748	10.5
10	79-2150 x 78-7024	49.3	25.1	150.7	7.56	2024	1241	11.4
11	23DAE x 78-7024	48.0	35.2	182.8	5.71	2052	1255	8.9
12	78-2224 x 78-7024	47.8	17.2	132.5	7.66	1346	915	10.7
13	80-2113 x 78-7088	48.0	51.0	174.6	3.66	2581	1183	12.5
14	79-2081 x 78-7088	47.3	68.2	199.5	2.98	2926	1298	11.8
15	79-2094 x 78-7088	47.3	67.5	214.8	3.66	2089	829	11.8
16	79-2150 x 78-7088	48.7	43.8	206.2	5.85	2619	1201	11.4
17	80-2113 x 79-1137	----	28.7	121.4	4.14	1540	973	12.1
18	79-2081 x 79-1137	49.7	32.3	193.8	7.18	2322	1070	11.1
19	80-2203 x 79-1137	----	16.5	246.1	16.77	1263	554	11.0
20	79-2150 x 79-1137	49.0	53.1	210.3	4.89	1973	846	11.0
21	79-2059 x 79-4104	49.7	33.0	214.3	6.62	1271	518	11.3
22	79-2081 x 79-4104	50.3	15.8	152.4	10.73	2002	1063	12.4
23	79-2094 x 79-4104	----	15.8	146.4	9.22	1599	896	12.5
24	79-2150 x 79-4104	50.3	18.7	120.6	6.35	1928	1291	11.9
25	23 DAE x 756 + 10% 756	49.3	10.1	225.8	28.86	2892	1438	8.6
26	23 DAE x 656 + 10% 653	49.0	52.4	220.1	6.79	2011	903	10.2
27	23 DAE x 28R83D	----	20.8	180.8	9.19	2193	2018	6.0
28	23 DA x 28R83D	----	48.1	211.5	4.40	2546	2597	5.5
29	23 DAE x 64 (756 x RMP)	49.4	34.4	156.0	4.53	1950	1639	7.6
30	23 DAE x 655 (756 x B39)	48.9	9.3	141.6	15.18	1614	1409	7.7
LSD (.05)		1.29	29.4	99.1	9.67	NS	463	2.1
C.V.		1.62	39.60	37.19	87.74	36.94	24.18	10.00

significantly less than the sorghum average. This low plant establishment can be contributed to damage caused by the Attrazine.

Pearl millet averaged 177000 heads/ha harvested, ranging from 246143 to 120566. Harvested heads/ha for sorghum ranged from 121036 to 78460 with an average of 101000. The pearl millet average was significantly greater than the sorghum average. Pearl millet hybrids that had the lowest plants/ha were among the top in heads harvested. This ability to compensate for low plant population can be seen in the number of heads/plant.

Millet hybrids averaged of 8.15 heads/plant with a range of 28.86 to 2.98 heads/plant. Sorghum ranged from 1.26 to 0.94, averaging of 1.09. The top five millets were the only hybrids significantly greater than the sorghum hybrids. Significant correlations again showed the ability of millet to compensate for low populations by increased tillering.

As expected the grain weight of sorghum was significantly greater than pearl millet. Sorghum ranged from 27.3 g/th to 20.7 g/th seeds. Millet ranged from 12.5 g/th to 5.46 g/th. Georgia hybrids had significantly smaller seed than the Kansas millets.

The small seeded millets also had the greatest number of seeds/head. Millet ranged from 2597 to 902 seeds/head. The sorghum hybrids ranged from 1620 to 594 seeds per head.

Seed set ratings for the millet hybrids averaged 2.93, ranging from 6.33 to 1.00. This low seed set rating could be attributed to low temperatures occuring during the boot or half-bloom stage.

Tribune 1981

Temperatures for the 1981 growing season deviated only slightly from normal (Table A-11 Appendix A). Average temperatures for May, June, July, and August were 14.2 C, 23.8 C, 25.3 C, and 23.1 C, respectively. Precipitation for this four month period totaled 17.42 cm, 10.07 cm below normal.

Sorghum hybrids significantly out yielded all pearl millet hybrids (Table 15). Sorghum averaged 7091 kg/ha with a range from 8731 kg/ha to 5103 kg/ha. Pearl millet ranged from 3787 kg/ha to 1092 kg/ha with an average of 2155 kg/ha.

Millet had significantly more heads harvested than sorghum. Millet ranged from 57410 to 391810 heads/ha, averaging 216342. Sorghum had a narror range of 94720 to 165050 heads/ha averaging 129329.

Seed weight of sorghum was also significantly greater than millet. Sorghum average seed weight was 22 g/th with millet averaging 14 g/th. The Georgia millets were significantly smaller than all Kansas millets, except hybrid 11. Correlations showed that seed weight increased with decreasing number of seeds/head.

Sorghum had the greatest number of seeds/head with a range of 2619 to 1550. This was significantly different from all millets except for entries 30 and 24. Millet ranged from 1865 to 452 seed/head.

The seed set rating for millet averaged 6.7, ranging from 8.6 to 4.6. Temperatures during the boot stage and half-bloom stage reached the critical levels and could have had an effect on seed set.

Table 15 . Hybrid Performance at Tribune in 1981.

Entry Number	Hybrid	Heads/ ha, th.	Yield (kg/ha)	Seed wt g/th	Seeds/ head
1	ACCO 1014	102.9	5103	32.0	1551
2	Funk G-611	149.3	8139	28.3	1942
3	Golden Acres T-E Y45	131.6	6884	27.2	1928
4	Asgrow Corral	123.4	6897	27.7	2070
5	Pioneer 8324	128.2	8731	26.3	2617
6	DeKalb F67	140.7	6794	23.7	2063
7	80-2113 x 78-7024	162.2	1428	14.4	613
8	79-2081 x 78-7024	189.0	1328	13.7	497
9	79-2094 x 78-7024	146.8	1092	12.5	586
10	79-2150 x 78-7024	191.4	2664	13.5	1033
11	23DAE x 78-7024	201.4	1831	11.4	785
12	78-2224 x 78-7024	300.0	2504	12.7	660
13	80-2113 x 78-7088	239.7	3518	15.1	980
14	79-2081 x 78-7088	284.2	3787	14.3	922
15	79-2094 x 78-7088	227.2	1753	14.5	578
16	79-2150 x 78-7088	158.4	2414	14.7	1035
17	80-2113 x 79-1137	172. 2	2163	15.4	818
18	79-2081 x 79-1137	269.3	2719	13.3	806
19	80-2203 x 79-1137	251.2	2318	12.6	773
20	79-2150 x 79-1137	112.0	1164	12.5	764
21	79-2059 x 79-4104	196.6	2202	13.6	844
22	79-2081 x 79-4104	167.9	1987	15.5	763
23	79-2094 x 79-4104	203.8	1170	12.9	452
24	79-2150 x 79-4104	219.6	3435	12.5	1257
25	23 DAE x 756 _ 10% 756	263.1	2258	11.0	772
26	23 DAE x 656 + 10% 653	253.1	1946	10.8	699
27	23 DAE x 28R83D	318.6	1545	7.3	661
28	23 DA x 28R83D	-----	----	----	----
29	23 DAE x 64 (756 x RMP)	319.1	2443	9.8	811
30	23 DAE x 655 (756 x B39)	129.1	1918	8.7	1865
LSD (.05)		83.2	1142	1.2	429
C.V.		25.64	21.97	4.59	24.43

Table 16. Pearl millet seed set scores for 1981.

Entry Number	Hybrid	Ashland Irrigated	Ashland Dryland	Minneola	Fort Hays	St. John	Tribune
7	80-2113 x 78-7024	7.6	4.5	3.6	8.0	1.6	7.0
8	79-2081 x 78-7024	5.6	5.5	4.5	8.5	2.3	7.6
9	79-2094 x 78-7024	5.0	5.5	4.5	8.0	2.6	7.5
10	79-2150 x 78-7024	5.0	4.0	5.0	8.7	2.3	5.0
11	23DAE x 78-7024	6.3	3.0	4.5	8.5	3.6	8.0
12	78-7224 x 78-7024	7.0	5.5	4.5	8.2	3.6	6.0
13	80-2113 x 78-7088	5.0	3.0	2.5	8.5	3.0	6.0
14	79-2081 x 78-7088	5.0	4.5	4.6	8.2	3.0	4.6
15	79-7094 x 78-7088	7.0	5.5	6.6	7.5	6.3	7.0
16	79-2150 x 78-7088	4.0	2.5	3.0	8.0	2.3	5.6
17	80-2113 x 79-1137	5.3	4.0	2.6	8.7	3.6	5.6
18	79-2081 x 79-1137	5.0	4.0	3.3	8.5	2.6	6.5
19	80-2203 x 79-1137	7.0	2.5	5.0	8.5	2.3	6.5
20	79-2150 x 79-1137	4.0	2.5	3.3	8.5	2.6	6.6
21	79-2059 x 79-4104	5.6	5.0	4.5	7.5	6.0	6.6
22	79-2081 x 79-4104	5.3	4.0	4.6	7.5	3.0	6.3
23	79-2094 x 79-4104	5.6	5.5	5.0	6.7	4.0	7.6
24	79-2150 x 79-4104	4.3	4.0	4.5	7.6	2.6	5.3
25	23DAE x 756 + 10% 756	7.6	4.5	7.0	7.7	3.0	8.5
26	23DAE x 656 + 10% 653	7.6	7.0	6.0	9.0	2.6	7.6
27	23DAE x 28R83D	4.3	2.0	4.8	8.7	1.0	8.3
28	23DA x 28R83D	8.0	6.5	9.0	8.2	1.6	8.6
29	23DAE x 64 (756 x RMP)	6.0	2.0	3.0	8.5	1.3	6.3
30	23DAE x 655 (756 x B39)	6.6	3.5	4.5	7.5	2.6	6.3
	LSD (.05)	2.4	1.9	0.9	1.8	2.4	3.19
	C.V.	25.40	22.53	7.45	24.85	20.28	17.84

Manhattan (Ashland) Dryland 1982

There was a total of 62.22 cm of rainfall with no more than 4.77 cm occuring on a single day (Table A-12 Appendix A). This uniform distribution throughout the season lowered the requirement for water on the irrigated trials which were only irrigated twice during July and August. Average temperatures for June, July, and August were 21.0 C, 26.7 C, and 25.2 C, respectively. There were only 31 days during this three month period where temperatures exceeded 32 C.

Sorghum average yield was significantly greater than the pearl millet average. Sorghum hybrids ranged from 5570 kg/ha to 4385 kg/ha, averaging 4930 kg/ha (Table 17). Pearl millet averaged 3515 kg/ha with a range of 4456 to 2052 kg/ha. The top four millet hybrids were not significantly different from the sorghum average.

Plant population for both crops ranged from 210980 to 40180 plants/ha. Sorghum averaged 154286 plants/ha, significantly greater than the millet average of 103284 plants/ha.

Although there was a significant correlation between plant population and yield there was not a strong relationship between the two (r=0.29). There was a strong significant correlation between plant population and heads/plant (-0.73) which showed that millet can compensate for low plant populations by increased tillering (Table B-3 Appendix B).

The number of heads harvested for millet ranged between 395640 heads/ha and 204280 heads/ha, averaging 270390 heads/ha.

This was significantly greater than sorghum which averaged 155320 heads/ha. There was a significant relationship (r=0.33) between heads harvested and yields.

Number of heads/plant ranged from 8.5 to 1.7 for millet and from 1.46 to 0.91 for sorghum. They averaged 3.16 and 1.09, respectively. The Georgia hybrids had an average of 5.20 heads/plant. There were no significant differences among the Kansas millet hybrids.

Due to the large variance there were no significant differences among hybrids for seeds/head. However, there were significant differences for seed weight. Sorghum hybrids averaged 20.87 g/th seeds, significantly larger than millet which averaged 10.99 g/th. Seed weight in millet was reduced by increasing the number of heads/plant or by an increase in the number of seeds/head.

Average number of days to half-bloom was 60.0 for sorghum and 49.6 for millet. There were significant parental group differences among the Kansas millets. Male parental groups 78-7024 and 78-7088 were earlier than the other parental groups. There was no relationship between maturity rating and yields.

The seed set rating for millet averaged 2.54. ranging from 3.33 to 1.0. This low seed set rating could be caused by the four nights that had temperatures reaching the critical temperature levels (13-16 C) that can induce floral sterility. These four nights coincided with the half-bloom dates for the majority of the millet hybrids.

Table 17 . Hybrid Performance at Ashland Dryland, Manhattan in 1982.

Entry Number	Hybrid	Days to half bloom	Plants/ ha th.	Heads/ ha th.	Heads/ plant	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	61.0	211.0	189.5	0.91	5132	18.20	1507	----
2	Funk G-611	59.0	153.6	149.3	1.01	5009	22.00	1557	----
3	Golden Acres T-E Y45	60.0	168.0	164.6	0.98	4386	21.60	1297	----
4	Asgrow Corral	57.7	126.8	151.7	1.46	4666	24.93	1238	----
5	Pioneer 8324	59.0	144.5	142.1	0.99	4814	18.40	1825	----
6	DeKalb F67	63.0	122.0	134.9	1.21	5577	20.13	2068	----
7	80-2113 x 78-7024	48.0	110.0	235.9	2.16	2921	13.20	970	3.00
8	79-2081 x 78-7024	48.7	111.5	266.0	2.40	3155	12.27	986	2.67
9	79-2094 x 78-7024	50.7	64.6	225.9	3.54	3367	11.87	1282	2.67
10	79-2150 x 78-7024	47.0	130.1	226.8	1.78	3858	12.53	1379	2.33
11	23DAE x 78-7024	49.3	150.7	374.1	2.53	4131	9.87	1148	3.33
12	78-2224 x 78-7024	46.0	128.2	294.7	2.29	3171	8.20	3672	2.50
13	80-2113 x 78-7088	46.0	143.0	279.9	1.95	4457	12.80	1331	3.00
14	79-2081 x 78-7088	47.7	91.4	215.8	2.55	3122	12.90	1121	3.17
15	79-2094 x 78-7088	48.7	108.6	274.1	2.45	3624	12.00	1329	2.83
16	79-2150 x 78-7088	46.0	135.9	255.5	1.92	3967	11.70	1348	2.50
17	80-2113 x 79-1137	51.7	119.1	204.3	2.14	3268	10.40	1605	2.50
18	79-2081 x 79-1137	51.0	80.9	259.8	3.49	3366	11.70	1107	2.33
19	80-2203 x 79-1137	55.7	116.3	361.2	3.22	3661	11.47	887	2.67
20	79-2150 x 79-1137	53.7	123.0	236.8	1.93	3420	11.97	1214	2.17
21	79-2059 x 79-4104	54.0	72.2	241.1	3.84	3291	12.00	1147	2.50
22	79-2081 x 79-4104	51.3	94.7	218.6	2.94	3047	11.70	1239	2.83
23	79-2094 x 79-4104	53.3	141.1	263.6	1.88	3527	11.80	1121	2.50
24	79-2150 x 79-4104	51.7	120.0	207.6	1.73	3502	11.60	1509	3.00
25	23 DAE x 756 + 10% 756	51.7	79.9	372.2	5.36	3953	9.93	1092	3.33
26	23 DAE x 656 + 10% 653	49.3	61.2	288.5	5.00	2053	8.70	829	3.33
27	23 DAE x 28R83D	56.7	82.3	395.6	5.58	4378	8.40	1326	1.17
28	23 DA x 28R83D	68.0	67.0	212.9	3.60	3698	8.67	2018	1.00
29	23 DAE x 64(756 x RMP)	54.0	104.8	311.9	3.14	4141	9.13	1468	1.67
30	23 DAE x 655 (756 x B39)	56.3	40.2	267.0	8.59	3279	9.30	1329	2.17
LSD (.05)		4.6	50.1	71.9	2.26	1091	2.7	NS	1.02
C.V.		5.57	27.04	17.79	50.43	17.57	12.80	65.16	27.89

Manhattan (Ashland) Irrigated 1982

The top five millet hybrids were not significantly different from the sorghum average (5641 kg/ha) (Table 18). This was significantly greater than the 4222 kg/ha average of millet. There were few significant differences among pearl millet hybrids, whiched ranged from 5211 kg/ha to 2851 kg/ha.

Sorghum reached half-bloom 10 days later than millet, based on their averages. Sorghum averaged 60.2 days, ranging from 57.3 to 64.0 days. There were no parental group differences among the Kansas millets, however, the Georgia millets were significantly later than all parental groups. Kansas millets averaged 45.6 days and the Georgia millets averaged 53.6 days.

Sorghum had a significantly higher plant population than millet, on an average basis. Nonetheless, the sorghums were scattered through out the population range for both crops. Sorghum averaged 180110 plants/ha, ranging from 203800 to 141130 plants/ha. The millets averaged 162900 ranging from the 235370 to 130600.

Millet had a significantly larger number of heads harvested than the sorghum hybrids. Millet averaged 351800 heads/ha, ranging from 58700 to 259700 heads. Sorghum was not significantly different among hybrids and had an average of 179220 heads.

Millet was able to compensate for the lower plant populaion by producing significantly more heads/plant than sorghum. Millets averaged 2.2 heads/plant, ranging from 3.91 to 1.43. Sorghum ranged from 1.06 to 0.97 averaging 1.0 head/plant. There was a

Table 18. Hybrid Performance at Ashland Irrigated, Manhattan in 1982.

Entry Number	Hybrid	Days to half bloom	Plants/ ha th.	Heads/ ha th.	Heads/ plant	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	60.7	203.8	198.1	0.97	5186	19.40	1362	----
2	Funk G-611	59.7	186.1	189.9	1.05	5986	19.40	1613	----
3	Golden Acres T-E Y45	59.7	194.2	188.5	0.99	5100	19.80	1380	----
4	Asgrow Corral	57.3	181.8	177.0	0.97	5928	20.53	1655	----
5	Pioneer 8324	59.7	173.7	171.7	1.01	5988	20.20	1739	----
6	DeKalb F67	64.0	141.1	150.2	1.06	5660	20.33	1865	----
7	80-2113 x 78-7024	48.0	196.2	315.8	1.62	4066	12.87	1002	2.67
8	79-2081 x 78-7024	48.7	161.2	343.0	2.17	3622	12.67	835	3.33
9	79-2094 x 78-7024	47.3	163.1	349.7	2.16	3961	11.07	1035	1.83
10	79-2150 x 78-7024	48.0	197.6	282.7	1.44	4077	11.47	1352	2.50
11	23DAE x 78-7024	48.0	235.4	401.9	1.70	4458	9.20	1216	2.67
12	78-2224 x 78-7024	48.0	171.3	349.2	2.02	4108	11.40	1068	2.33
13	80-2113 x 78-7088	48.0	215.8	308.1	1.44	3868	12.27	1026	3.33
14	79-2081 x 78-7088	48.0	143.5	351.6	2.56	4670	11.27	1189	2.00
15	79-2094 x 78-7088	48.7	156.9	311.9	1.99	4328	11.53	1223	2.00
16	79-2150 x 78-7088	48.0	131.1	311.9	2.51	4535	11.47	1296	2.67
17	80-2113 x 79-1137	48.7	137.3	259.8	1.92	4816	11.13	1671	1.83
18	79-2081 x 79-1137	48.0	130.6	277.5	2.13	4009	11.40	1264	2.17
19	80-2203 x 79-1137	48.7	147.4	442.1	3.07	5012	10.00	1151	3.17
20	79-2150 x 79-1137	49.3	138.7	299.0	2.20	5211	10.93	1614	1.83
21	79-2059 x 79-4104	49.3	180.8	331.1	1.84	4242	11.40	1122	2.67
22	79-2081 x 79-4104	50.0	137.3	328.2	2.43	3752	11.27	1017	2.17
23	79-2094 x 79-4104	50.0	139.7	282.3	2.03	3821	11.33	1211	2.33
24	79-2150 x 79-4104	48.7	155.0	304.3	1.97	4076	11.47	1188	2.50
25	23 DAE x 756 + 10% 756	48.0	150.2	587.0	3.91	4804	8.00	1034	2.50
26	23 DAE x 656 + 10% 653	48.0	163.6	301.4	1.87	3579	9.27	1346	2.67
27	23 DAE x 28R83D	59.0	138.7	466.5	3.32	4763	8.00	1367	1.33
28	23 DA x 28R83D	67.0	182.3	269.8	1.53	2851	6.20	1630	1.17
29	23 DAE x 64(756 x RMP)	48.7	198.1	438.2	2.21	4248	6.93	1427	1.50
30	23 DAE x 655 (756 x B39)	51.0	137.3	530.1	3.87	4457	8.27	1020	2.50
LSD (.05)		1.8	38.4	113.5	0.78	1233	1.14	438	0.81
C.V.		2.14	14.12	21.89	24.11	16.75	5.68	20.67	23.92

significant (Table B-3 Appendix B) relationship between heads/plant, heads/ha, and yield. Increasing the number of heads per plant increased total head number harvested and increased yield.

Sorghum had significantly larger seeds than millet, averaging 19.94 and 10.45 g/th seeds, respectively. Georgia hybrids had the smallest seed averaging of 7.7 g/th. Correlations showed that seed weight decreased with increasing heads/plant and of seeds/head.

Sorghum had significantly more seeds per head than millet. Sorghum averaged 1601 seeds/head. Number of seeds/head decreased with increasing heads/plant (r=-0.24).

Seed set rating for the millet hybrids averaged 2.31, nearly identical to the rating for the dryland trials. Days to half-bloom were about the same and they were planted within three days of each other. Consequently, the four cool nights would have the same influence on the amount of floret sterility occuring.

Hutchinson 1982

Temperatures for the four month period of April through July were below normal for the south central region (Table A-15 Appendix A) Precipitation was also below normal from July through September, totaling 50.54 cm. There was above average rainfall during May and June making conditions during planting below optimum for establishment and early growth. Average temperatures for May and June were 18.0 C and 21.1 C, respectively.

Sorghum average yield (3123 kg/ha) was significantly greater

than pearl millet (2091 kg/ha). Millet hybrids ranged from 2684 to 1262 kg/ha, with few significant differences among millet hybrids (Table 19).

Plant populations for sorghum averaged 150060 significantly less than millet which averaged 163250 plants/ha. The small seeded Georgia millets had the lowest plant populations.

Average heads/ha harvested for the two crops were not significantly different. Sorghum averaged 180600 heads/ha and millet averaged 190680 heads/ha.

Sorghum hybrids did not produce a significant number of viable tillers averaging 1.01 heads/plant. Millet, however, had 1.25 heads/plant average, ranging from 2.30 to 0.96 heads/plant. The Georgia millets produced the greatest number of viable tillers averaging 1.61 heads/plant. Millet showed its tillering ability at lower populations by a significant correlation between plant population and heads/plant (Table B-3 Appendex B).

Sorghum hybrids averaged 20.43 g/th seeds and were significantly larger than pearl millet. Millets averaged 10.20 g/th seeds, ranging from 5.2 to 13.0 g/th. Correlations indicated seed weight increased with decreasing heads/plant and decreasing seeds/head. A correlation coefficient of 0.44 (significant at the 0.01% level) showed the relationship between seed weight and yields.

The crops differed significantly in seeds/head. Millet averaged 1120 seeds/head and sorghum averaged 893 seeds/head. A significant correlation of 0.49 showed a relationship of increasing yield with increasing seeds/head.

On the average, millet hybrids were ten days earlier than

Table 19 . Hybrid Performance at Hutchinson in 1982.

Entry Number	Hybrid	Days to half bloom	Plants/ ha th.	Heads/ ha th.	Heads/ plant	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	68.3	207.2	210.0	1.01	3420	18.13	905	----
2	Funk G-611	67.0	175.8	175.6	1.00	3605	22.00	932	----
3	Golden Acres T-E Y45	63.7	166.0	162.2	0.98	2043	22.47	568	----
4	Asgrow Corral	58.3	171.3	183.2	1.08	2168	23.80	506	----
5	Pioneer 8324	68.7	202.4	209.1	1.04	3618	15.60	1130	----
6	DeKalb F67	67.3	149.3	143.5	0.96	3887	20.60	1321	----
7	80-2113 x 78-7024	55.7	142.1	162.2	1.17	2044	10.93	1157	1.83
8	79-2081 x 78-7024	55.0	133.0	150.2	1.13	2022	12.20	1104	2.00
9	79-2094 x 78-7024	53.7	142.0	221.0	1.56	2418	12.07	914	3.50
10	79-2150 x 78-7024	53.7	173.2	176.1	1.02	2271	9.53	1349	2.00
11	23DAE x 78-7024	53.7	196.1	215.3	1.09	2210	9.40	1106	3.00
12	78-2224 x 78-7024	53.3	167.0	199.0	1.19	2101	11.60	1100	3.00
13	80-2113 x 78-7088	54.0	208.1	200.0	0.96	2162	10.67	1053	2.83
14	79-2081 x 78-7088	51.3	181.3	216.2	1.21	1877	10.73	812	4.00
15	79-2094 x 78-7088	50.0	160.7	216.2	1.34	2142	12.73	787	3.83
16	79-2150 x 78-7088	53.0	186.6	187.1	1.01	2271	10.90	1116	2.83
17	80-2113 x 79-1137	55.7	177.0	183.7	1.04	2254	11.00	1111	2.00
18	79-2081 x 79-1137	55.3	139.7	167.0	1.19	2285	11.50	1207	1.83
19	80-2203 x 79-1137	54.7	175.1	222.9	1.28	2089	9.60	981	1.83
20	79-2150 x 79-1137	56.7	152.1	170.8	1.12	2365	9.33	1518	1.50
21	79-2059 x 79-4104	55.7	151.2	149.3	0.98	2294	10.87	1471	2.67
22	79-2081 x 79-4104	57.0	125.3	160.7	1.34	2311	11.60	1242	2.00
23	79-2094 x 79-4104	58.0	201.9	209.5	1.04	2256	10.20	1054	1.67
24	79-2150 x 79-4104	55.3	167.4	176.5	1.06	2685	10.27	1491	2.00
25	23 DAE x 756 + 10% 756	58.3	121.5	266.5	2.30	1590	7.40	805	3.50
26	23 DAE x 656 + 10% 653	54.7	133.0	173.2	1.33	1842	10.70	956	4.00
27	23 DAE x 28R83D	59.3	128.7	202.8	1.58	1703	8.33	1141	2.33
28	23 DA x 28R83D	81.7	140.2	174.6	1.29	1709	7.33	1336	1.50
29	23 DAE x 64(756 x RMP)	56.0	119.1	207.6	1.75	2039	8.33	1244	1.83
30	23 DAE x 655 (756 x B39)	54.0	124.9	167.4	1.46	1262	7.67	1028	2.00
LSD (.05)		3.66	31.39	38.9	0.36	667	1.82	383	1.12
C.V.		3.86	11.95	12.62	18.52	17.77	9.01	21.84	27.61

sorghum in reaching half-bloom, 55.0 days and 65.5 days,respectively. There were male parental group differences among Kansas millets, parental group 78-7088 was significantly earlier than all other groups. Georgia millets required more days to reach half-bloom than all the Kansas male parental groups. Maturity differences, however, could not be related to yield differences among the hybrids.

Seed set ratings for millet hybrids averaged 2.47, ranging from 4.00 to 1.5. The relationship of cool temperatures and floral sterility was not apparent using the critical temperature levels reported by Mashingaidze and Muchena (9). There was only one night throught the range of bloom dates with low temperatures within the critical level.

Garden City 1982

Temperatures for the entire six month growing season were below normal with above normal precipitation (Table A-13 Appendix A). There was a total rainfall of 40.53 cm (April - September), 10.46 cm above normal. Average maximum temperatures were 25.6 C, 32.7 C, and 31.8 C, for June, July, and August, respectively.

Yield trials were located in a low spot that had excessive moisture during early developmental stages which reduced stand establishment and vigorous seedling growth.

Average yield of sorghum (2938 kg/ha) was significantly greater than the 2331 kg/ha average yield of millet (Table 20). Sorghum ranged from 4425 to 1665 kg/ha and millet ranged from

Table 20. Hybrid Performance at Garden City in 1982.

Entry Number	Hybrid	Plants/ ha th.	Heads/ ha th.	Heads/ plant	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	106.7	106.7	0.94	1666	20.00	938	----
2	Funk G-611	110.5	110.5	1.03	1751	18.87	852	----
3	Golden Acres T-E Y45	193.8	181.8	0.95	3328	23.67	760	----
4	Asgrow Corral	127.3	125.8	1.02	3483	24.00	1151	----
5	Pioneer 8324	139.2	139.2	1.01	4426	21.47	1520	----
6	DeKalb F67	111.5	95.7	0.89	2978	17.53	1777	----
7	80-2113 x 78-7024	70.8	154.0	2.17	2850	13.13	1467	1.50
8	79-2081 x 78-7024	60.3	150.7	2.62	2667	13.13	1484	2.17
9	79-2094 x 78-7024	57.4	212.4	3.81	2758	11.40	1128	2.17
10	79-2150 x 78-7024	82.3	173.7	2.15	2657	10.13	1665	2.33
11	23DAE x 78-7024	92.3	250.2	2.68	2455	9.93	994	3.00
12	78-2224 x 78-7024	61.2	173.2	2.86	2165	12.47	1008	2.00
13	80-2113 x 78-7088	130.6	209.1	1.65	2290	11.67	954	2.67
14	79-2081 x 78-7088	121.5	209.1	1.74	2449	11.67	1006	2.17
15	79-2094 x 78-7088	91.9	202.8	2.24	1961	11.67	854	3.00
16	79-2150 x 78-7088	108.6	212.9	2.00	2646	11.40	1106	2.00
17	80-2113 x 79-1137	95.2	171.8	1.84	2422	12.60	1158	1.83
18	79-2081 x 79-1137	63.6	136.4	2.07	1865	11.47	1330	1.17
19	80-2203 x 79-1137	78.9	224.7	2.99	2768	11.67	973	2.00
20	79-2150 x 79-1137	70.8	173.7	2.48	2641	11.47	1331	1.67
21	79-2059 x 79-4104	62.2	202.8	3.34	2762	12.20	1133	2.50
22	79-2081 x 79-4104	55.5	216.7	4.08	2393	12.07	959	2.00
23	79-2094 x 79-4104	89.9	182.3	2.03	2073	11.80	962	1.67
24	79-2150 x 79-4104	73.2	195.2	2.68	2200	12.40	902	2.00
25	23 DAE x 756 + 10% 756	----	193.3	----	1832	7.60	1225	2.00
26	23 DAE x 656 + 10% 653	29.2	220.6	7.50	1543	10.00	736	2.50
27	23 DAE x 28R83D	45.0	233.5	8.20	2738	7.00	1716	2.00
28	23 DA x 28R83D	35.9	133.9	3.85	1981	6.50	2281	1.67
29	23 DAE x 64(756 x RMP)	34.9	228.7	6.97	2220	7.80	1262	2.50
30	23 DAE x 655 (756 x B39)	45.9	236.8	5.16	1631	7.93	911	2.17
LSD (.05)		36.7	72.2	1.99	1295	2.24	594	0.88
C.V.		27.58	24.29	42.70	32.31	10.70	30.71	26.39

2850 to 1542 kg/ha. Only four millet hybrids were significantly different from sorghum average yield. Reduced yields of both crops were due to excessive moisture during early development and heavy weed infestations.

Soghum had better stand establishment, ranging from 193000 to 106200 plants/ha, averaging 131480 plants/ha. Millets plant population, which was reduced by early weed problems, averaged 69050 plants/ha, ranging from 130610 to 29180 plants/ha. There was no apparent relationship between plant population and yield.

Millet was able to compensate for the lower populations by producing significantly more heads per plant. Millet averaged 3.80 heads/plant, ranging from 8.20 to 1.65 heads/plant. Sorghum averaged 0.97 heads/plant, ranging from 1.03 to 0.88 heads/plant. Georgia millets produced the most heads/plant, with heads coming from both tillers and branched tillers.

This significant difference in tillering could be seen in the number of heads harvested. Millet hybrids averaged 195760 heads/ha, significantly greater than sorghum average of 126610 heads/ha. The range for both crops was from 250210 to 95680 heads/ha.

As expected, Georgia millets had the smallest seed weights and sorghum seed weights were significantly greater than millet. Sorghum averaged 20.92 g/th seeds and millet averaged 10.79 g/th seeds. The small seeded Georgia millets also had the lowest plant population. Correlation coefficients indicated that seed weights increased with decreasing heads/plant (Table B-3 Appendex B).

There was no significant difference in seeds/head on a crop average basis. Millet averaged 1188 seeds/head and sorghum

averaged 1166 seeds/head. There was no apparent relationship between seeds/head,or seed weight and yield.

Seed set rating for the millet hybrids averaged 2.11. They had a narrow range from 3.00 to 1.16. Basing the days to half-bloom at 50-60 days, there were several cool nights occuring from 20 July through 8 August. These cool temperatures ranging from 13-16 C, could be responsible for the high floral sterility.

Minneola 1982

Climate for Minneola had normal to below normal temperatures from April through June (Table A-16 Appendix A). Average temperatures for April, May, and June were 11.3 C, 18.1 C, and 21.0 C, respectively. During this three month period there were 17.82 cm of rainfall, with no more than 1.75 cm occuring on a single day. The three month period of June through August had a average maximum temperature of 31.3 C. There were 50 days when temperatures exceeded 32.5 C.

Sorghum average yield (3281 kg/ha) was significantly greater than millet average yield (2696 kg/ha). Millet ranged from 3372 to 1222 kg/ha, fifteen millet hybrids were not significantly different from sorghum average (Table 21).

Days to half-bloom for sorghum averaged 66.2, and was significantly greater than the millet average of 56.4 days. There were male parental group differences, with parental group 78-7088 being the earliest, and the other three groups not significantly

Table 21. Hybrid Performance at Minneola in 1982.

Entry Number	Hybrid	Days to half bloom	Plants/ ha th.	Heads/ ha th.	Heads/ plant	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	65.7	172.2	158.8	0.93	3122	13.47	1467	----
2	Funk G-611	68.3	199.5	184.2	0.92	3374	14.73	1238	----
3	Golden Acres T-E Y45	63.3	168.4	162.7	0.97	2874	16.60	1063	----
4	Asgrow Corral	61.0	155.5	145.4	0.94	3251	16.67	1349	----
5	Pioneer 8324	66.0	153.6	138.7	0.90	3407	14.80	1708	----
6	DeKalb F67	73.3	124.4	127.3	1.02	3663	17.80	1607	----
7	80-2113 x 78-7024	57.0	66.0	185.6	2.83	2643	10.60	1353	2.83
8	79-2081 x 78-7024	55.7	37.8	199.0	6.85	2926	10.20	1444	3.17
9	79-2094 x 78-7024	54.7	29.7	167.4	6.55	2356	11.07	1294	3.33
10	79-2150 x 78-7024	56.7	61.2	159.8	2.79	2777	9.53	1819	2.67
11	23DAE x 78-7024	55.0	76.6	210.5	2.75	3294	10.00	1587	3.83
12	78-2224 x 78-7024	55.0	70.8	198.5	2.85	3077	10.87	1437	4.00
13	80-2113 x 78-7088	54.3	122.5	192.3	1.57	2419	11.20	1119	4.17
14	79-2081 x 78-7088	54.7	90.9	215.8	2.39	2235	9.93	1068	6.00
15	79-2094 x 78-7088	54.0	84.7	209.1	2.47	2970	10.27	1400	4.00
16	79-2150 x 78-7088	54.0	78.0	181.8	3.06	2987	10.73	1518	3.67
17	80-2113 x 79-1137	56.0	97.6	182.8	1.92	2818	10.33	1495	3.17
18	79-2081 x 79-1137	55.3	67.5	190.9	3.01	2986	10.40	1504	3.50
19	80-2203 x 79-1137	56.3	51.7	190.4	4.53	2240	10.07	1187	3.33
20	79-2150 x 79-1137	58.0	78.9	176.5	2.25	2734	9.27	1646	3.17
21	79-2059 x 79-4104	55.0	56.0	198.5	3.70	2883	10.80	1348	3.33
22	79-2081 x 79-4104	57.7	47.8	199.5	4.60	2245	9.80	1119	3.17
23	79-2094 x 79-4104	56.3	119.6	211.0	1.71	2767	10.20	1281	3.33
24	79-2150 x 79-4104	57.7	69.9	202.4	4.18	3372	10.27	1625	2.83
25	23 DAE x 756 + 10% 756	54.3	40.7	266.0	18.17	2505	8.00	1201	4.33
26	23 DAE x 656 + 10% 653	54.3	49.3	229.6	4.66	3153	10.27	1336	3.83
27	23 DAE x 28R83D	59.7	24.9	195.7	7.99	2159	5.93	1895	3.33
28	23 DA x 28R83D	77.00	59.3	126.8	2.37	1222	5.80	1834	5.33
29	23 DAE x 64(756 x RMP)	56.0	40.2	293.3	7.52	3342	8.13	1389	4.17
30	23 DAE x 655 (756 x B39)	54.7	12.2	211.0	17.83	2602	7.60	1693	4.67
LSD (.05)		2.28	34.17	41.8	5.6	875	1.86	404	1.12
C.V.		2.40	25.01	13.45	83.86	19.04	10.50	17.26	21.61

different from each other. Georgia millets were significantly later than all Kansas parental groups. Correlations showed the earlier the maturity rating the higher the yields (Table B-3 Appendex B).

Average sorghum plant population was over twice the millet average. Sorghum averaged 162200 plants/ha and millet averaged 63890 plants/ha. The small seeded Georgia hybrids had the lowest populations, ranging from 59000 to 12000 plants/ha.

Millet was able to compensate for low plant population by the significantly greater number of heads/plant. There was a significant relationship of lower populations having increased number of heads/plant. Millet averaged 4.94 heads/plant, ranging from 18.17 to 1.56 heads/plant. The variance was so large, that there were few significant differences among the millet hybrids. The sorghum hybrids averaged 0.94 heads/plant.

Differences in heads/plant held through to total heads harvested. Millet had significantly more heads harvested than sorghum, averaging 199750 and 152850 heads/ha, respectively. Those hybrids with the greatest number of heads/plant were also among the top in total heads harvested.

Grain weights of the sorghum were relatively smaller, compared to other locations. Average seed weight of was 15.67 g/th. This was significantly greater than millets average of 9.63 g/th. Correlations showed a positive relationship between yields and seed weight.

Number of seeds per head was not significantly different between the crops. Millet averaged 1441 seeds/head and sorghum

averaged 1405 seeds/head. There was no apparent relationship between seeds/head and yield.

Average seed set rating for the millet hybrids was 3.7, ranging from 6.00 to 2.66. Again, cool temperatures during boot and half-bloom stage could account for the floral sterilty.

St John 1982

Temperatures for the south central region were below normal for April through July (Table A-17 Appendix A). Average maximum temperatures for June, July, and August were 27.4 C, 33.7 C and 34.5 C, respectively. During this three month period there were 53 days with temperatures exceeding 32.0 C. There was 47.60 cm of rainfall for the six month growing season, 26.08 cm occured during May and June creating good conditions for stand establishment and early development.

Sorghum yields ranged from 4875 to 3183 kg/ha, averaging 4009 kg/ha (Table 22). This was significantly greater than millet average of 2254 kg/ha. All millet hybrid yields were significantly less than the sorghum average. Millet yields ranged from 2821 to 912 kg/ha.

Sorghum plant population averaged 124400 plants/ha, ranging from 170790 to 95200 plants/ha. Pearl millet plant populations were significantly less than sorghum, averaging 67110 plant/ha and ranging from 98550 to 13870 plants/ha. The small seeded Georgia hybrids had the lowest population averaging 44900 plants/ha.

Millet averaged 3.35 heads/plant showing its ability to

Table 22 . Hybrid Performance at St. John in 1982.

Entry Number	Hybrid	Plants/ ha th.	Heads/ ha th.	Heads/ plant	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	170.8	154.5	0.91	3793	18.67	1320	----
2	Funk G-611	117.7	123.0	1.05	4189	22.20	1543	----
3	Golden Acres T-E Y45	122.5	125.3	1.02	3183	22.07	1173	----
4	Asgrow Corral	126.8	134.4	1.06	4514	19.80	1768	----
5	Pioneer 8324	113.4	121.0	1.07	4875	19.60	2069	----
6	DeKalb F67	95.2	106.7	1.15	3502	22.07	1487	----
7	80-2113 x 78-7024	89.5	165.1	1.95	2191	12.33	1074	4.67
8	79-2081 x 78-7024	57.9	133.5	2.39	1593	14.20	825	5.83
9	79-2094 x 78-7024	33.0	201.4	9.24	1476	10.73	710	5.67
10	79-2150 x 78-7024	98.6	157.4	1.72	2079	12.33	1072	4.00
11	23DAE x 78-7024	95.7	278.0	2.99	2139	10.53	755	6.00
12	78-2224 x 78-7024	80.9	178.9	2.23	1850	12.33	865	5.67
13	80-2113 x 78-7088	75.6	190.4	2.56	2507	14.00	990	5.67
14	79-2081 x 78-7088	77.0	224.4	2.96	2425	12.73	856	5.83
15	79-2094 x 78-7088	69.4	204.8	3.15	2656	11.60	1152	4.33
16	79-2150 x 78-7088	65.5	155.0	2.43	2594	12.67	1342	3.83
17	80-2113 x 79-1137	93.3	155.5	2.20	2596	12.40	1349	3.50
18	79-2081 x 79-1137	71.8	151.7	2.21	2526	11.27	1489	3.50
19	80-2203 x 79-1137	77.5	183.2	2.43	2277	11.07	1131	3.33
20	79-2150 x 79-1137	80.4	152.1	1.93	2821	11.87	1569	3.67
21	79-2059 x 79-4104	61.7	146.4	2.45	2508	12.20	1412	3.00
22	79-2081 x 79-4104	57.9	152.6	3.03	2062	11.47	1166	3.83
23	79-2094 x 79-4104	75.1	155.0	2.12	2620	11.93	1428	4.17
24	79-2150 x 79-4104	80.9	153.6	1.89	2762	12.40	1506	3.33
25	23 DAE x 756 + 10% 756	13.9	122.0	8.71	912	8.30	901	6.67
26	23 DAE x 656 + 10% 653	55.5	185.9	3.40	2598	10.73	1327	5.33
27	23 DAE x 28R83D	40.7	253.1	6.51	2768	7.93	1392	2.67
28	23 DA x 28R83D	60.8	166.9	2.91	2315	8.93	1555	2.67
29	23 DAE x 64(756 x RMP)	72.2	209.5	3.24	1935	8.40	1155	4.33
30	23 DAE x 655 (756 x B39)	26.3	148.8	5.80	1895	8.67	1507	3.17
LSD (.05)		30.3	49.9	2.5	671	1.61	374	1.30
C.V.		23.6	18.35	54.22	15.76	7.48	18.12	19.86

compensate for the low populations. A significant correlation of -0.71 between plant population and heads/plant was found (Table B-3 Appendix B). Sorghum averaged 1.04 heads/plant, significantly less than millet.

Due to the increased tillering ability of millet it had a significantly greater number of heads/ha. Millet averaged 176800 heads, and sorghum averaged 127400 heads/ha.

As expected sorghum hybrids had the largest seed weight, averaging 20.73 g/th seeds. This was significantly greater than millets average of 11.29 g/th. Georgia millets averaged 8.82 g/th, significantly less than the Kansas millet average of 12.11 g/th. Correlations showed increased seed weight could be related to reduced heads/plant. Sorghum had significantly more seeds/head than millet. Millet ranged from 1568 to 710 seeds, with an average of 1188 seed/ha. Sorghum averaged 1560 ranging from 2068 to 1173 seed/head.

Seed set scores for the millet hybrids averaged 4.36 ranging from 6.66 to 2.67. The susceptibility of hybrid millets, in comparison to a millet bulk population, to floral sterility induced by low temperatures could be observed. A bulk population trial next to the hybrid trials which was planted the same day, showed very little floral sterility.

Tribune 1982

Precipitation for the six month growing season totaled 36.46 cm 2.06 cm above from normal (Table A-18 Appendix A). The 2.76 cm of rainfall occuring six days after planting caused crusting

Table 23 . Hybrid Performance at Tribune in 1982.

Entry Number	Hybrid	Heads/ ha em.	Yield (kg/ha)	Seed wt. g/th.	Seeds/ head	Seed set
1	ACCO 1014	145.0	3293	13.47	1710	----
2	Funk G-611	156.0	1880	14.40	842	----
3	Golden Acres T-E Y45	163.6	2789	14.60	1360	----
4	Asgrow Corral	130.1	2326	14.87	1211	----
5	Pioneer 8324	112.0	1928	12.40	1382	----
6	DeKalb F67	127.3	1692	10.87	1234	----
7	80-2113 x 78-7024	138.3	1378	11.40	937	4.50
8	79-2081 x 78-7024	112.4	1132	11.20	859	4.67
9	79-2094 x 78-7024	104.1	846	10.60	768	5.00
10	79-2150 x 78-7024	148.3	2052	10.20	1356	3.33
11	23DAE x 78-7024	136.5	1181	9.60	908	4.50
12	78-2224 x 78-7024	115.8	859	10.87	753	5.33
13	80-2113 x 78-7088	161.2	2030	12.67	942	4.17
14	79-2081 x 78-7088	99.0	1127	12.60	905	4.17
15	79-2094 x 78-7088	91.9	836	12.73	742	5.67
16	79-2150 x 78-7088	126.8	1822	11.20	1294	4.67
17	80-2113 x 79-1137	149.7	2233	12.13	1228	3.17
18	79-2081 x 79-1137	130.6	1558	11.87	970	4.50
19	80-2203 x 79-1137	128.7	972	11.00	702	5.00
20	79-2150 x 79-1137	123.0	1657	10.87	1216	3.67
21	79-2059 x 79-4104	186.1	1785	11.27	877	3.50
22	79-2081 x 79-4104	78.0	1758	10.87	2813	3.67
23	79-2094 x 79-4104	183.7	1489	9.40	844	4.33
24	79-2150 x 79-4104	185.6	2248	9.73	1242	3.33
25	23 DAE x 656 + 10% 756	----	----	----	----	----
26	23 DAE x 656 + 10% 653	93.5	538	11.00	555	6.25
27	23 DAE x 28R83D	179.8	1104	7.27	746	5.83
28	23 DA x 28R83D	----	----	----	----	----
29	23 DAE x 64 (756 x RMP)	232.0	1452	9.30	687	4.25
30	23 DAE x 655(756 x B39)	99.5	1090	5.93	825	3.67
	LSD (.05)	65.7	917	1.36	815	1.05
	C.V.	28.99	33.81	7.32	45.40	17.60

of the soil and poor establishnment, consequently plots had to be replanted. Average temperatures for June, July, and August were 19.2 C, 24.6 C and 34.7 C, respectively. Of the total 21.01 cm of rainfall occuring from July through September, 15.10 cm occured on three days.

Yields for both crops were the lowest of all locations. Sorghum averaged 2318 kg/ha and millet averaged 1631 kg/ha (Table 23).

These low yields can be attributed to the poor planting conditions during May. There were also weed problems that prevented good stand establishment and vigorous vegetative development.

There were no significant differences between crop averages for number of heads harvested. Sorghum averaged 139000 heads/ha and millet averaged 138000 heads/ha.

Seed weights of sorghum were significantly greater than millet, but smaller when compared to the other locations. Sorghum averaged 13.43 g/th with a high of only 14.60 g/th seeds. All other locations averaged 19.81 g/th seeds.

Millet hybrids did not deviate much from the across location average of 10.42 g/th. Millet hybrids averaged 10.87 g/th. seeds. The small change in seed weight, compared to the change occuring in sorghum, showed millets seed weight stability over changing environments.

There was no significant difference in average number of seeds/head between crops. Sorghum averaged 1289 seeds/head and millet averaged 1045 seeds/head.

Seed set ratings among the millet hybrids averaged 4.45.

They ranged from of 3.0 to 7.0.

Hays 1982

Precipitation for Hays was below normal during the latter part of the growing season. There was a uniform distribution occuring the latter part of May and early June. This gave adequate moisture at planting for establishment and early growth. Temperatures for the growing season did not deviate from normal throughout the growing season (Table A-14 Appendix A) . June, July, and August had average temperatures of 19.5 C, 25.4 C and 25.3 C, respectively.

Sorghum significantly out yielded millet with averages of 4625 kg/ha and 3471 kg/ha, respectively (Table 24). The top four millet hybrids were not significantly different from the sorghum average. Millet ranged from 4228 kg/ha to 1433 kg/ha.

There were male parental group differences for days to half-bloom among the Kansas millets. Male parental group 78-7024 was the earliest averaging 51.1 days. Georgia millets were the longest ranging from 77.3 to 51.5 days, averaging 59.1. Sorghum averaged 61.0 days, significantly greater than the millet average of 54.6 days. A significant correlation (Table B-3 Appendex B) was found indicating the earlier the hybrid the greater the yield.

Millet, on the average, had twice as many heads harvested/ha than sorghum . Millet hybrids averaged 208450 heads/ha, ranging from 283750 to 167400 heads/ha. All millet hybrids had

significantly more heads/ha than all sorghum hybrids.

Again sorghum had significantly greater seed weight than millet. Sorghum averaged 20.17 g/th and millet averaged 9.48 g/th seeds. There was a significant relationship between seed weight and yield. The top yielding millets had the larger seed weights.

Seeds/head were also significantly positively correlated with yield. Millet averaged 1754 seeds/head. Sorghum had a significantly larger number of seeds/head, averaging 2176 seeds.

Seed set ratings for the millet hybrids were the highest of all locations. Hybrids ranged from 7.0 to 9.0 with an 8.5 average. This high seed set rating could be contributed to all the millet production surrounding the hybrid trials which increased the pollen concentration in the air, which increased the seed set.

Table 24 . Hybrid Performance at Hays in 1982.

Entry Number	Hybrid	Days to half bloom	Heads/ ha th.	Yield (kg/ha)	Seed wt. g/th.	Seed set	Seeds/ head
1	ACCO 1014	61.8	108.5	4437	18.20	----	2241
2	Funk G-611	63.3	106.1	4878	21.80	----	2118
3	Golden Acres T-E Y45	57.5	109.1	4115	21.05	----	1790
4	Asgrow Corral	55.8	123.5	4752	20.05	----	1912
5	Pioneer 8324	61.0	89.7	5067	21.15	----	2674
6	DeKalb F67	67.0	104.1	4505	18.80	----	2321
7	80-2113 x 78-7024	51.3	187.8	3453	11.60	9.00	1609
8	79-2081 x 78-7024	51.8	193.5	3350	11.40	8.75	1534
9	79-2094 x 78-7024	50.5	246.1	3655	11.30	8.50	1311
10	79-2150 x 78-7024	50.0	191.1	4007	10.00	8.25	2122
11	23DAE x 78-7024	52.5	200.0	3775	9.20	9.00	2144
12	78-2224 x 78-7024	50.5	191.7	4117	11.00	8.25	1963
13	80-2113 x 78-7088	51.5	173.4	3840	10.95	9.00	2009
14	79-2081 x 78-7088	51.8	188.4	3351	10.60	8.75	1668
15	79-2094 x 78-7088	54.5	204.5	4228	10.60	9.00	1962
16	79-2150 x 78-7088	51.0	183.0	4172	10.45	7.50	2181
17	80-2113 x 79-1137	55.5	167.7	3708	9.50	9.75	2302
18	79-2081 x 79-1137	56.3	192.3	3902	10.10	9.50	2006
19	80-2203 x 79-1137	54.3	217.4	3462	9.53	9.00	1672
20	79-2150 x 79-1137	55.5	209.6	3432	8.50	9.25	1903
21	79-2059 x 79-4104	53.0	174.9	2807	10.80	8.50	1478
22	79-2081 x 79-4104	55.3	202.4	2747	9.65	8.75	1398
23	79-2094 x 79-4104	56.8	214.4	3316	9.80	9.00	1581
24	79-2150 x 79-4104	54.8	179.7	3452	8.20	8.50	2538
25	23 DAE x 756 + 10% 756	51.5	280.2	2674	6.80	8.25	1425
26	23 DAE x 656 + 10% 653	55.5	191.7	3475	9.80	9.75	1836
27	23 DAE x 28R83D	61.0	283.8	1974	9.00	10.00	826
28	23 DA x 28R83D	77.3	212.6	1434	5.65	8.25	1224
29	23 DAE x 64(756 x RMP)	56.0	255.7	3076	6.40	9.25	1409
30	23 DAE x 655 (756 x B39)	53.3	261.3	2616	6.80	8.25	1505
LSD (.05)		2.3	35.8	887	1.57	.73	421
C.V.		2.57	13.57	17.57	9.65	5.7	16.31

Genotype by Environment Analyses

1980

Environmental indexes (sorghum location means) ranged from 1339 to 4560 kg/ha. Sorghum average across location and hybrids was 2660 kg/ha, significantly greater than millet (2017 kg/ha). Millet yields across locations ranged from 2588 kg/ha to 1493 kg/ha (Table 25).

Response of millet in this abnormally hot and dry year did not differ from sorghum. Only 4 of 27 millet hybrids had regression coefficients significantly different from 1.0 (Table 25). Coefficients for millet ranged from 0.09 (Figure 8) to 1.23 (Figure 4).The r^2 ranged from 0.91 to 0.02.

1981

Sorghum location means were the highest of all years. Sorghum had an across hybrid and location mean of 6121 kg/ha, significantly greater than millet (3043 kg/ha). Environmental indexes ranged from 2442 to 8152 kg/ha. Millet yields ranged from 1795 to 3968 kg/ha, the higest average of all years.

Millet did not respond to the high producing enviornments like sorghum. All millet regression coefficients were significantly different from 1.0, however, none were significantly different from 0.0. Regression coefficients ranged from -0.09 (Figure 9) to 0.40 (Figure 15). There were no r^2 values larger than 0.63.

1982

Millet response in 1982 was very similar to that in 1980, however, with higher yields. Average millet yield across hybrids and locations was 2735 kg/ha, significantly less than sorghum (3844 kg/ha). Environmental indexes ranged from 2229 to 5660 kg/ha.

Millet regresssion coeficients ranged from 0.49 (Figure 20) to 1.05 (Figure 21). Only 3 hybrids had coefficients significantly different from 1.0 (Table 20). Hybrid 28 was the only hybrid with a coefficient not significantly different from 0.0. The r^2 ranged from 0.39 to 0.93.

1981-1982

Due to the extreme difference between the millet and sorghum yields at Ashland dryland, Ashland irrigated, and Tribune, these locations were not used in the regression calculations. Environmental indexes ranged from 2229 to 5763 kg/ha.

All except three millet hybrids had coefficients significantly different from 1.0 (Table 26). Two Georgia millets had coefficients not significantly different from 0. Regression coefficients ranged from -.07 (Figure 29) to .85 (Figure 26).

Average yields over the 11 locations ranged from 1941 to 3098 kg/ha. Sorghums average across locations and hybrids 4040 kg/ha, millet averaged 3168 kg/ha.

Figure 30 shows the response of the four Kansas male parental groups. There were no significant differences (LSD =.17 (.05)) among the regression coefficients.

Table 25. Response parameters for pearl millet, 1980.

Entry Number	Hybrid	B_1	Mean
4	79-2208 x 79-4140	.55	1493
5	79-2208 x 78-7024	.69*	1997
6	79-2201 x 79-4104	.48	1818
7	79-2201 x 78-7024	.79*	2091
8	79-2017 x 79-4104	.53	1659
9	79-2017 x 78-7024	.75*	2124
10	79-2156 x 78-7024	1.14*	2287
11	79-2221 x 78-7024	.79*	1966
12	79-2221 x 79-4104	1.23*	2248
13	79-2216 x 78-7024	.75*	1786
14	79-2216 x 79-4104	.76*	2146
15	79-2161 x 78-7024	.81*	1857
16	79-2161 x 79-4104	.68*	2232
17	79-2157 x 78-7024	.69*	2174
18	79-2157 x 79-4104	.77*	2031
19	79-2148 x 79-4104	1.21*	2588
20	79-2148 x 78-7024	.86*	2222
21	79-2059 x 79-4104	.97*	2217
22	79-2059 x 78-7024	.93*	2171
23	79-2055 x 79-4140	1.05*	2180
24	79-2055 x 78-7024	.78*	1996
25	79-2042 x 79-4104	1.02*	2117
26	79-2042 x 78-7024	.98*	2083
27	Tift 9 23DAE x R83D28	----	----
28	Tift 1 23DAE x 653+653	.433*	1638
29	Tift 2 23DAE x 656+653	.09+	1931
30	Tift 3 23DAE x 656+653	.959*	1732
31	Tift 8 (23DAE x 756) x 656+653	.85*	1812
LSD (.05)		.60	554

* not significant ($P > .05$) different from 1.0.
+ does not contribute significantly ($P > .05$) to the model $Y = X_\beta + e$.

Table 26 . Response parameters for pearl millet 1981, 1982 and combined 1981 and 1982.

Entry Number	Hybrid	1981		1982		1981-1982	
		B_1	Mean	B_1	Mean	B_1	Mean
7	80-2113 x 78-7024	-.086+	2594	.61	2693	.52	2814
8	79-2081 x 78-7024	-.063+	2311	.58	2558	.53	2643
9	79-2094 x 78-7024	-.20+	2320	.74*	2604	.63	2659
10	79-2150 x 78-7024	.067+	2811	.64	2972	.56	2984
11	23 DAE x 78-7024	.16+	2946	.88*	2655	.67	2971
12	78-2224 x 78-7024	.14+	2573	.83*	2608	.72	2688
13	80-2113 x 78-7088	.38+	3968	.75*	2946	.63	3098
14	79-2081 x 78-7088	.168+	3692	.88*	2657	.67	2893
15	79-2094 x 78-7088	.24+	3219	.98*	2843	.78*	2938
16	79-2150 x 78-7088	.25+	3892	.80*	3124	.74*	3326
17	80-2113 x 79-1137	.36+	3317	.70*	3014	.69	3043
18	79-2081 x 79-1137	.17+	3247	.73*	2812	.60	2922
19	80-2203 x 79-1137	.50+	3362	.99*	2810	.86*	2829
20	79-2150 x 79-1137	.35+	3401	.85*	3035	.71	3088
21	79-2059 x 79-4104	.45+	3166	.55	2821	.58	2809
22	79-2081 x 79-4104	.31+	3275	.49	2539	.52	2680
23	79-2094 x 79-4104	.10+	2492	.67*	2733	.59	2740
24	79-2150 x 79-4104	.37+	3692	.51	3037	.59	3132
25	23 DAE x 756 + 10% 756	.009+	2591	1.05*	2609	.39+	2575
26	23 DAE x 656 + 10% 653	.31+	3169	.68*	2347	.59	2488
27	23 DAE x 28R83D	.28+	3130	.92*	2698	.64	2746
28	23 DA x 28R83D	.03+	1795	.53+	2172	-.07+	1941
29	23 DAE x 64 (756 x RMP)	.40+	3575	.77*	2806	.67	2899
30	23 DAE x 655 (756 x B39)	.34+	2785	.90*	2354	.65	2372
LSD (.05)		.61	1116	.49	524	.37	729

* not significantly (P> .05) different from 1.0.
+ does not contribute significantly (P> .05) to the model $Y = X_\beta + e$

THIS BOOK CONTAINS NUMEROUS PAGES WITH DIAGRAMS THAT ARE CROOKED COMPARED TO THE REST OF THE INFORMATION ON THE PAGE.

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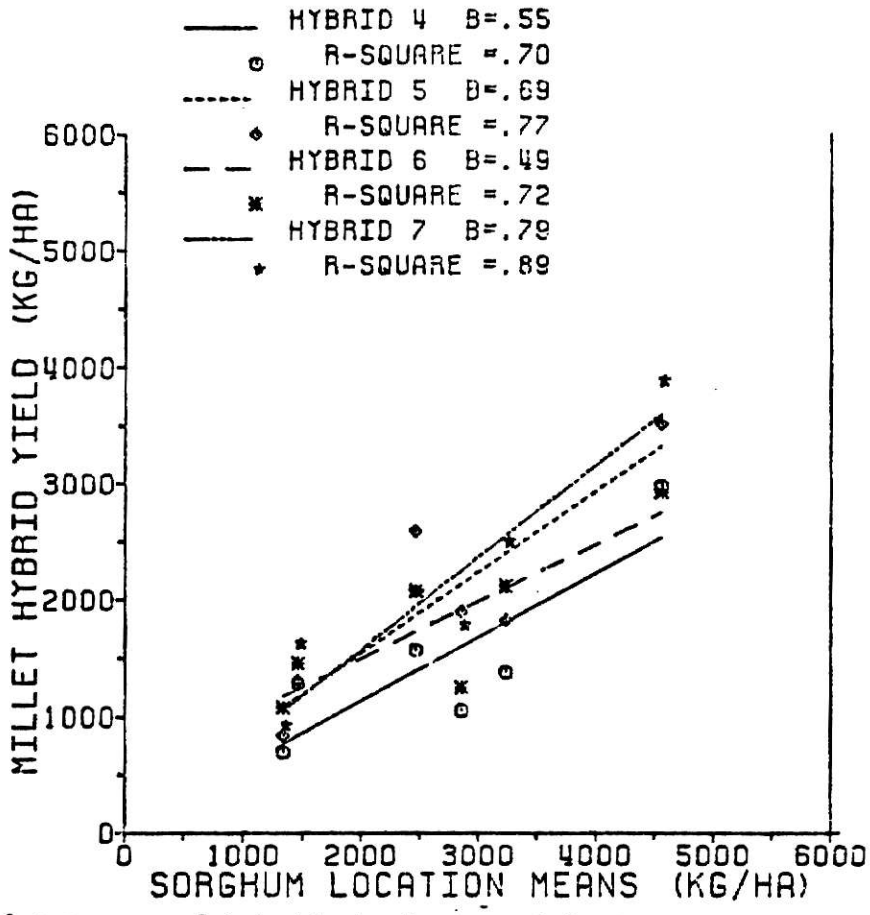

Figure 2. Yield response of hybrids 4, 5, 6, and 7, 1980.

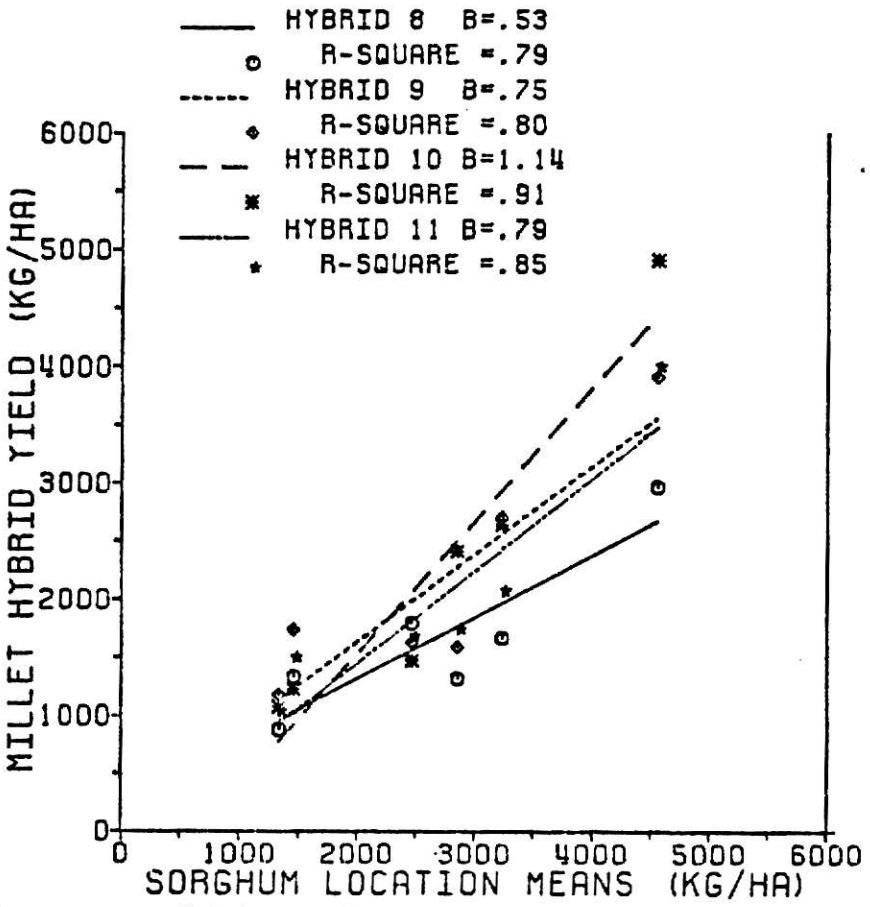

Figure 3. Yield response of hybrids 8, 9, 10, and 11, 1980.

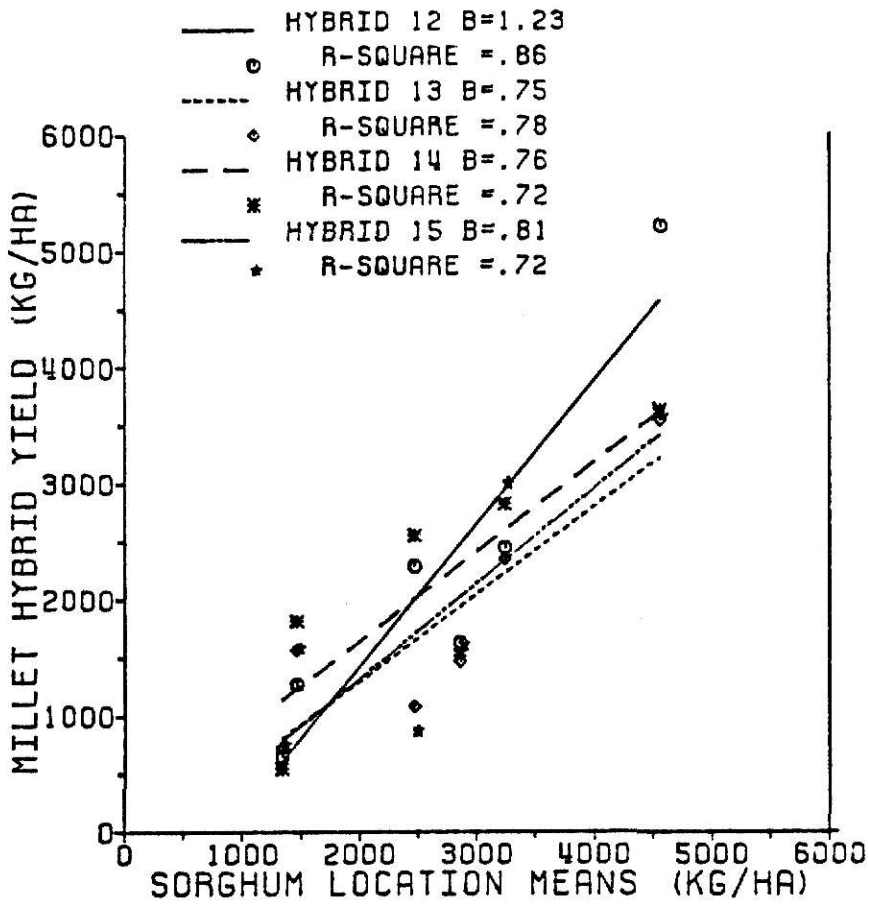

Figure 4. Yield response of hybrids 12, 13, 14, and 15, 1980.

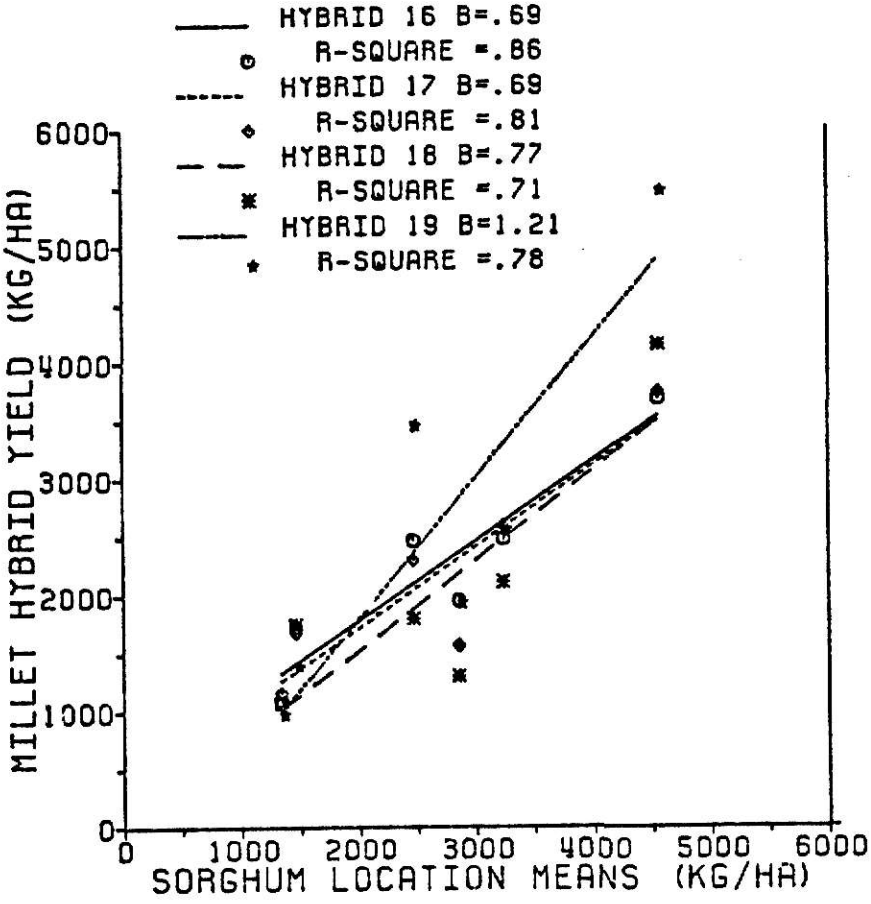

Figure 5. Yield response of hybrids 16, 17, 18, and 19, 1980.

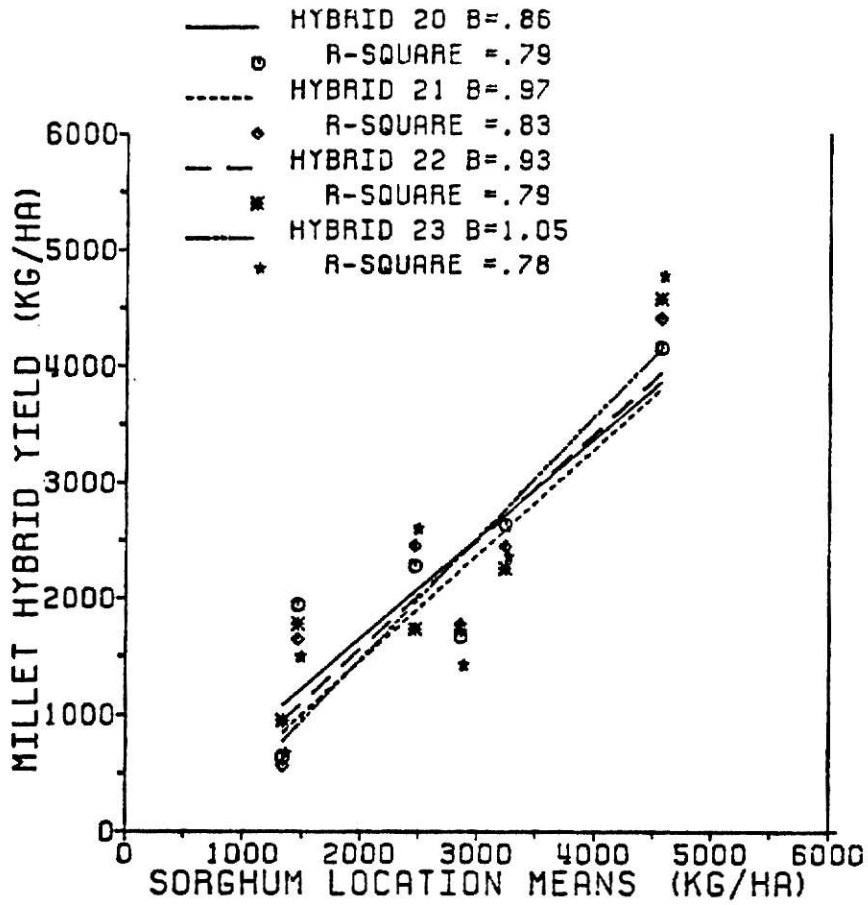

Figure 6. Yield response of hybrids 20, 21, 22, and 23, 1980.

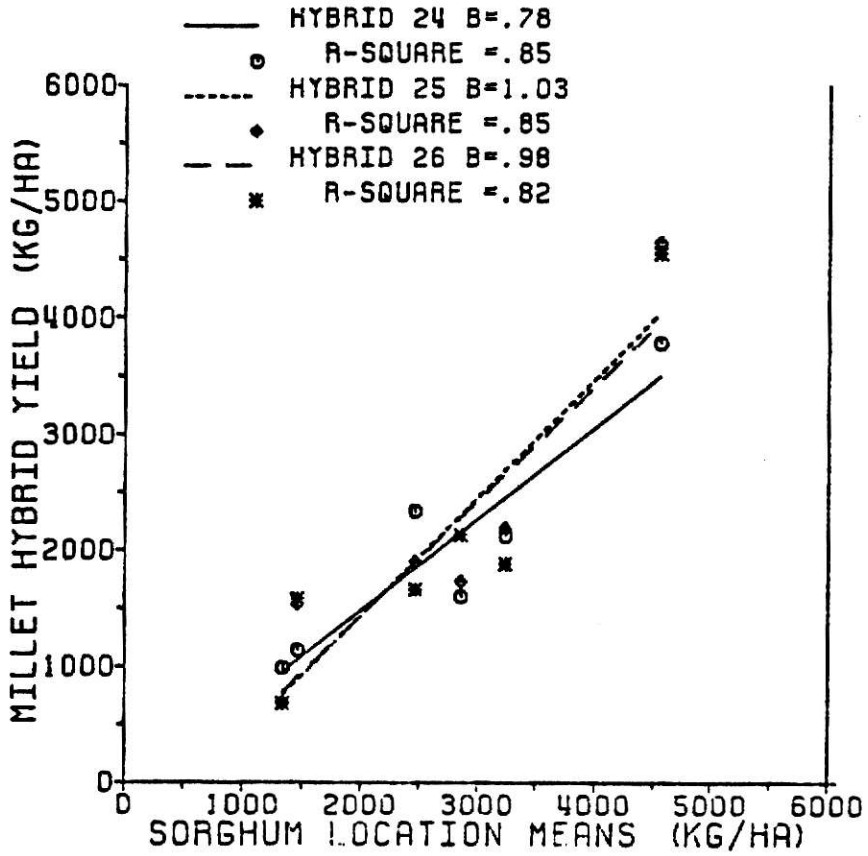

Figure 7. Yield response of hybrids 24, 25, and 26, 1980.

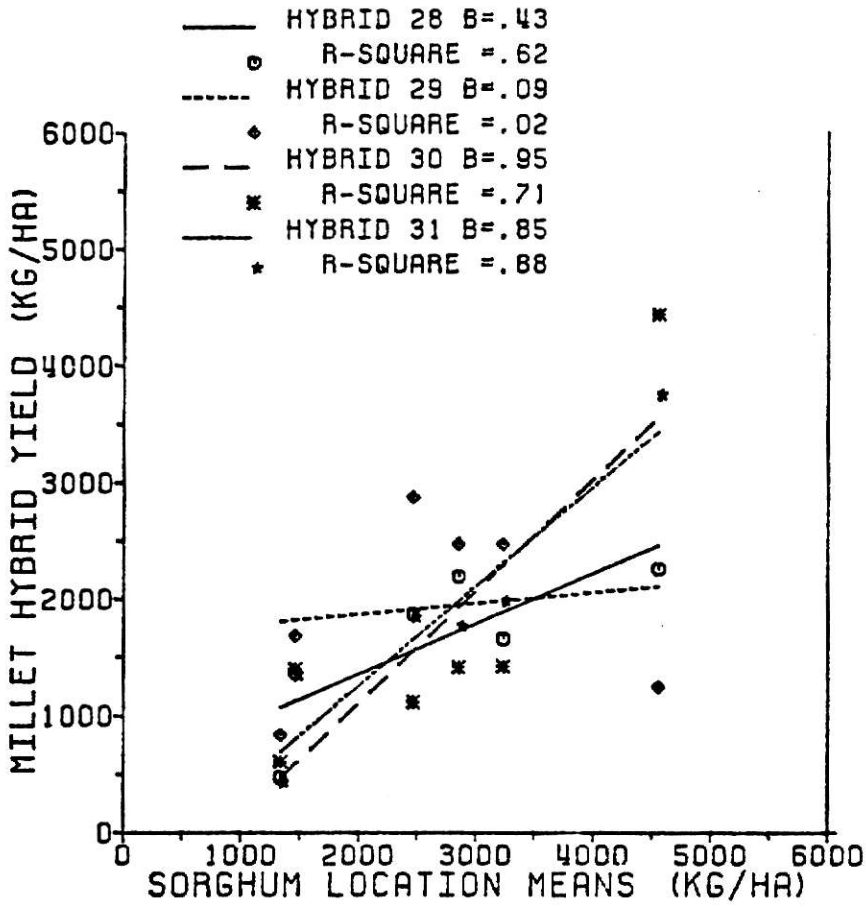

Figure 8. Yield response of hybrids 28, 29, 30, and 31, 1980.

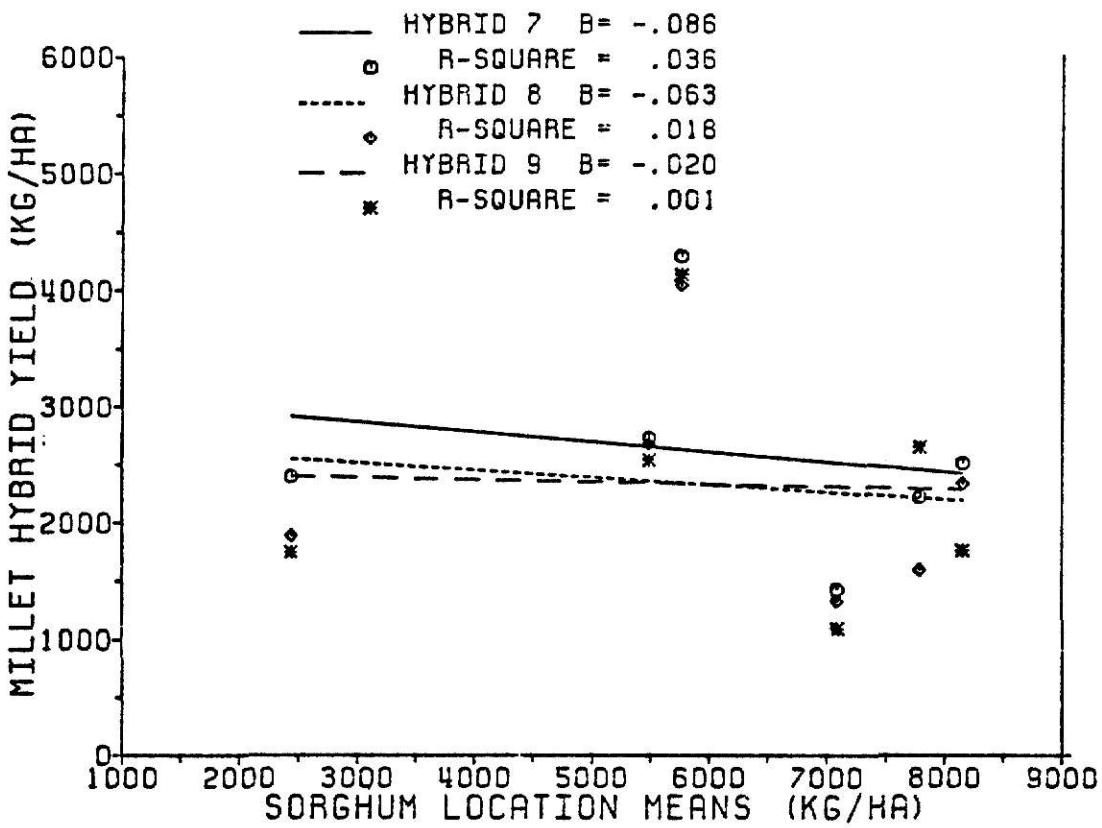

Figure 9. Yield response of hybrids 7, 8, and 9, 1981.

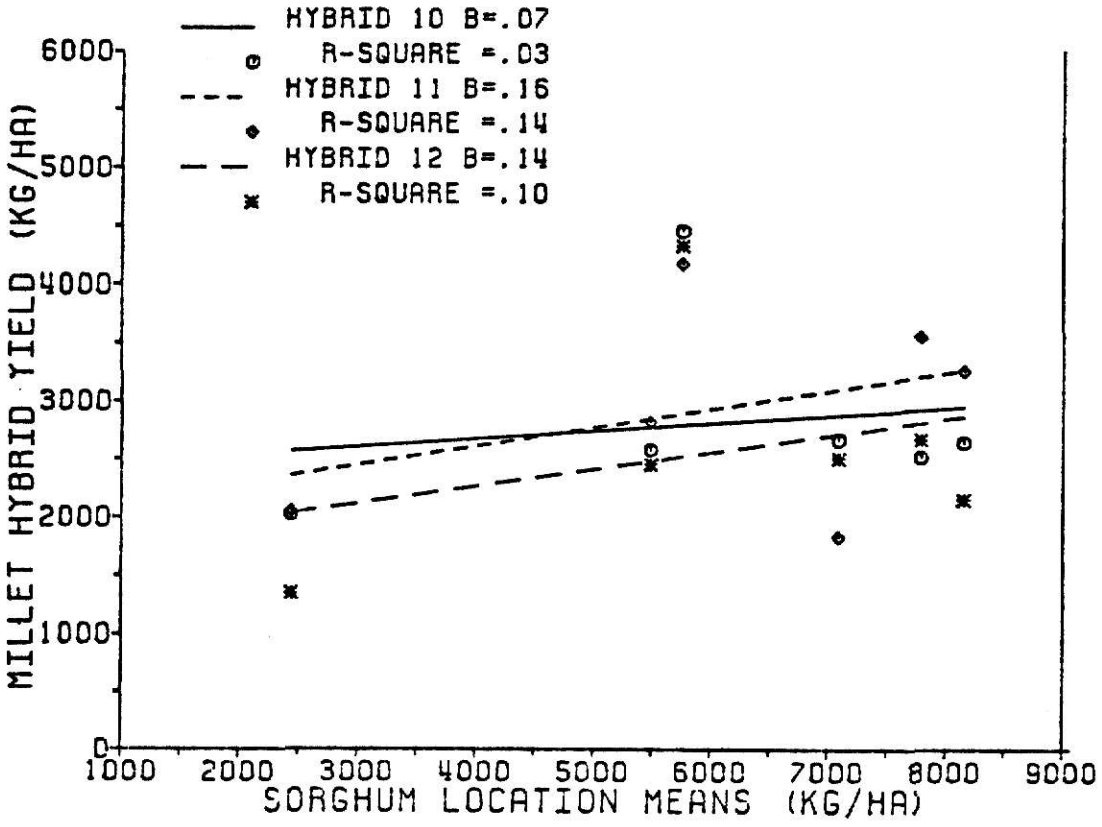

Figure 10. Yield response of hybrids 10, 11, and 12, 1981.

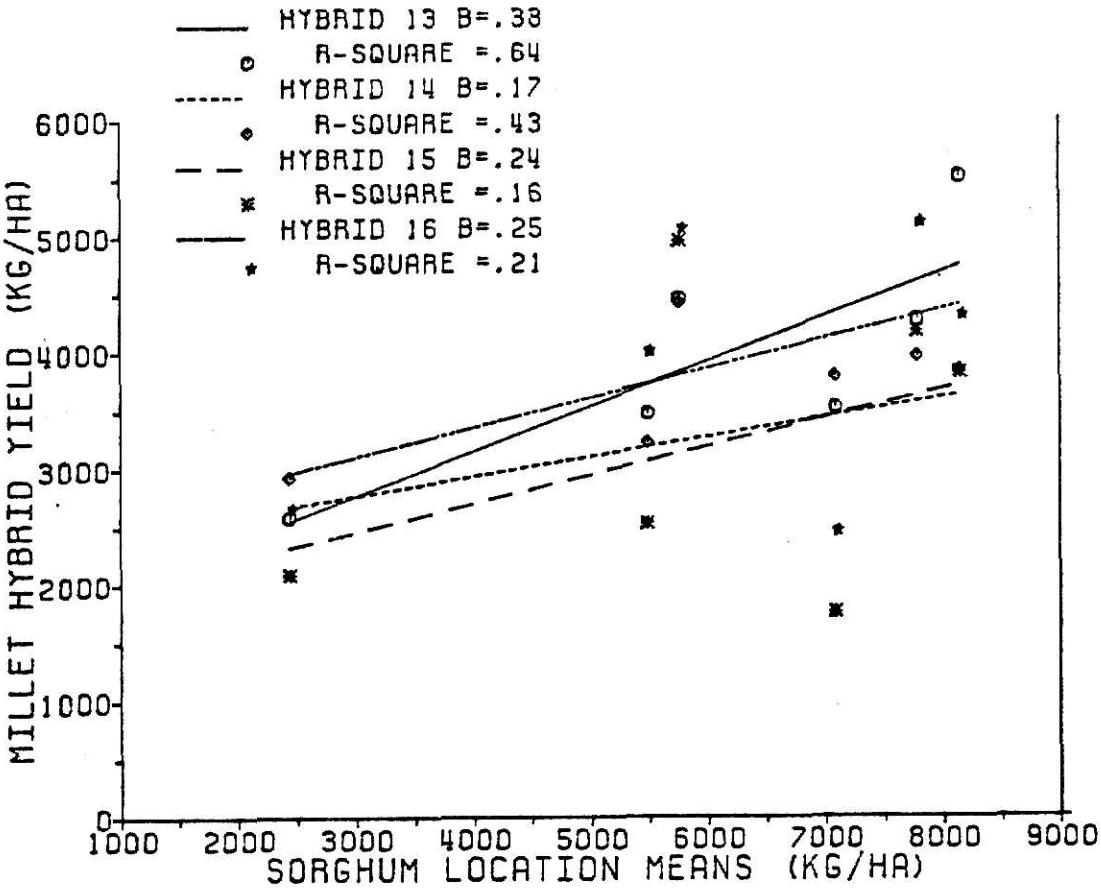

Figure 11. Yield response of hybrids 13, 14, 15, and 16, 1981.

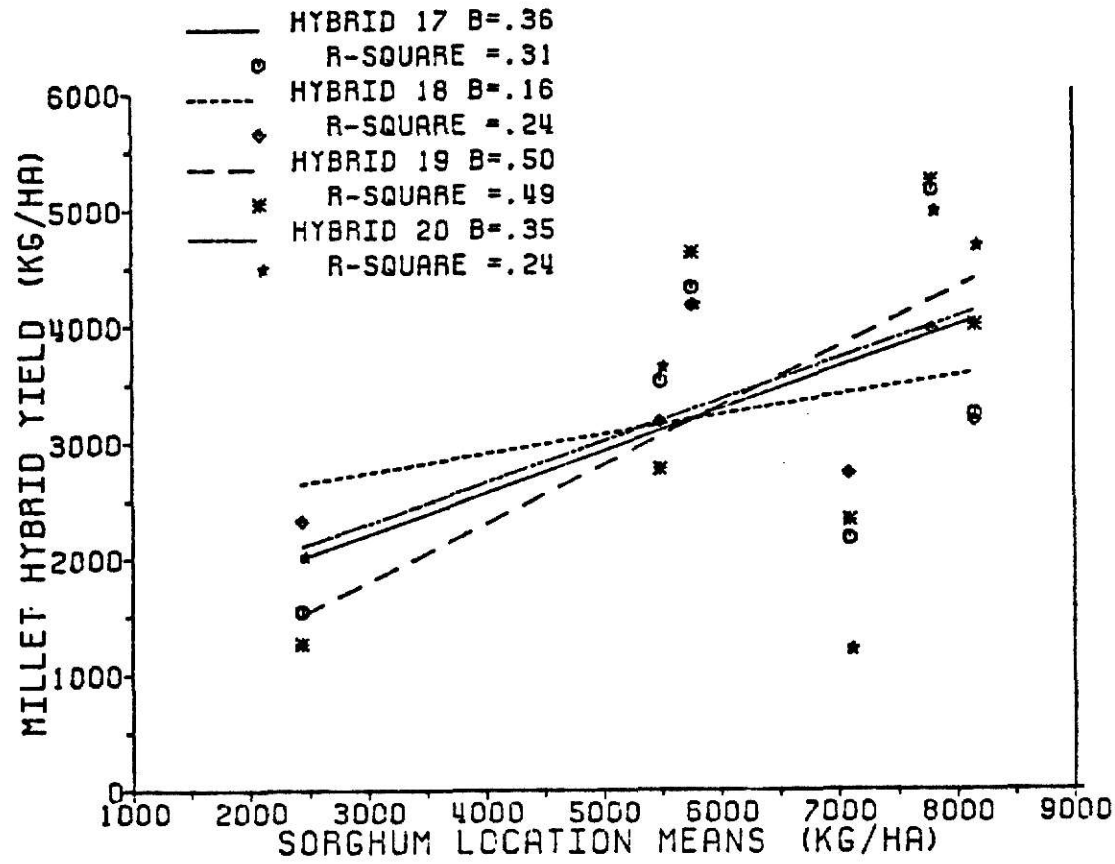

Figure 12. Yield response of hybrids 17, 18, 19, and 20, 1981.

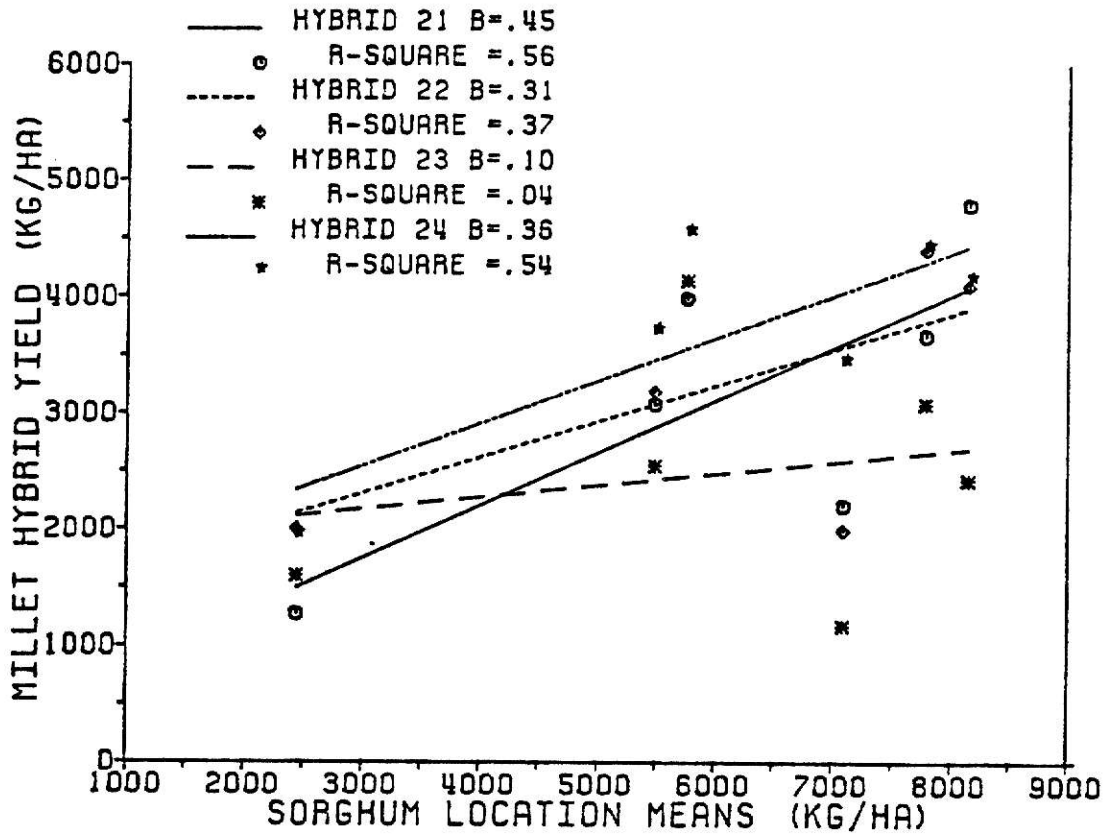

Figure 13. Yield response of hybrids 21, 22, 23, and 24, 1981.

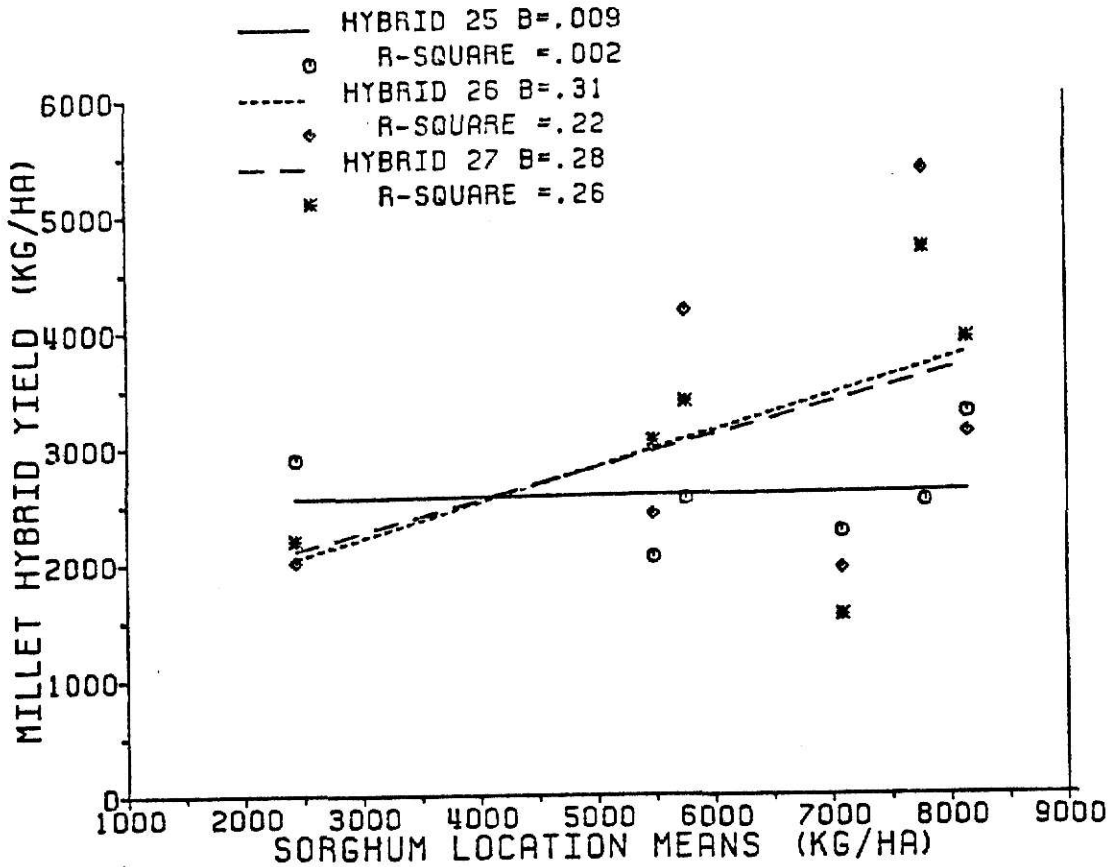

Figure 14. Yield response of hybrids 25, 26, and 27, 1981.

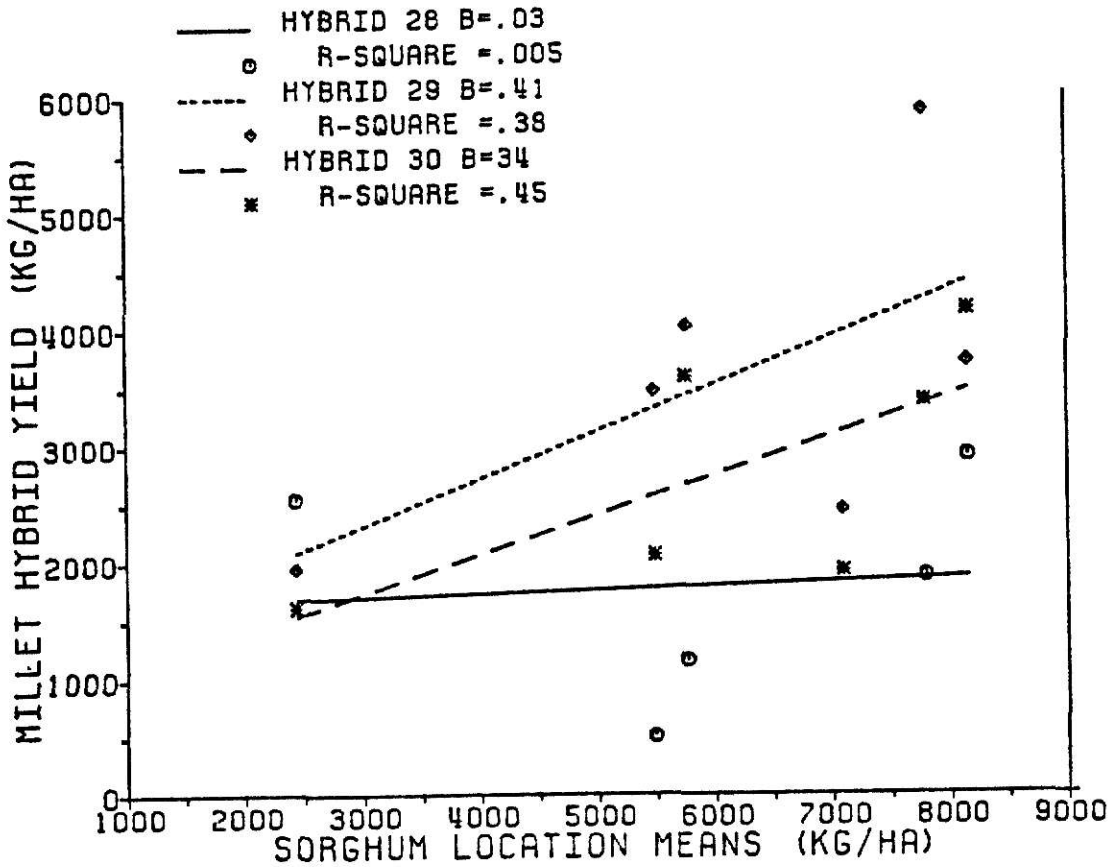

Figure 15. Yield response of hybrids 28, 29, and 30, 1981.

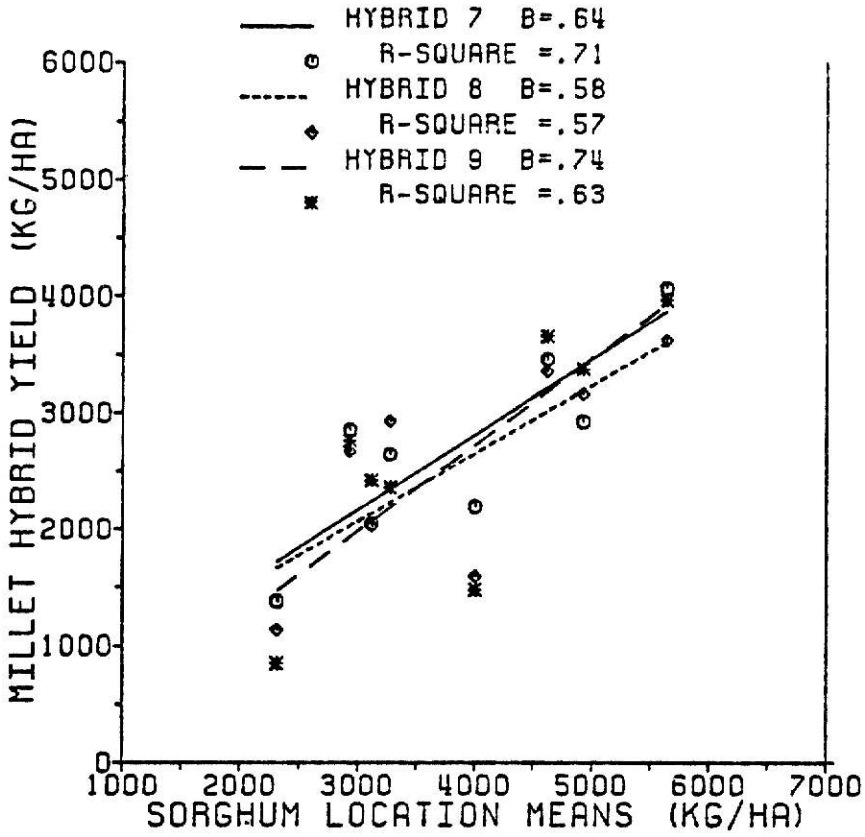

Figure 16. Yield response of hybrids 7, 8, and 9, 1982.

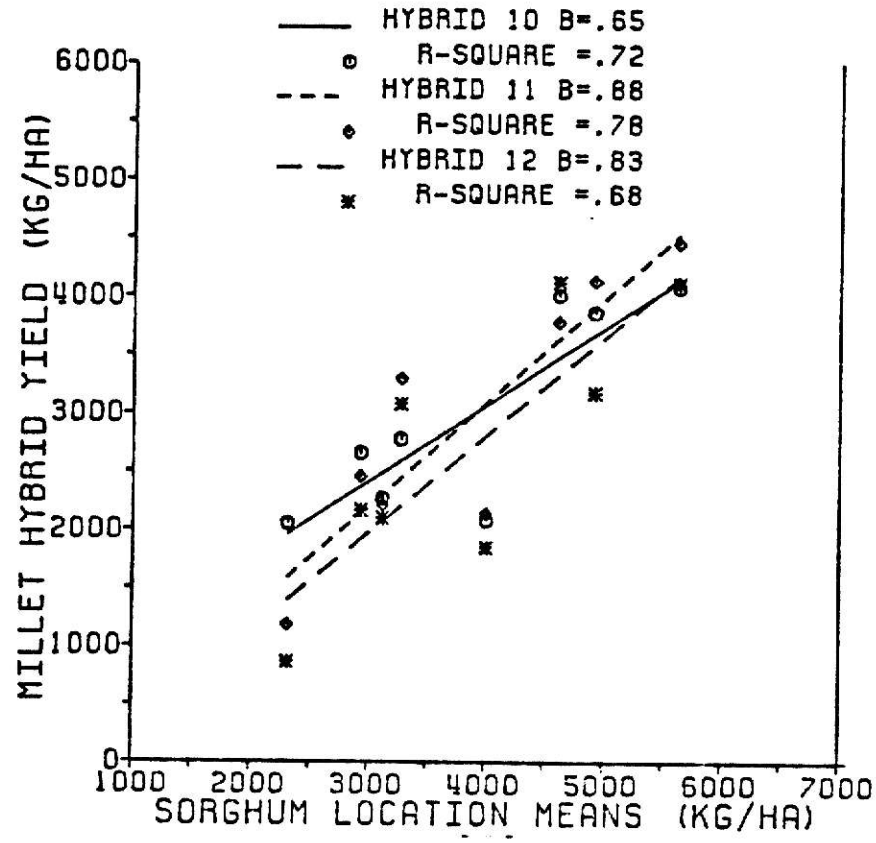

Figure 17. Yield response of hybrids 10, 11, and 12, 1982.

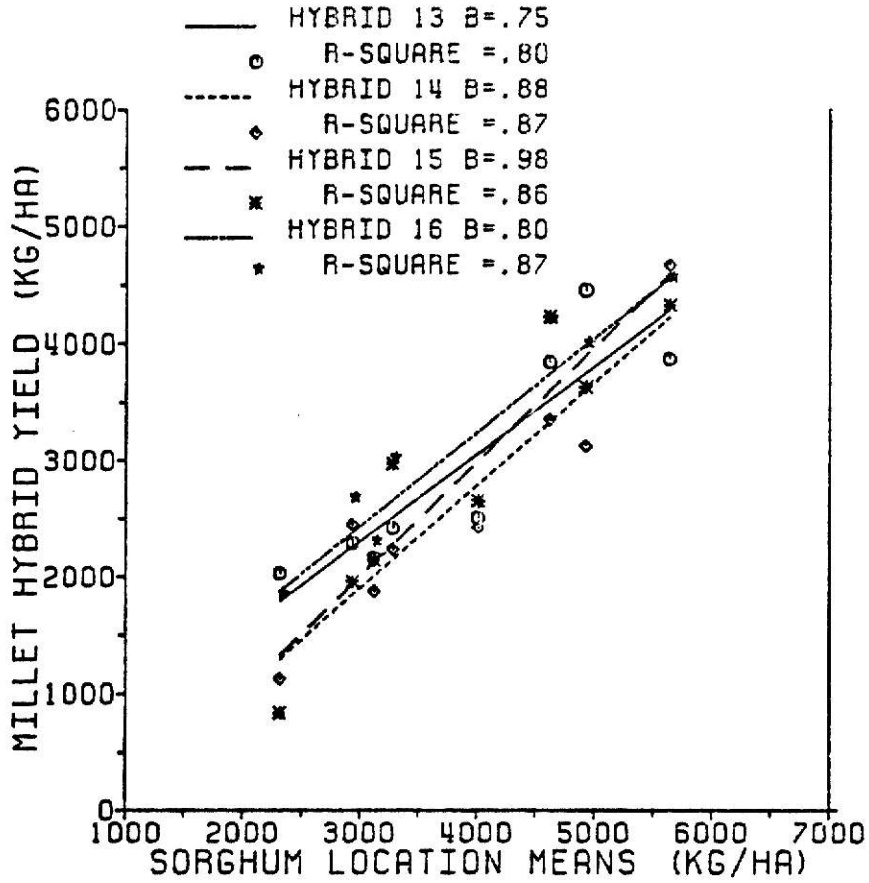

Figure 18. yield response of hybrids 13, 14, 15, and 16, 1982.

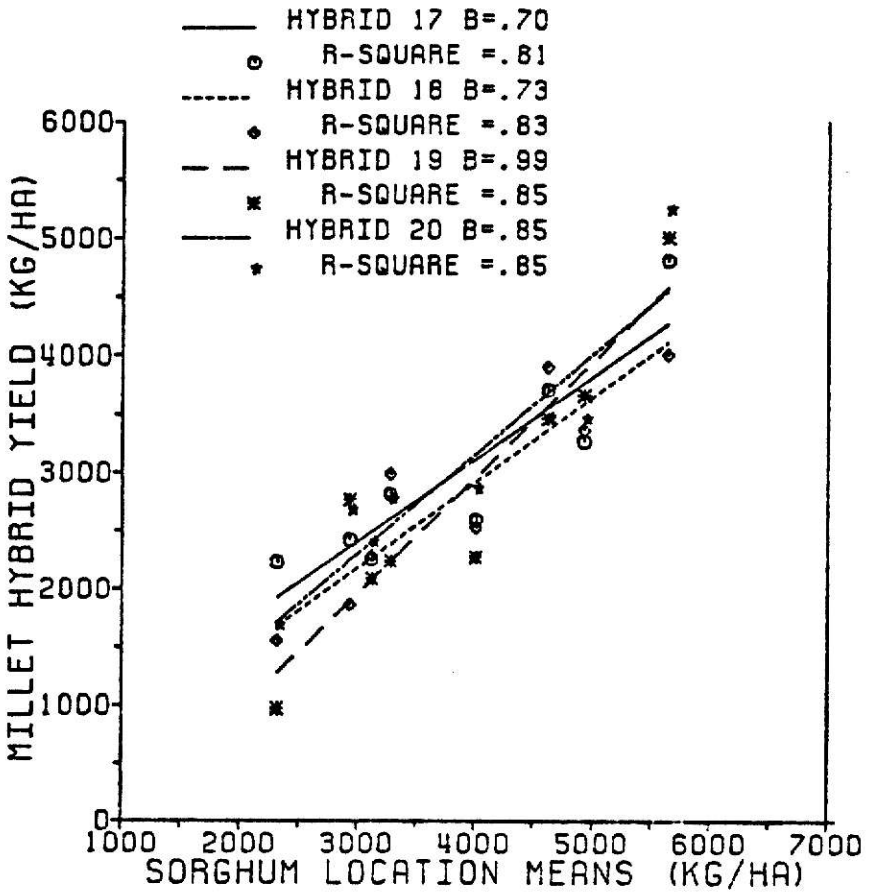

Figure 19. Yield response of hybrids 17, 18, 19, and 20, 1982

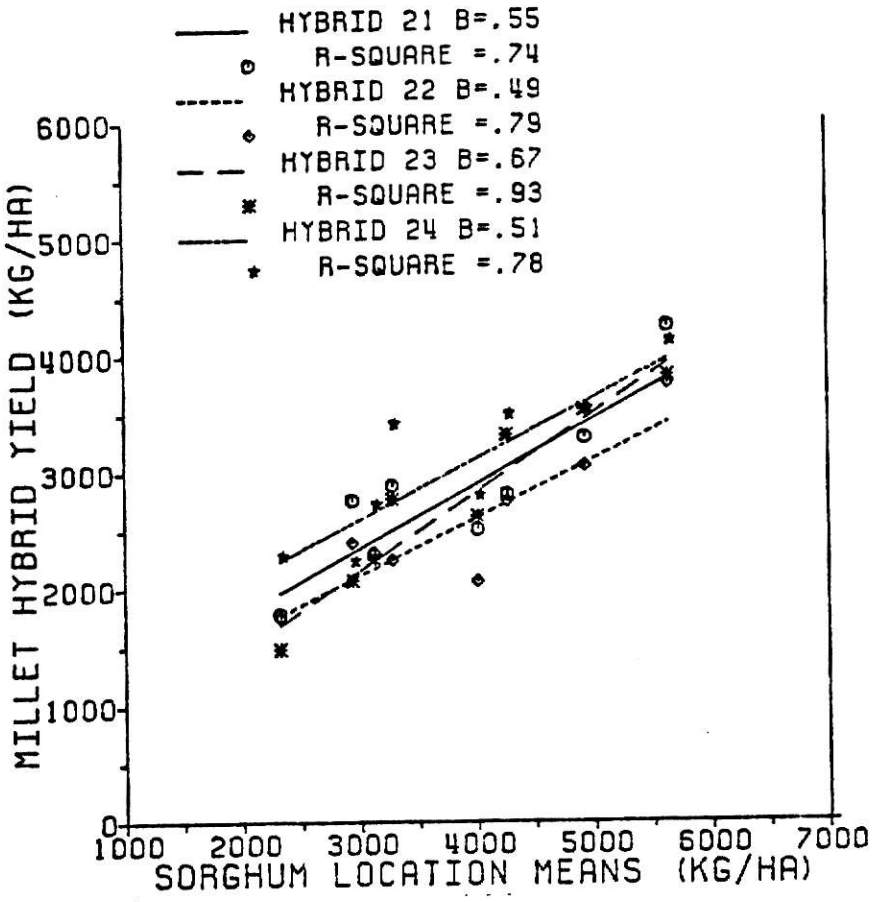

Figure 20. Yield response of hybrids 21, 22, 23, and 24, 1982.

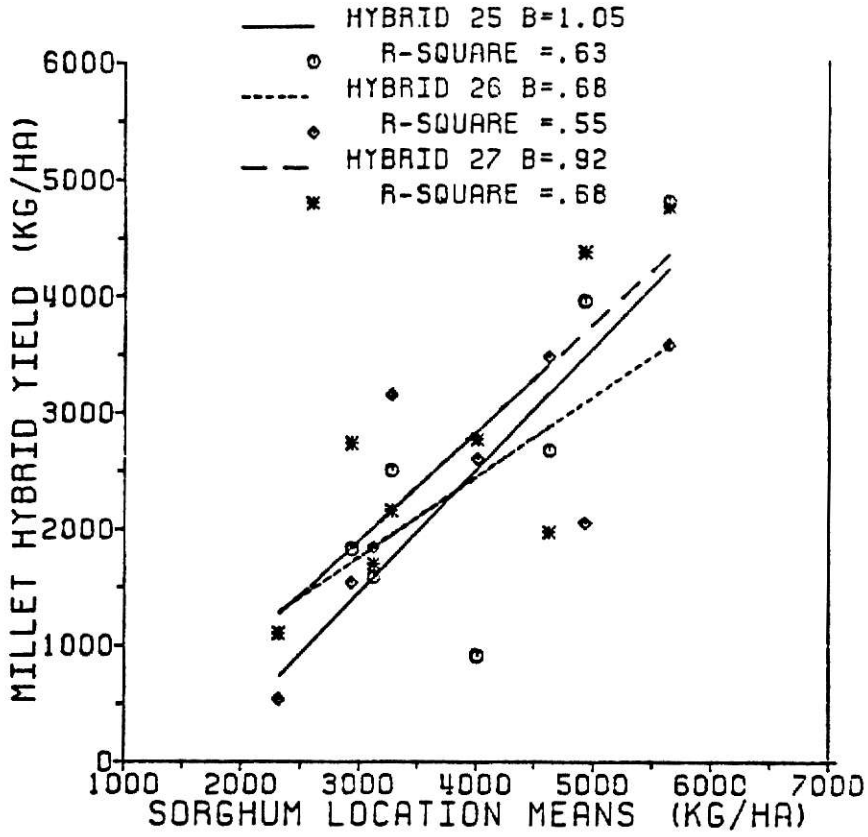

Figure 21. Yield response of hybrids 25, 26, and 27, 1982.

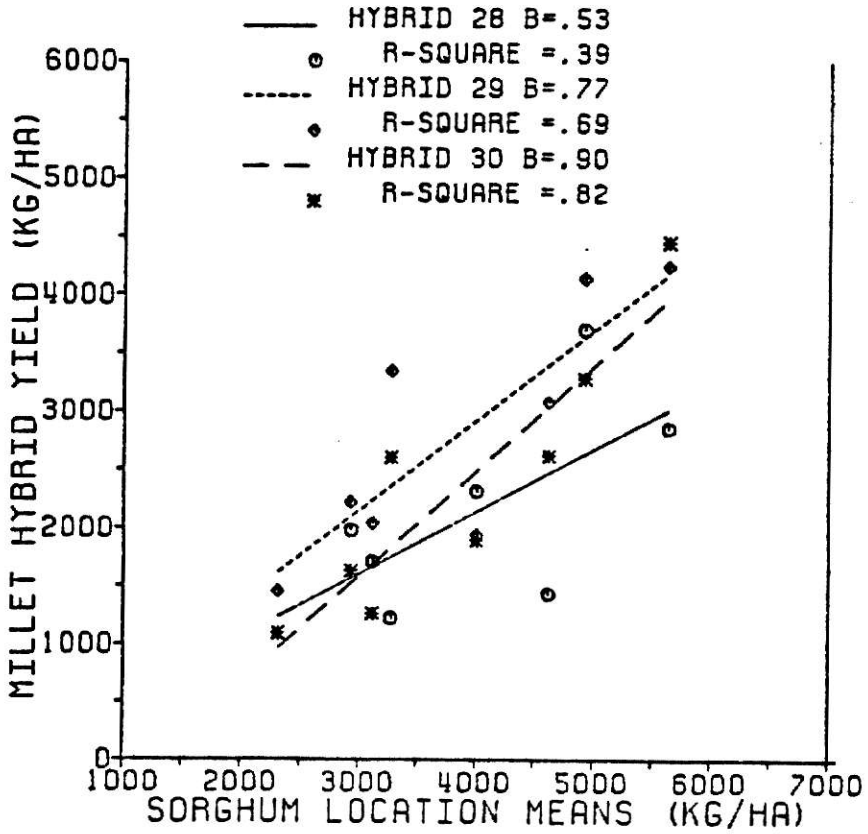

Figure 22. Yield response of hybrids 28, 29, and 30, 1982.

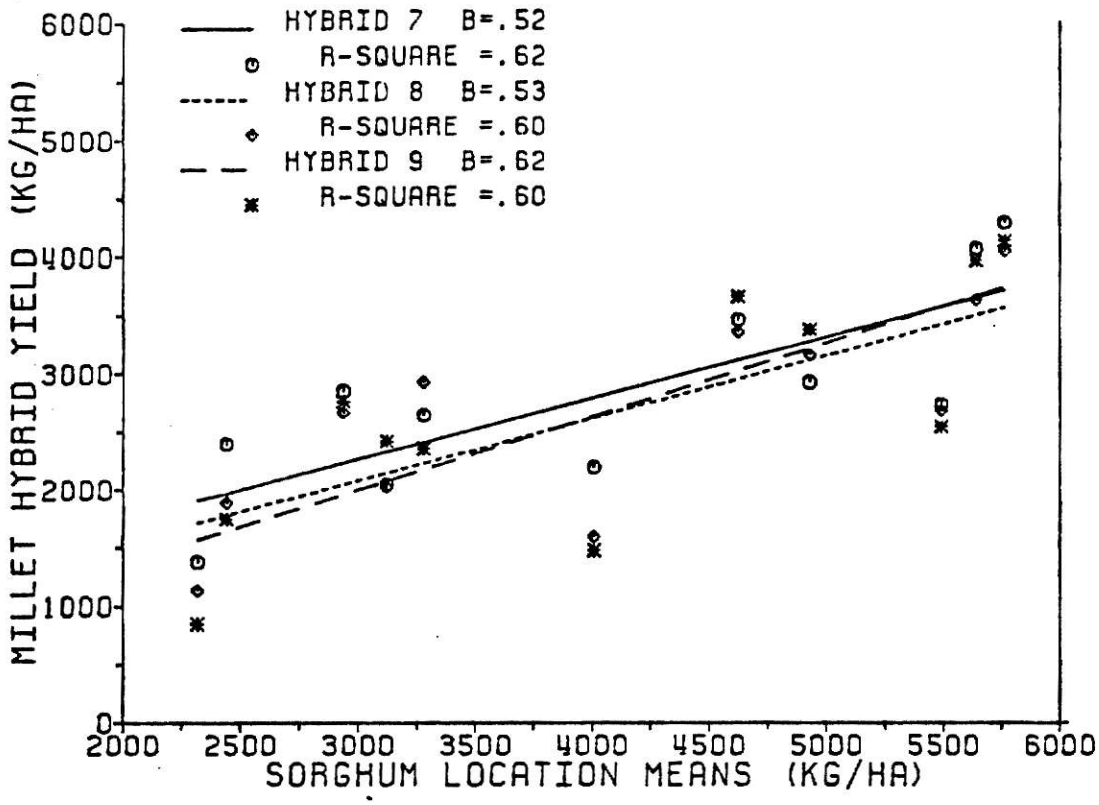

Figure 23. Yield response of hybrids 7, 8, and 9, 1981-82.

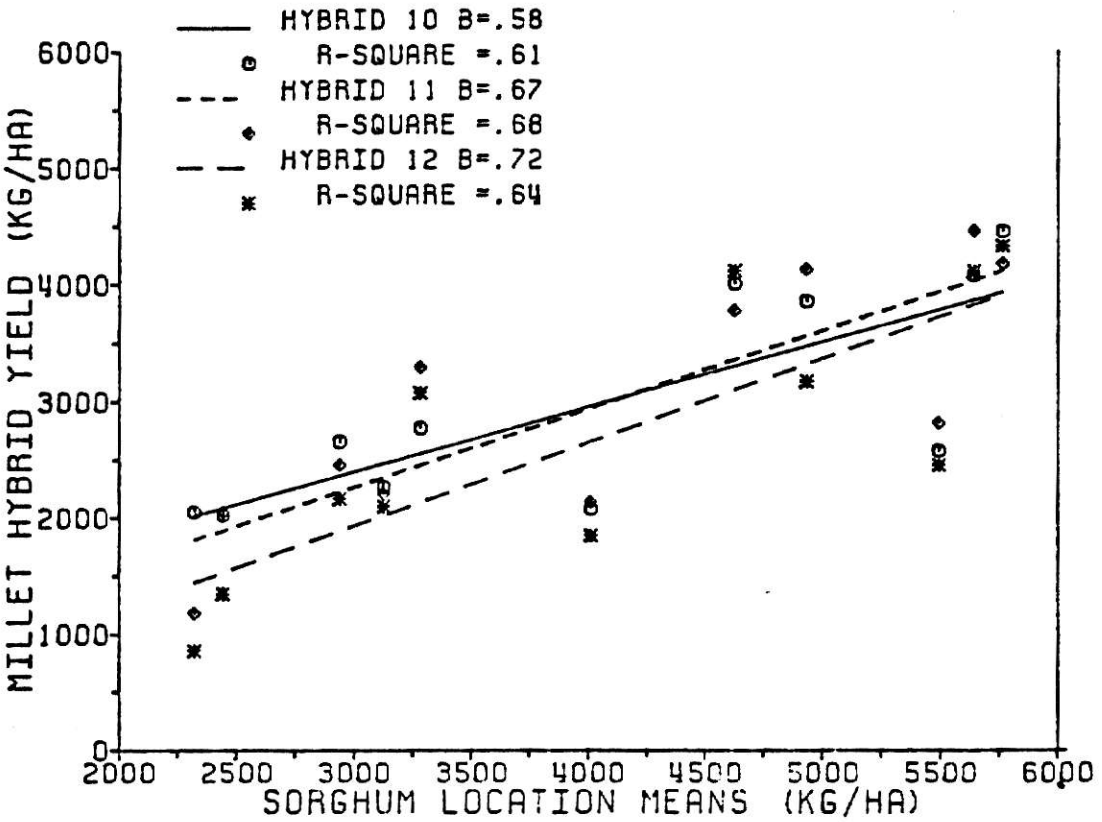

Figure 24. Yield response of hybrids 10, 11, and 12, 1981-82.

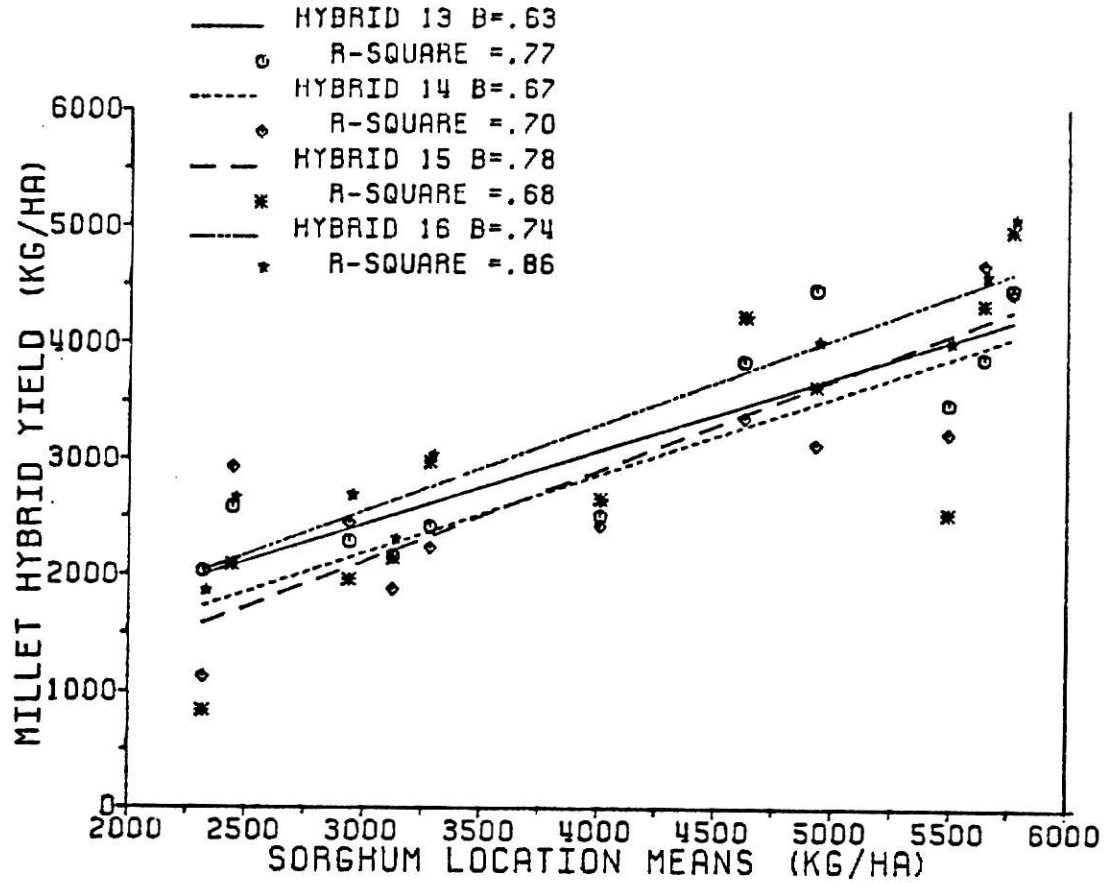

Figure 25. Yield response of hybrids 13, 14, 15, and 16, 1981-82.

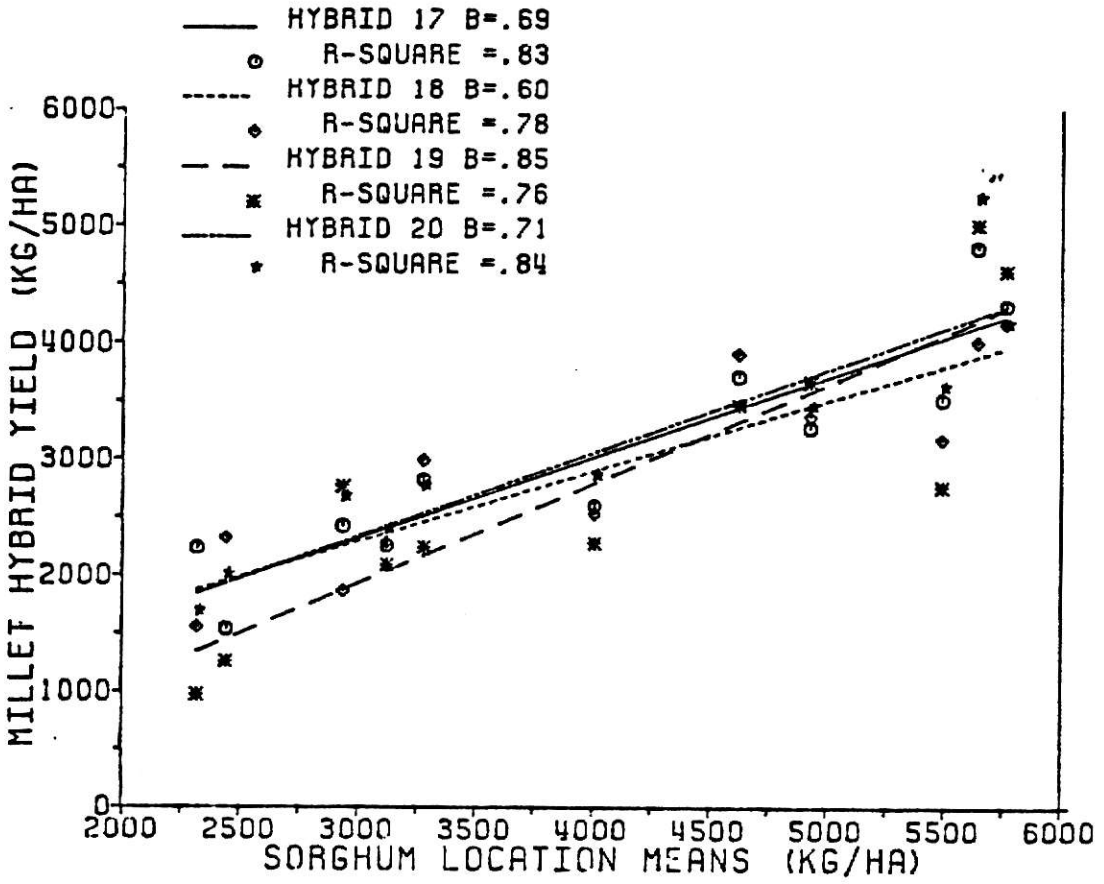

Figure 26. Yield response of hybrids 17, 18, 19, and 20, 1981-82.

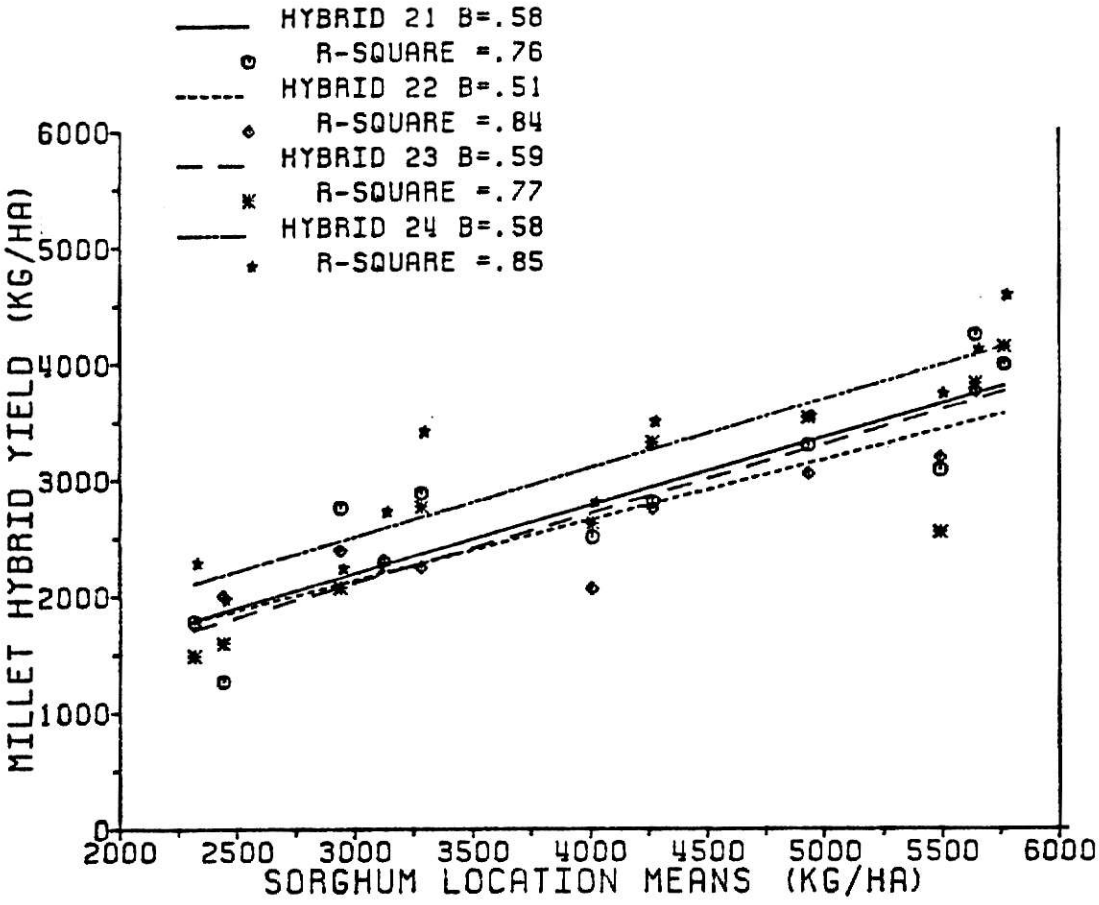

Figure 27. Yield response of hybrids 21, 22, 23, and 24, 1981-82.

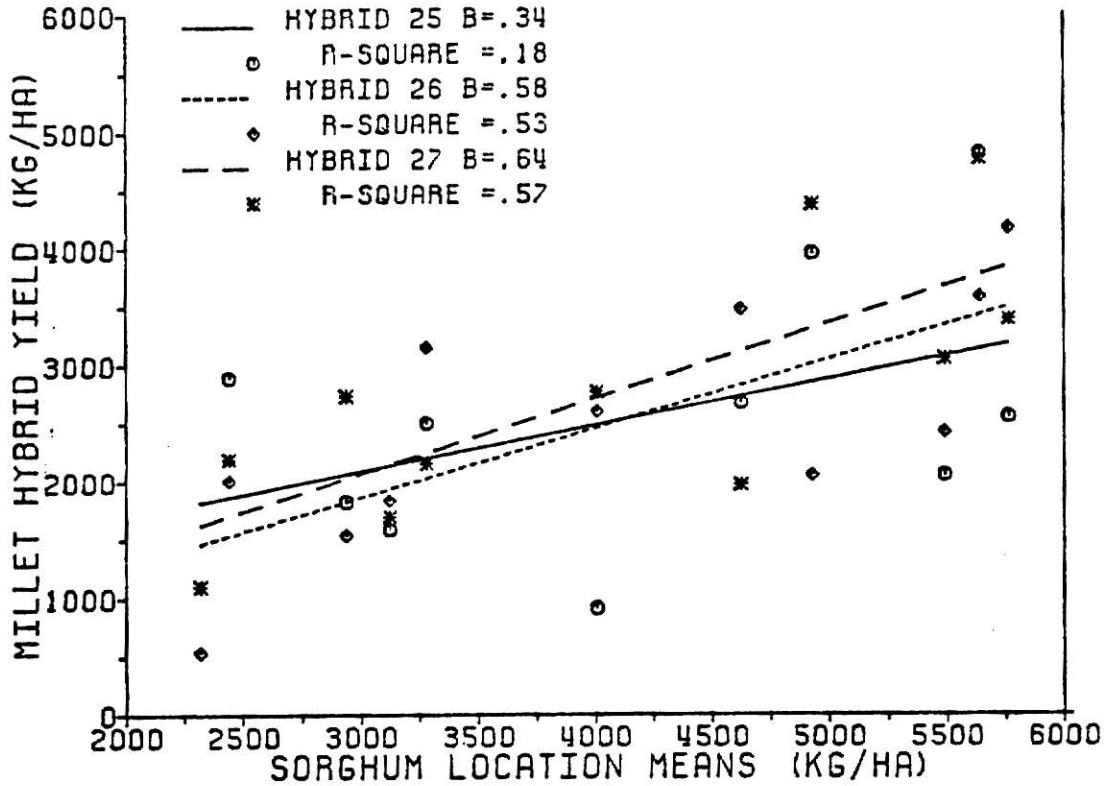

Figure 28. Yield response of hybrids 25, 26, and 27, 1981-82.

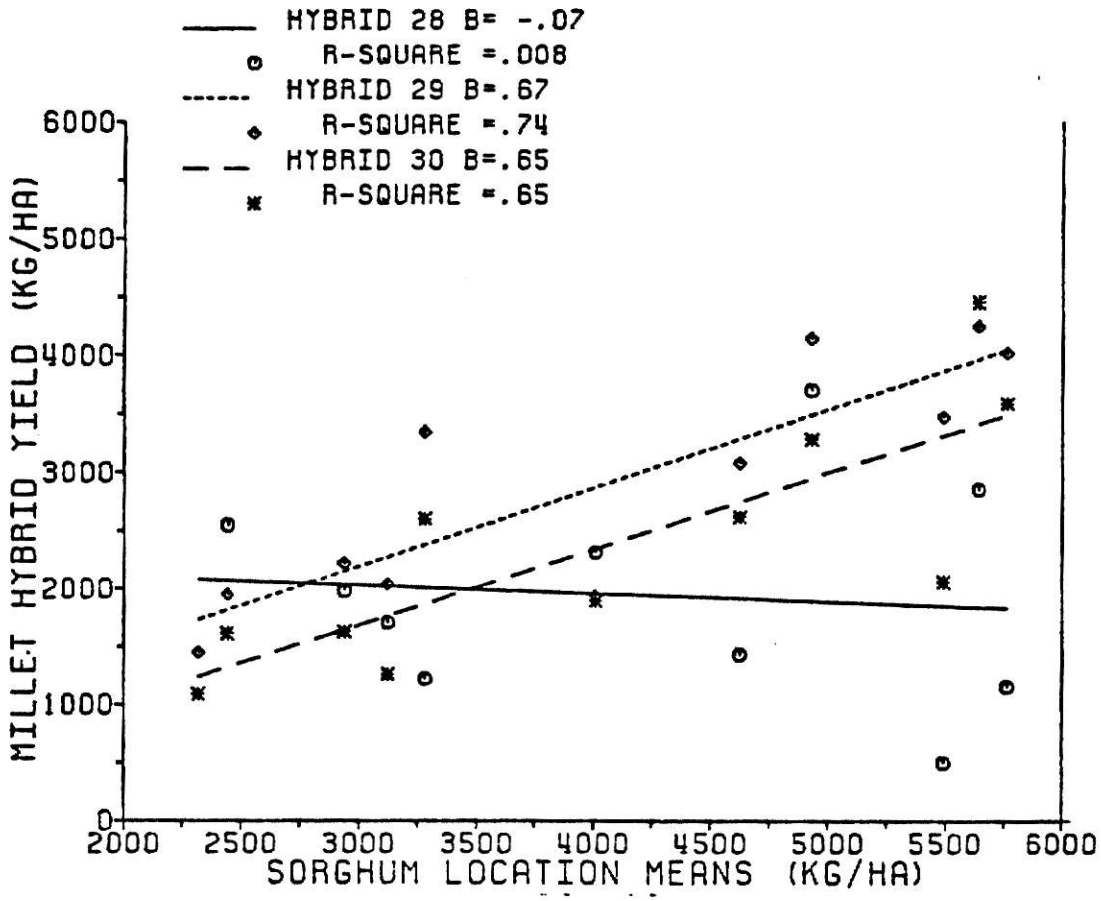

Figure 29. Yield response of hybrids 28, 29, and 30, 1981-82.

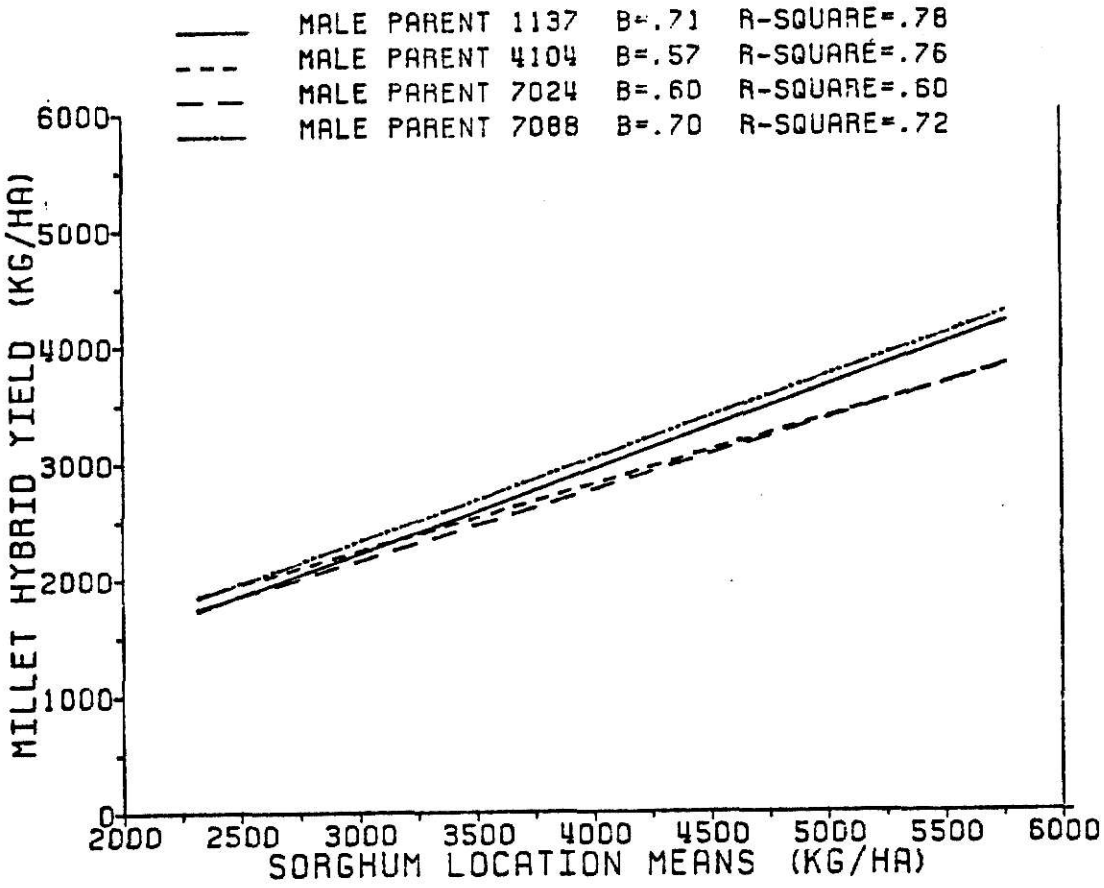

Figure 30. Yield response of Kansas male parental groups 1137, 4104, 7024, and 7088, 1981-82.

Conclusions

Millet yields averaged 65% of sorghum yields. Sorghum average yield across locations was greater than pearl millet for all three years, however, sorghum did not always out yield pearl millet at every location. Nonetheless, during hot dry growing conditions when sorghum did not out yield millet, sorghum yield was well below normal.

Sorghum had significantly larger seed weights than millet. Millet ranged between 5 g/th and 13 g/th, with the Georgia millets having the smaller seed weight. Sorghum seed weight was reduced by poor environments to a greater extent than millet.

Millet plant populations were lower than sorghum. Millet had better establishment in lighter soils than in heavier soils and smaller seeded millet had the lowest populations. Low plant populations did not tend to affect the yield due to millets profound tillering ability. However, greater head numbers did not always produce larger yields.

The biggest deterrent to millet yield was floral sterility. Millet hybrids had an across years and location average of 4.5. These low seed set ratings could be related to the critical temperature reported by Mashingaidze and Muchena (9).

Pearl millet required from 47 to 81 days to reach half-bloom. The Georgia millets required the greater number of days with Hybrid 28, which lacked the e_2 gene for photoperiod insensitivity having the longest maturity rating.

Millets response to sorghum environments can best be summarized by using Figure 31. This hypothetical graph indicates what would occur if both millet and sorghum hybrid yields were

regressed on a theoretical environmental index. This index would account for all possible factors that could affect yields.

During 1980 the overall yield of sorghum was higher than millet, however, not at every location or every hybrid at each location. Regression coefficients were not significantly different from 1.0.

During 1981 millet did not have the genetic ability to respond to the higher producing environments as did sorghum. Yields for both crops were the highest off all years and the range between the crops was the largest. With this large range at the highest environmental sites, regression coefficients were not significantly different from 0.0.

Response in 1982 was similar to 1980, however, yields were higher. Sorghum out yielded millet but, the range between the Yields was not as large as in 1981. All but seven hybrids had regression coefficients that were not significantly different from 1.0.

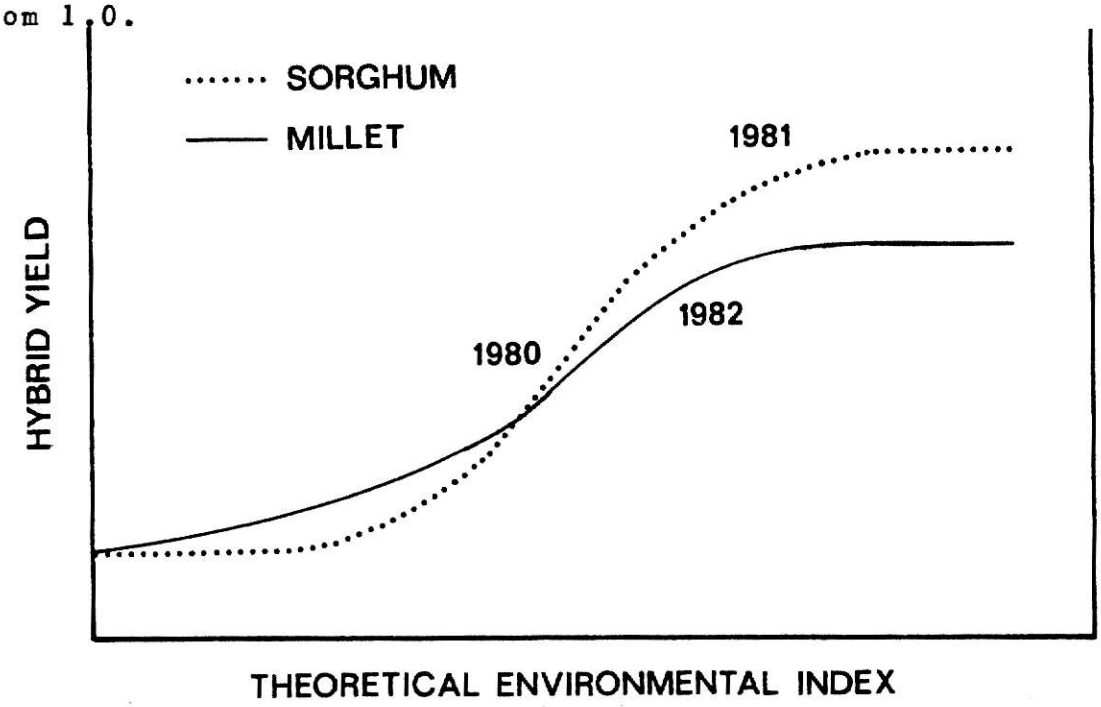

Figure 31. Response of sorghum and millet to a theoretical environmental index.

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Finally I would like to thank my parents for their perpetual encouragement, support and generosity.

APPENDIX A

Table A-1. Climatic data for Ashland Research Farm, Manhattan, 1980.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	19.3	5.05	12.2	-.83	3.50	-4.11	2.03	3
May	25.1	11.1	18.1	-.27	4.57	-6.47	1.87	16
June	32.3	19.1	25.7	2.27	7.13	-7.69	2.84	1
July	38.5	23.3	31.0	4.8	3.04	-8.07	1.77	3
August	35.8	21.7	28.8	3.0	7.46	-1.67	3.81	15
September	29.2	15.7	22.5	1.8	6.40	-3.65	2.79	1

Table A-2. Climatic data for Garden City. 1980.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	17.1	2.0	9.5	-1.9	4.72	2.43	2.05	25
May	21.3	7.8	14.6	-2.5	14.50	4.01	4.95	28
June	31.8	15.8	23.8	1.0	3.98	-4.59	2.33	20
July	37.5	19.2	28.3	2.8	1.27	-5.58	.66	26
August	3.3	17.5	25.2	.94	7.11	1.19	5.02	15
September	28.5	12.2	20.3	.94	.01	-3.96	.01	15

1/ Climatic data recorded at the Garden City Experiment Station.
2/ Departures from normal were taken from records at the Garden City Airport.

Table A-3. Climatic data for Hays 1980.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	18.6	3.3	11.0	- .61	4.16	.68	2.48	3
May	22.8	9.1	16.0	-1.1	6.04	2.87	2.64	16
June	32.3	17.2	24.8	2.05	1.95	-9.37	1.85	20
July	39.5	21.2	30.3	4.5	1.82	-6.88	.66	21
August	34.0	18.8	26.4	1.0	14.96	7.88	8.43	16
September	28.5	12.8	20.6	.66	1.90	-4.49	.53	15

Table A-4. Climatic data for Minneola 1980.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Depature from Normal	Greatest Day	Date
April	18.8	4.7	11.7	- .44	4.80	.45	2.26	24
May	23.1	10.8	17.0	- .77	9.14	1.19	3.17	27
June	32.3	19.1	25.7	2.6	9.77	1.29	4.67	19
July	38.8	22.4	30.6	4.4	5.08	-2.74	1.77	20
August	34.8	20.7	27.8	2.2	5.23	-1.47	2.10	14
September	30.5	15.6	23.0	2.5	0.2	-4.21	.02	11

1/ Climatic data records from Dodge City approximately 19 miles NE of the experiment field.

Table A-5. Climatic data for St. John[1/] 1980.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure[2/] from normal	Total	Departure from normal	Greatest Day	Date
April	19.3	5.6	12.5	-1.4	2.43	-3.37	1.65	3
May	24.8	11.0	17.9	-1.11	5.56	-3.60	2.79	16
June	33.9	18.7	26.3	+1.72	2.31	-8.50	.83	20
July	39.1	22.8	31.0	3.9	.99	-8.28	.04	31
August	35.5	21.3	28.4	2.1	9.72	3.27	3.65	15
September	30.8	15.6	23.2	1.6	0.0	-5.61	0.0	--

Table A-6. Climatic data for Tribune 1980.

Month	Temperature °C				Precipitation (cm)			
	Average Max	Average Min.	Average	Departure from normal	Total	Departure from normal	Greatest Day	Date
April	16.8	0.11	8.5	-2.0	5.91	3.03	1.49	1
May	21.4	6.38	13.9	-2.0	10.9	4.49	3.45	16
June	31.3	12.7	22.0	.55	10.2	2.66	4.54	20
July	36.9	16.7	26.8	2.1	2.15	-4.77	1.44	26
August	33.1	15.9	24.5	.83	11.81	5.25	3.75	15
September	29.2	10.4	19.8	1.0	0.81	-2.20	0.76	9

1/ Climatic data recorded at Hudson approximately 14 miles from Sandyland experiment field.
2/ Temperature departures from normal are for the South-central region.

Table A-7. Climatic Data for Ashland Research Farm, Manhattan, 1981.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	23.9	11.0	17.5	4.4	5.61	-2.00	3.02	19
May	22.7	11.0	16.9	1.5	17.93	6.88	3.25	9
June	30.2	18.6	24.5	1.0	16.61	1.7	5.05	27
July	31.2	21.5	26.3	.2	14.19	3.07	3.22	27
August	29.5	17.8	23.8	1.8	7.01	-2.13	2.43	2
September	37.2	14.5	21.1	.5	3.53	-6.52	1.39	1

Table A-8. Climatic data for Hays 1981.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	23.7	8.2	16.0	-4.3	5.38	.53	3.32	20
May	20.8	8.8	14.8	-2.3	12.72	3.81	3.42	17
June	31.2	16.8	24.0	1.2	2.94	-8.38	1.52	2
July	32.1	19.3	25.7	.11	13.18	4.47	4.36	3
August	31.0	16.9	24.0	1.3	3.17	-3.88	1.14	13
September	28.3	12.0	20.2	.22	6.50	.10	4.92	7

Table A-9. Climatic data for Minneola[1/], 1981.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	24.2	7.9	16.1	3.8	1.93	-2.56	.86	18
May	22.83	10.05	16.6	-1.3	14.55	6.60	2.31	9
June	33.0	18.5	25.8	2.6	3.53	-4.95	1.37	14
July	34.3	21.3	27.8	1.6	13.46	5.63	2.64	27
August	32.1	18.9	25.5	- .05	5.74	- .96	1.85	2
September	29.2	14.7	22.0	1.5	7.79	3.55	5.00	6

1/ Climatic data recorded at Dodge City approximately 19 miles NE of the experiment field.

Table A-10. Climatic data for St. John[1/], 1981.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure[3/] from Normal	Total	Departure from Normal	Greatest Day	Date
April	26.0	10.2	18.1	4.22	3.07	-2.74	2.03	19
May	22.5	10.3	16.4	-2.05	15.72	6.55	4.90	9
June	32.6	18.7	25.7	1.4	13.03	2.20	4.11	4
July	33.8	20.8	27.1	.77	14.47	5.20	4.92	3
August	32.2	18.3	25.2	-1.1	2.56	-3.8	.86	7
September	29.2	14.3	21.8	.33	5.00	- .60	2.03	6

1/ Climatic data recorded at Hudson approximately 14 miles NE from Sandyland experiment field.
2/ Departure from Normal (Temperature) are for that of the South-central region.

Table A-11. Climatic data for Tribune 1981.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	23.6	4.3	14.0	3.4	3.45	- .43	3.32	19
May	21.3	7.1	14.2	-1.7	9.39	2.89	3.91	28
June	33.6	14.1	23.8	2.3	1.06	-6.47	.55	29
July	33.7	17.0	25.3	.66	5.15	-1.77	1.75	27
August	31.5	14.6	23.1	- .61	1.82	-4.72	.93	13
September	29.4	10.7	20.1	1.2	6.42	3.40	5.74	4

Table A-12. Climatic data for Ashland Research Farm, Manhattan 1982.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	18.2	4.2	11.2	-1.7	3.07	-4.54	1.60	29
May	24.7	13.8	19.2	.83	20.11	9.06	3.25	6
June	26.6	15.3	21.0	-2.5	10.13	-4.69	2.26	15
July	32.7	20.8	26.7	.61	10.43	- .68	4.62	1
August	30.5	19.8	25.2	- .55	10.05	.91	4.77	5
September	26.3	14.7	20.5	- .05	8.43	1.62	3.32	17

Table A-13. Climatic data for Garden City[1/], 1982.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	18.6	1.9	10.2	- .77	2.10	- .86	1.39	30
May	23.0	9.38	16.2	.0	4.01	.10	1.57	14
June	25.6	12.6	19.1	-3.16	14.98	2.56	6.68	25
July	32.7	17.7	25.2	- .16	12.11	4.47	4.16	27
August	31.8	17.6	24.7	1.0	3.91	4.29	2.64	21
September	27.4	11.8	19.6	1.2	3.42	-2.10	1.32	12

Table A-14. Climatic data for Hays 1982.

Month	Temperature °C				Precipitation (cm)			
	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	16.2	3.1	10.7	.88	3.25	-1.60	1.87	28
May	23.1	11.3	17.2	.11	10.51	1.60	3.45	25
June	25.3	13.5	19.5	-3.27	6.04	-5.29	1.90	11
July	33.3	18.5	25.9	.05	11.17	2.46	3.30	28
August	32.2	18.3	25.3	- .05	1.87	-5.18	.53	23
September	27.8	12.5	20.2	.22	1.72	-4.67	.93	13

1/ Climatic data recorded at the Garden City experiment station. The departures from normal are from records at the Garden City airport.

Table A-15. Climatic data for Hutchinson 1982.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure[1/] from Normal	Total	Departure[1/] from Normal	Greatest Day	Date
April	18.8	4.7	11.8	-1.38	.60	1.39	.43	28
May	24.0	12.3	18.2	- .38	17.67	8.99	3.63	12
June	27.2	15.0	21.1	-3.11	12.52	2.74	4.26	11
July	34.0	19.8	27.0	- .05	9.16	- .96	3.04	28
August	34.7	20.0	27.3	1.0	5.41	-4.85	2.92	30
September	28.6	14.3	21.5	.33	5.18	-3.70	4.80	14

Table A-16. Climatic data for Minneola[1/], 1982.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	18.9	3.6	11.3	- .88	1.6	-2.66	1.04	30
May	24.1	12.1	18.1	.38	6.95	- .99	1.75	11
June	26.8	15.1	21.0	-2.1	9.27	.78	2.1	14
July	33.6	20.5	27.1	.83	13.84	6.24	5.30	9
August	33.7	20.8	27.2	1.6	2.56	-4.14	1.67	4
September	29.1	15.4	22.2	1.77	3.32	- .91	2.05	5

1/ Departures from normal are for the South-central region.

Table A-17. Climatic data for St. John[1/], 1982.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure[2/] from Normal	Total	Departure from Normal	Greatest Day	Date
April	19.0	4.5	11.7	-1.66	.99	-4.82	.81	28
May	26.1	12.0	18.2	- .38	15.59	6.42	4.31	12
June	27.4	14.8	21.1	-3.1	10.49	- .33	3.12	11
July	33.7	20.2	27.0	- .05	11.93	2.66	3.65	19
August	34.5	19.7	27.1	1.0	4.90	-1.54	1.21	30
September	28.7	15.1	21.9	.33	3.70	-1.90	1.87	14

Table A-18. Climatic data for Tribune, 1982.

	Temperature °C				Precipitation (cm)			
Month	Average Max.	Average Min.	Average	Departure from Normal	Total	Departure from Normal	Greatest Day	Date
April	20.0	- 0.16	9.9	-.61	1.24	-2.64	.53	16
May	24.4	7.0	15.7	-.16	5.20	-1.29	1.27	13
June	27.3	11.16	19.2	-2.2	9.01	1.47	1.95	26
July	33.6	15.7	24.6	-.05	13.20	6.27	9.47	27
August	33.0	16.3	34.7	1.0	3.42	-3.12	3.35	5
September	28.0	10.5	19.2	.38	4.39	1.37	2.28	13

1/ Climatic data records from Hudson approximately 14 miles NE from Sandyland experiment field.
2/ Departures from Normal (temperatures) are for the South-central region.

APPENDIX B

Table B-1. 1980 Significant correlation coefficients for Pearl Millet.

Location	Variables	r	N
Ashland			
	Plants/ha vs Heads/plant	-.69**	86
	Heads/ha vs Heads/plant	.58**	86
	Heads/ha vs Yield	.31**	86
	Heads/plant vs Seed weight	-.57**	86
	Seeds/head vs Yield	.80**	86
Garden City			
	Heads/ha vs Yield	.40**	81
	Seed weight vs Yield	.44**	81
	Seed/head vs Yield	.60**	81
Hays			
	Heads/a vs Yield	.54**	104
	Seed/head vs Yield	.76**	104
Minneola			
	Heads/ha vs Yield	.43**	81
	Seed weight vs Yield	.42**	81
	Seed/head vs Yield	.61**	81
St. John			
	Heads/plant vs Plants/ha	-.56**	87
	Heads/plant vs Heads/ha	.44**	87
	Heads/plant vs Yield	.47**	87
	Heads/plant vs Seed weight	-.32**	87
	Heads/ha vs Yield	.61**	87
	Heads/ha vs Seed/head	-.48**	86
	Yield vs Bloom date	-.31**	87
	Yield vs Seeds/head	.23**	86
	Seeds weight vs Seed/head	-.51**	86
Tribune			
	Heads/ha vs Yield	.55**	81
	Heads/ha vs Seed/head	-.41**	81
	Yield vs Seed/head	.33**	81

* Significant at the .01% level.
**Significant at the .05% level.

Table B-2. 1981 significant correlations coefficients for pearl millet.

Location	Variables	r	N
Ashland Dryland			
	Heads/ha vs Yield	-.23**	71
	Heads/ha vs Seed weight	.98*	71
	Heads/ha vs Seeds/head	.98*	71
	Yield vs Seed weight	-.30**	71
	Yield vs Seed/head	-.30**	71
	Seed weight vs Seed/head	.99**	71
Ashland Irrigated	Heads/ha vs Yield	.52**	72
	Heads/ha vs Seed/head	-.39**	72
Hays			
	Bloom date vs Yield	-.52**	96
	Heads/ha vs Seed/head	-.61**	96
	Yield vs Seed weight	.55**	96
	Yield vs Seed/head	.51**	96
Minneola			
	Bloom date vs Yield	.26*	68
	Plants/ha vs Head/plant	-.64**	70
	Plants/ha vs Yield	.30**	70
	Plants/ha vs Seed weight	.42**	70
	Heads/ha vs Heads/plant	.58**	70
	Heads/ha vs Seeds/head	-.45**	70
	Heads/plant vs Seed weight	-.46**	70
	Yield vs Seed weight	.37**	70
	Yield vs Seed/head	.44**	70
St. John			
	Plants/ha vs Heads/plant	-.40**	70
	Plants/ha vs Yield	.28*	70
	Heads/ha vs Heads/plant	.36**	70
	Heads/ha vs Yield	.61**	70
	Yield vs Seed/head	.39**	70
	Seed weight vs Seed/head	-.48	70
Tribune			
	Heads/ha vs Yield	.46**	69
	Heads/ha vs Seed weight	-.27*	69
	Yield vs Seed/head	.51**	69

* Significant at the .05% level.
**Significant at the .01% level.

Table B-3. 1982 significant correlations coefficients for pearl millet.

Location	Variables	r	N
Ashland Dryland			
	Plant/ha vs Head/plant	-.72**	72
	Plant/ha vs Yield	.29**	72
	Head/ha vs Yield	.32**	72
	Head/ha vs Seed weight	-.40**	71
	Seed weight vs Seed/head	-.25*	71
Ashland Irrigated			
	Plant/ha vs Head/plant	-.52**	72
	Heads/ha vs Heads/plant	.82**	72
	Heads/ha vs Yield	.52**	72
	Heads/ha vs Seed weight	-.40**	72
	Heads/ha vs Seed/head	-.37**	72
	Heads/plant vs Yield	.50**	72
	Heads/plant vs Seed weight	-.33**	72
	Heads/plant vs Seed/head	-.24*	72
	Yield vs Seed/head	.24*	72
	Seed weight vs Seed/head	-.28**	72
Garden City			
	Plant/ha vs Head/plant	-.68**	69
	Heads/ha vs Head/plant	.38**	69
	Heads/ha vs Seed/head	-.44**	72
	Heads/plant vs Seed weight	-.53**	69
	Yield vs Seed weight	.23**	72
Hays			
	Bloom date vs Yield	-.54**	96
	Heads/ha vs Seed weight	-.39**	96
	Heads/ha vs Seed/head	-.50**	96
	Yield vs Seed weight	.53**	96
	Yield vs Seed/head	.65**	96
Hutchinson			
	Plant/ha vs Head/plant	-.65**	72
	Heads/ha vs Head/plant	.58**	72
	Heads/ha vs Seed/head	-.58**	72
	Heads/plant vs Seed weight	-.27**	72
	Heads/plant vs Seed/head	-.29*	72
	Yield vs Seed weight	.44**	72
	Yield vs Seed/head	.49**	72
	Seed weight vs Seed/head	-.23*	72
Minneola			
	Bloom date vs Yield	-.35**	70
	Plant/ha vs Head/plant	-.68**	72
	Heads/ha vs Head/plant	.35**	72
	Heads/ha vs Yield	.52**	72
	Heads/ha vs Seed/head	-.26*	72
	Yield vs Seed weight	.45**	72
	Seed weight vs Seed/head	-.51**	72

(continued)

Table B-3. (continued).

Location	Variables	r	N
St. John	Plants/ha vs Heads/plant	-.71**	72
	Plants/ha vs Yield	.39**	72
	Yield vs Head/ha	.27*	72
	Seed/head vs Head/ha	-.39**	72
	Head/plant vs Yield	-.36**	72
	Head/plant vs Seed weight	-.38**	72
	Head/plant vs Seed/head	-.29**	72
	Yield vs Seed/head	.59**	72
Tribune			
	Yield vs Head/ha	.48**	61
	Seed wt vs Head/ha	-.35**	61
	Head/ha vs Seed/head	-.25*	61
	Yield vs Seed/head	.51**	61

* Significant at the .05% level.
**Significant at the .01% level.

APPENDIX C

Table C-1. Analysis of variance for yield and yield components, 1980. Mean Squares.

Location	Source	df	Yield (kg/ha)	Days to half-bloom	Dependent Variables: Plants/ha (th)	Heads/ha (th)	Heads/plant	Seed weight (g/th)	Seeds/ head
Ashland	Rep	2	50218	1.7743	870.9732	2181.7523	0.5139	0.9367	112926
	Hybrid	31	990080	39.8780**	2739.1084**	5588.3945**	5.2760**	8.2072**	259331*
	Error	61	635167	1.5921	285.7255	1423.8626	0.7266	1.2460	120942
Garden City	Rep	2	2902397**	-----	-----	5447.5029*	-----	16.5443**	959194**
	Hybrid	29	378768**	-----	-----	1244.1854	-----	15.5169**	283444**
	Error	58	116981	-----	-----	1775.7656	-----	1.9561	127151
Hays	Rep	3	11386071**	-----	-----	1848.3539	-----	3.3028**	188132*
	Hybrid	29	920111**	-----	-----	5894.7255**	-----	77.462**	184401**
	Error	82	361670	-----	-----	1174.2781	-----	0.4221	64930
Minneola	Rep	2	3996469**	5.5445	-----	4179.7266**	-----	2.5723	325057**
	Hybrid	29	811341**	4441.6077**	-----	1940.9578**	-----	20.9120**	196473**
	Error	58	221755	4.4639	-----	915.5916	-----	1.3569	56169
St. John	Rep	2	1642463**	69.3562**	831.0940	116085**	7.9131*	2.4908	7324588
	Hybrid	31	198817	335.1697**	2135.69**	29834**	7.3416**	23.0165**	84455**
	Error	62	140995	5.0810	459.0157	9329	1.7779	1.0172	16182[1/]
Tribune	Rep	2	1464752	-----	-----	17885*	-----	2.8128**	168436
	Hybrid	29	2504640**	-----	-----	28523**	-----	26.5874**	349028**
	Error	58	876654	-----	-----	4865	-----	0.5497	103632[2/]

** Significant at the 1% level.
* Significant at the 5% level.

1/ Degrees of freedom for seeds/head
Rep = 2
Hybrid = 31
Error = 61

2/ Degrees of freedom for seeds/head
Rep = 2
Hybrid = 27
Error = 54

Table C-2. Analysis of variance for yield, plants/ha, heads/ha, and heads/plant 1981 Mean squares.

Location	Source	df	Dependent Variables: Yield (kg/ha)	Plants/ha (th.)	Heads/ha (th.)	Heads/plant
Ashland Dryland	Rep	2	38409	-------	38111	-------
	Hybrid	29	11702758**	-------	52090**	-------
	Error	58	1016500	-------	12872	-------
Ashland Irrigated	Rep	2	66161	-------	16619	-------
	Hybrid	29	13608567**	-------	25542**	-------
	Error	58	1638096	-------	12248	-------
Hays	Rep	3	341198	-------	638.243	-------
	Hybrid	29	4494301**	-------	26727.549**	-------
	Error	87	403072	-------	2320.931	-------
Minneola	Rep	2	984160	3051.9223**	7467.9850*	3.2678[1/]
	Hybrid	29	4950775**	672.1664	7358.6058**	9.1766**
	Error	58	315440	461.8772	2272.1992	2.5504
St. John	Rep	2	8889702**	2017.8425**	18913.0866**	72.1805
	Hybrid	29	792673	3010.4816**	6318.8092*	106.4038**
	Error	56	577697	324.2784	3671.4070	34.9784[2/]
Tribune	Rep	2	942998	-------	4242.621	-------
	Hybrid	28	14563156**	-------	12235.06**	-------
	Error	56	487449	-------	2587.102	-------

1/ Degrees of freedom for Minneola heads/plant are Rep = 2; Hybrid = 29; Error = 57.
2/ Degrees of freedom for St. John heads/plant are Rep = 2; Hybrid = 29; Error = 57.
* Significant at the .01% level.
**Significant at the .05% level.

Table C-3. Analysis of variance for days to half-bloom, seed weight, seeds/head and seed set, 1981 Mean squares.

Location	Source	df	Dependent Variables: Days to half-bloom	Seed weight (g/th.)	Seeds/ head	Seed set df	Seed set Mean squares
Ashland Dryland	Rep	2	10.0533[1/]**	1.2980	199771	1	0.0208
	Hybrid	29	35.6172**	134.6699**	1040267**	23	3.8614**
	Error	58	1.7445	2.3925	81302	23	0.8903
Ashland Irrigated	Rep	2	4.4777	3.036*	7132337	2	3.1805
	Hybrid	29	26.5042**	134.1119**	2436476	23	5.1570**
	Error	58	2.9260	.7394	2505529	46	2.0935
Hays	Rep	3	0.2973	3.9672	89412	3	.0659
	Hybrid	29	129.149**	1496.024**	1272464**	23	1.1711**
	Error	87	1.6133	2.8314	192911	69	.3698
Minneola	Rep	2	2.7701[2/]	6.7737*	209244	3	4.9631
	Hybrid	29	25.7383**	76.4275**	829216**	23	5.1751
	Error	58	1.6986	1.9779	186594	35	1.2645
St. John	Rep	2	1.8485[3/]	.0347	409420**	2	2.3888
	Hybrid	29	1.9767**	96.5323**	575523**	23	4.5791**
	Error	58	.6267	1.6992	80249	46	2.0555
Tribune	Rep	2	--	0.1118	67810.66	2	10.4659**
	Hybrid	28	--	126.115**	1004070**	23	3.3487**
	Error	56	--	0.5264	68882	44	1.4260

**Significant at the .01% level.
*Significant at the .05% level.
1/Degrees of freedom for Ashland Dryland, Days to half-bloom are Rep = 2; Hybrid = 27; Error = 50.
2/Degrees of freedom for Minneola, Days to half-bloom are Rep = 2; Hybrid = 29; Error = 56.
3/Degrees of freedom for St. John, Days to half-bloom are Rep = 2; Hybrid = 29; Error = 56.

Table C-4. Analysis of variance for yield, plants/ha, heads/ha, and heads/plant 1982 Mean squares.

Location	Source	df	Dependent Variables: Yield (kg/ha)	Plants/ha (th.)	Heads/ha (th.)	Heads/plant
Ashland Dryland	Rep	2	751199	5207.3600	6918.6978	7.3737
	Hybrid	29	1735955**	3934.1428	14278	8.2900
	Error	58	445744	941.6113	1937.4390	1.9271
Ashland Irrigated	Rep	2	1421933	999.8728	6909.8346	0.6360
	Hybrid	29	1743190**	2353.6858**	31874**	1.8629**
	Error	58	569679	551.9376	4824.4163	0.2323
Garden City	Rep	2	1143306	71.7869	1954.0694[1/]	1.4913**
	Hybrid	29	1124033*	4652.9360**	5297.1629**	1.4707
	Error	58	628363	505.8835	1954.0283	11.2089
Hays	Rep	3	1414970*	----------	4086.1931**	-------
	Hybrid	29	2668882**	----------	10389**	-------
	Error	87	398574	----------	652.2493	-------
Hutchinson	Rep	2	720387*	1290.0739*	106.1261	0.1515
	Hybrid	29	1085459**	2222.9995**	2283.2204**	0.2502**
	Error	58	166854	368.8148	566.9316	.6508
Minneola	Rep	2	1285823*	273.6727	720.2431	10.8227
	Hybrid	29	752889**	6920.3031**	3815.3995**	54.3292
	Error	58	287145	436.9791	656.4613	12.0697
St. John	Rep	2	431406	2070.8047**	1101.2765	8.2597*
	Hybrid	29	2260617**	3061.9496**	4617.4637**	12.8114**
	Error	58	168611	344.5235	932.4023	2.4565
Tribune	Rep	2	1134435*	----------	181.5335	--------
	Hybrid	27	1072865**	----------	3139.9559	--------
	Error	49	315203	----------	1615.5598	--------

* Significant at the .05% level.
**Significant at the .01% level.

[1/] Degrees of freedom for Garden City, heads/plant are Rep = 2; Hybrid = 28; Error = 56.

Table C-5. Analysis of variance for days to half-bloom, seed weight, seeds/head and seed set 1982 Mean squares.

			Dependent Variables				
Location	Source	df	Days to half-bloom	Seed weight (g/th.)	Seeds/ head	df	Mean squares
Ashland	Rep	2	28.9411*[1/]	11.6087*	639970	2	11.7951**
Dryland	Hybrid	29	44.5589**	57.5736**	807679	23	1.1121**
	Error	58	8.3058	2.76165	830302	46	0.3893
Ashland	Rep	2	1.5693	0.09244	8429	2	4.2534**
Irrigated	Hybrid	29	84.0130**	52.6001**	20055**	23	0.9704**
	Error	58	1.2220	0.4919	71936	46	0.2353
Garden City	Rep	2	-------	1.1141	65025	2	.64513
	Hybrid	29	-------	63.8212**	365068**	23	.5772*
	Error	58	-------	1.8842	132438	46	0.2878*
Hays	Rep	3	3.1194	4.4380*	220705	3	0.1944
	Hybrid	29	133.5945**	85.8216**	665528**	23	1.3623**
	Error	87	2.0734**	1.2568	89995	69	0.3393
Hutchinson	Rep	2	16.3000*	4.7323*	55242	2	2.5312**
	Hybrid	29	133.9620**	62.3663**	181770**	23	1.9587**
	Error	58	5.0241	1.2199	55139	46	.4696
Minneola	Rep	2	23.6633**	2.9151	60872	2	4.4201**
	Hybrid	29	80.2958**	24.6798**	156641**	23	1.8730**
	Error	58	1.9495	1.2985	61290	46	0.5541
St. John	Rep	2	-------	1.5963	19971	2	2.6167*
	Hybrid	29	-------	52.6592**	298461**	23	4.2149**
	Error	58	-------	0.9734	52376	46	.6398
Tribune	Rep	2	-------	.5126	408434	2	.3535
	Hybrid	27	-------	8.7048**	545707**	21	2.0207**
	Error	49	-------	0.6992	248906	37	0.5462

[1/] Degrees of freedom for Manhattan Ashland Dryland, Days to half-bloom are Rep = 2; Hybrid = 27; Error = 56.
* Significant at the .01% level.
**Significant at the .05% level.

RESPONSE OF PEARL MILLET TO KANSAS GRAIN SORGHUM ENVIRONMENTS

by

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AN ABSTRACT OF A MASTER'S THESIS

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Pearl millet (*Pennisetum americanum* (L.) Leeke) being tall and vigorous with exceptional grain and fodder yielding potential is considered more efficient in its utilization of moisture and appears to have a higher level of heat tolerance than does sorghum. Breeding programs have been established in Kansas to develop hybrids adapted for grain production in the semi-arid regions of the central great plains of the United States. The objective of this study was to evaluate the response of pearl millet hybrids in grain sorghum environments of Kansas.

Twenty environmental locations were used in 1980, 1981, and 1982. In 1980 28 pearl millet hybrids were compared to 3 commercial grain sorghum hybrids, 23 of these hybrids were developed at the Fort Hays Experiment Station, and 5 developed at Tifton, Georgia. In 1981 and 1982, 24 pearl millet hybrids were compared to 6 grain sorghum hybrids. Eighteen millet hybrids were developed in Kansas and 6 in Georgia. At each location the experimental design was a randomized complete block, replicated three times.

To measure the response of millet in the sorghum environments a linear regression analysis was used. Millet hybrid means were regressed on the sorghum location means. The slopes of the regression lines and hybrid mean yields were used as parameters for comparison.

Grain sorghum, based on across location and hybrid means, out yielded millet every year. However, sorghum did not out yield millet at every location. When their yields were not significantly different sorghum yields were well below normal. Millet yields ranged from 350 kg/ha to 5400 kg/ha, grain sorghum