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Yield and yield component comparisons were made using 24 millet hybrids and six grain sorghum hybrids at seven Kansas locations, from 1980 to 1982. To compare pearl millet production in grain sorghum environments, millet hybrid mean yields were regressed on sorghum location means. A desirable millet hybrid would have a high yield and a regression coefficient not significantly different from 1.0.

Average grain sorghum yields were greater than millet yields in all three years. Millet hybrid yields ranged from 350 to 5400 kg ha^{-1}. Over all locations and years, millet yield averaged 63% of sorghum yield.

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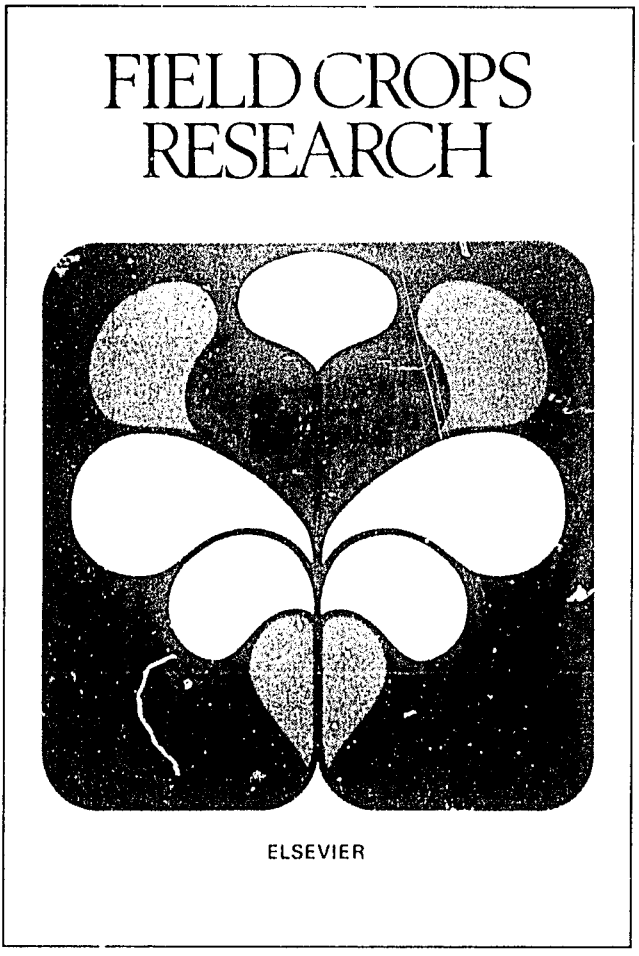

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Response of Pearl Millet to Grain Sorghum Environments

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ABSTRACT

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Increasing awareness of drought tolerance in pearl millet [*Pennisetum americanum* (L.) Leeke.] has stimulated research into pearl millet as a potential U.S. crop. Objectives of this study were to compare yield and yield components of pearl millet and grain sorghum [*Sorghum bicolor* (L.) Moench] and evaluate pearl millet response to a range of grain sorghum environments.

Yield and yield component comparisons were made using 24 millet hybrids and six grain sorghum hybrids at seven Kansas locations, from 1980 to 1982 To compare pearl millet production in grain sorghum environments, millet hybrid mean yields were regressed on sorghum location means. A desirable millet hybrid would have a high yield and a regression coefficient not significantly different from 1.0.

Average grain sorghum yields were greater than millet yields in all three years. Millet hybrid yields ranged from 350 to 5400 kg ha^{-1}. Over all locations and years, millet yield averaged 63% of sorghum yield.

In unfavorable environments, pearl millet yield and response to changing environments were not significantly different from those of grain sorghum. As environmental conditions improved, sorghum significantly yielded more than millet. Lower millet yields could be attributed to significantly smaller seed size and head sterility. The small seed also reduced plant establishment; however, millet's tillering ability compensated for reduced population.

INTRODUCTION

Pearl millet [*Pennisetum americanum* (L.) Leeke] is a robust, annual, bunchgrass grown on more than 20 million ha, mainly in the semiarid tropics (Burton, 1980). It is particularly well adapted to nutrient-poor, sandy soils and low rainfall.

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In the United States, pearl millet has been used mainly as a forage crop. The major forage breeding and research has been conducted at the Coastal Plain Experiment Station, Tifton, Georgia (Poehlman, 1979). Research and breeding programs for pearl millet as a grain crop began in 1969 at Kansas State University, Manhattan, and in 1971 at the Fort Hays Branch Experiment Station, Hays, Kansas. The work has progressed through initial screening of over 2300 lines and varieties (obtained from the Southern Regional Plant Introduction Station, the World Collection, the ICRISAT Germplasm Collection, the USDA Collection, and several tropical countries) to the present stage of development of several populations, composites, and dwarf, early-maturing hybrids and inbred lines (Christensen et al., 1984).

Palmer et al. (1978) reported millet yields at Manhattan as high as 4436 kg ha^{-1}. During 1979, yield evaluations at six locations in Kansas ranged from 2574 kg ha^{-1} at St. John to 4598 kg ha^{-1} at Tribune (Palmer et al., 1979).

The objectives of this study were to compare yield and yield components of pearl millet and grain sorghum and evaluate pearl millet yield over a range of grain sorghum environments.

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 0.76 m in width by 7.6 m long, with the exception of Hays where the row width was 0.91 m. Planting depth was approximately 0.04–0.06 m depending upon depth and amount of soil moisture. All locations were planted at 16 seeds per m row length between 25 May and 14 June.

Experimental material in 1980 consisted of four pearl millet hybrids developed at Tifton, Georgia by Dr. G.W. Burton (Research Geneticist USDA, SEA) and 23 pearl millet hybrids developed at the Fort Hays Branch Experiment Station by W.D. Stegmeier. Sorghum used for comparison consisted of early (ACCO 1014), medium (Pioneer 8324), and late (Dekalb F67) maturity hybrids, which required approximately 53, 64, and 70 days, respectively, to reach half bloom.

In 1981 an irrigated site was added at Manhattan (Table 1), and because of poor stand establishment and weed problems, the Garden City location was abandoned.

Pearl millet included six hybrids developed at Tifton, Georgia and 18 hybrids developed at Hays, Kansas. Six commercial sorghum hybrids, four early (ACCO 1014, Funk G-611, Golden Acres T-E Y-45, and Asgrow Corral), one medium (Poineer 8324), and one late (Dekalb F-67), were used for comparison. 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

Specific location data

Years	Location	Soil mapping unit
1980, 1981, 1982	Manhattan (Ashland)	Haynie vfsl, (coarse-silty, mixed, calcareous mes-sic Mollic Udifluvent)
1980, 1982	Garden City	Manter fsl, undulating (coarse-loamy, mixed messic Aridic Argiustol)
1980, 1981, 1982	Hays	Crete sicl, thin surface variant (fine Montmo-rillonitic, Mesic, Pachic Argustoll)
1982	Hutchinson	Clark-Ost Complex (fine loamy, Mixed thermic, Typic, Calciustoll)
1980, 1981, 1982	Minneola	Harney sil, 0-1% (fine Montmorillonitic, Mesic. Typic Argiustoll)
1980, 1981	St. John	Naron fsl (fine-loamy, Mixed. Thermic Udic Argiustoll,)
1982	St. John	Farnum fsl (fine-loamy, Mixed, Thermic Pachic Argiustoll)
1980, 1981, 1982	Tribune	Ulysses sil, 0-1% slopes, buried soil phase (fine silty mixed Mesic Ardic Haplus)

(Table 1). No sites were abandoned; however, Tribune had to be replanted because of a wet spring and emergence problems. The same pearl millet and sorghum hybrids as in 1981 were used. Plots were increased from two to four rows and seeding rates increased to 18 seeds per m row length.

Weed control all three years was obtained by an application of Propazine (2-chloro-4,6-bis(isopropylamino)-s-triazine, 2.52 kg a.i. ha^{-1}) at planting, post-emergence application of 2,4-D (2-4-Dichlorophenoxyacetic acid, 0.56 kg a.i. ha^{-1}) as needed, and by cultivation. Granular Furadan (2,3-dihydro-2,2-dimethyl-7-benzofuranyl methylcarbamate) was used at planting (1.12 kg a.i. ha^{-1}) for early control of chinch bugs. Later infestations were controlled with either Sevin (1-naphthyl methylcarbamate) or liquid Furadan.

Observations recorded (not all taken at all locations) included plants/ha, heads/ha, yield (kg ha^{-1}), seed weight (g/1000), and seeds per head. Mean comparisons were made using the average of all millet hybrids and the six top-yielding millets at each location. All data were analyzed across entries at each location with mean comparisons made using an LSD at the 0.05 level.

To compare the production of pearl millet in grain sorghum environments, a linear regression similar to that of Eberhart and Russell (1966) was used. Millet hybrid mean yields were regressed on the sorghum location means. Parameters for comparison included: hybrid mean yields, regression coefficients (b), and a test of regression coefficients contributing significantly to the model $Y=a+bX+e$. A hybrid with a nonsignificant coeffient would indicate no relationship of millet yields to sorghum yields. A desirable hybrid would have a high yield and a regression coefficient not significantly different from 1.0. This regression coefficient would indicate no significant difference in response between millet and sorghum.

This analysis was used for individual years 1980, 1981, and 1982. When 1981 and 1982 were combined, a quadratic analysis was used to estimate the sorghum yield above which millet did not respond. This was calculated by setting the derivative of the quadratic model equal to zero and solving for sorghum yield. When environmental conditions produced sorghum yields greater than this level, millet could not respond to improving conditions to the same degree as sorghum.

RESULTS AND DISCUSSION

In 1980, an abnormally hot and dry year, the across-location average yield of millet (2017 kg ha^{-1}) was significantly less than that of sorghum (2660 kg ha^{-1}). However, average yield of the top six millet hybrids (2577 kg ha^{-1}) was not significantly different from the average sorghum yield. Sorghum location means ranged from 1339 to 4560 kg ha^{-1} and millet location means ranged from 812 to 3868 kg ha^{-1} (Table 2). Only at two locations were yields of the top six millet hybrids significantly less than those of grain sorghum.

At all but two locations, millet had significantly more heads per ha than sorghum, even though planting rates were the same for both crops. Millet weight was significantly less than that of sorghum at each location. Seed weight of millet ranged from 8.7 to 11.1 g/1000. Pearl millet generally had more seeds/m^2 and grain sorghum more seeds per head.

Yields in 1981 were the highest of all years. Sorghum location means ranged from 2442 to 8152 kg ha^{-1} and millet yields ranged from 1975 to 3968 kg ha^{-1} (Table 3). Sorghum yield average (6121 kg ha^{-1}) was significantly greater than both the millet average (3057 kg ha^{-1}) and the top six millet hybrid average (3991 kg ha^{-1}). The best millet hybrid (5864 kg ha^{-1}) only produced 62% as much as the best sorghum (9362 kg ha^{-1}). The only location where

TABLE 2

Yield and yield components of pearl millet and grain sorghum, 1980

Location	Yield (kg ha^{-1})	Heads ha^{-1} (1000)	Seed wt. (g/1000)	Seeds/ head	Seeds m^{-2} (1000)
Manhattan					
Sorghum	2469aA*	161.0bB	13.0aA	1153aA	18.6aA
Millet	1967a	196.0a	10.8b	1010a	19.8a
6 top millet	2275A	221.8A	10.2B	1250A	27.6A
St. John					
Sorghum	1466aA	134.2bB	17.3aA	684aA	19.3aA
Millet	1537a	379.7a	8.7b	488b	18.5a
6 top millet	1824A	392.8A	9.0B	511B	28.6A
Minneola					
Sorghum	3240aA	106.5bB	19.1aA	1615aA	16.9aB
Millet	2239b	156.4a	11.1b	1271b	19.5a
6 top millet	2724A	152.7A	12.3B	1489A	23.9A
Hays					
Sorghum	2886aA	89.7bB	23.8aA	1386aA	12.2bB
Millet	1682b	182.4a	9.1b	1016a	18.5a
6 top millet	2175B	153.7A	9.2B	1180A	24.5A
Garden City					
Sorghum	1339aA	97.5aA	16.5aA	939aA	18.3aA
Millet	812b	99.9a	10.0b	854a	8.1b
6 top millet	1105B	96.5A	10.7B	1105A	11.1B
Tribune					
Sorghum	4560aA	—	19.1aA	—	23.9bB
Millet	3868b	273.0	10.5b	1142	31.2a
6 top millet	4913A	300.3	11.0A	1503	45.1A

*Values with same letter are not significantly different ($P<0.05$).
Capital letters compare sorghum to 6 top millet hybrids, small letters compare sorghum to all millet hybrids.

millet yields were not significantly less than sorghum was at St. John when poor plant establishment and low fertility contributed to low yield for sorghum.

Yield components measured were consistent with those reported in 1980. Millet had more heads/ha and seed/m^2 (Table 3); sorghum had larger seed size and generally more seeds per head.

In 1982, average millet yield across locations was 2776 kg ha^{-1}, significantly less than sorghum with 3858 kg ha^{-1}. The six top-yielding millets averaged

TABLE 3

Yield and yield components of pearl millet and grain sorghum, 1981

Location	Yield (kg ha^{-1})	Heads ha^{-1} (1000)	Seed wt. (g/1000)	Seeds/ head	Seeds m^{-2} (1000)
Manhattan (Dry)					
Sorghum	7790aA*	137.0bB	26.2aA	2194aA	29.9aB
Millet	3797b	364.6a	10.6b	1076b	37.4a
6 top millet	5264B	412.6A	10.3B	1422A	56.4A
Manhattan (Irr.)					
Sorghum	8152aA	156.0bB	26.4aA	2005aA	25.4aB
Millet	3484b	293.0a	10.4b	1531a	35.7a
6 top millet	4582B	285.3A	10.8B	2162A	47.8A
St. John					
Sorghum	2442aA	101.0bB	23.4aA	1060aA	10.7bB
Millet	2032a	177.0a	10.4b	1198a	20.7a
6 top millet	2660A	189.6A	10.4B	1551A	31.8A
Minneola					
Sorghum	1549aA	114.6bB	21.9aA	2283aA	25.5aB
Millet	2834b	191.1a	10.8b	1474b	26.7a
6 top millet	3666B	186.6A	11.1B	1838A	38.3A
Hays					
Sorghum	5763aA	95.1bB	24.9aA	2551aA	23.4bB
Millet	4041b	248.9a	10.5b	1675b	39.2a
6 top millet	4674B	229.5A	11.6B	1839B	47.7A
Tribune					
Sorghum	7091aA	129.3bB	22.0aA	2028aA	26.2aA
Millet	2155b	216.3a	14.0b	824b	18.1b
6 top millet	3104A	250.7A	13.6B	943B	24.3B

*Values with same letter are not significantly different ($P<0.05$).
Capital letters compare sorghum to 6 top millet hybrids, small letters compare sorghum to all millet hybrids.

3272 kg ha^{-1}, 85% of sorghum; sorghum location means ranged from 2229 to 5660 kg ha^{-1}, with millet ranging from 2032 to 4041 kg ha^{-1} (Table 4).

The yield components measured were consistent with those of previous years (Table 4). Sorghum had a higher plant population at all but two locations (where measured) and millet had significantly more heads ha^{-1} at all but the Hutchinson location. There was no clear difference over all locations in seeds per head between millet and sorghum. Millet generally had more seeds m^{-2}; the locations with the greatest yield had the largest number of seeds/m^2.

The greatest detriment to yield of pearl millet was floral sterility. Mashin-

TABLE 4

Yield and yield components of pearl millet and grain sorghum, 1982

Location	Yield (kg/ha^{-1})	Plants ha^{-1} (1000)	Heads ha^{-1} (1000)	Seed wt. (g/1000)	Seeds/ head	Seeds m^{-2} (1000)
Manhattan (Dry)						
Sorghum	4930aA*	154.3aA	155.3bB	20.8aA	1582aA	24.1bB
Millet	3517b	103.3b	270.4a	11.0b	1352a	32.4a
6 top millet	4171A	116.1B	331.5A	10.3B	1285A	43.0A
Manhattan (Irr.)						
Sorghum	5641aA	180.1aA	179.2bB	19.9aA	1601aA	28.3bB
Millet	4222b	162.9b	351.8a	10.4b	1221b	41.7a
6 top millet	4879A	142.6B	401.0A	9.9B	1338B	55.6A
Hutchinson						
Sorghum	3123aA	150.0aA	180.6aA	20.4aA	893bB	16.0bB
Millet	2091b	163.2a	190.6a	10.2b	1120a	20.8a
6 top millet	2393B	146.3A	174.2A	10.9B	1307A	24.5A
St. John						
Sorghum	4009aA	124.4aA	127.4bB	20.7aA	1560aA	19.7aB
Millet	2254b	67.1b	176.8a	11.3b	1188b	20.3a
6 top millet	2701B	67.0B	153.1A	11.1B	1395B	25.9A
Minneola						
Sorghum	3281aA	162.2aA	152.8bB	15.7aA	1405bB	21.1aB
Millet	2696b	63.9b	199.7a	9.6b	1441a	28.5a
6 top millet	3204A	64.1B	219.3A	10.0B	1482A	35.3A
Hays						
Sorghum	4625aA	—	106.8bB	20.2aA	2176aA	22.9bB
Millet	3471b	—	208.4a	9.5b	1754b	35.6a
6 top millet	4044A	—	193.3A	10.5B	2040A	42.5A
Garden City						
Sorghum	2938aA	131.5aA	126.6bB	20.9aA	1166aA	13.9bB
Millet	2331b	69.1b	195.8a	10.8b	1188a	22.4a
6 top millet	2757A	62.4B	196.3A	11.4B	1316A	29.6A
Tribune						
Sorghum	2318aA	—	139.0aA	13.4aA	1289aA	17.3aA
Millet	1631b	—	138.0a	10.4b	1045a	13.6a
6 top millet	2028A	—	159.6A	11.2B	1156B	18.8A

*Values with same letter are not significantly different ($P < 0.05$).
Capital letters compare sorghum to 6 top millet hybrids, small letters compare sorghum to all millet hybrids.

TABLE 5

Pearl millet seed-set scores, 1981 and 1982

Location	Year	
	1981	1982
Manhattan (Dry)	4.1	2.5
Manhattan (Irr.)	5.7	2.3
Hutchinson	—	2.5
St. John	2.7	4.4
Minneola	4.5	3.7
Hays	7.9	8.8
Garden City	—	2.1
Tribune	6.5	4.4

Seed set scores: 0 = 0% seed set; 10 = 100% seed set.

gaidze and Muchena (1982) reported that floral sterility could be induced by temperatures ranging from 13 to 16°C. Ong (1983) also reported spikelet fertility in millet was greatly reduced at 19°C with only 40–50% producing grain. All but one location during 1981 and 1982 had evening low temperatures in this critical range during flowering.

Seed set was scored from 0 (no seed set) to 10 (100% seed set). Table 5 lists the average seed set rating for 1981 and 1982. Overall, millet had a seed set rating of 4.5, similar to results reported by Ong (1983). There was no correlation between sterility ratings and seeds/m^2. Mashingaidze and Muchena (1982) reported the main cause of floral sterility to be the destruction of pollen induced by cool temperatures during boot stage, not a lack of receptiveness of the stigmas. Hays (average seed set rating = 8.2) had a large amount of pearl millet with various maturities surrounding the yield trials. This could have prolonged the concentration of pollen in the air, which would increase seed set.

Response of millet in 1980, an abnormally hot and dry year, did not differ from that of sorghum. Only four of 27 millet hybrids had regression coefficients significantly less than 1.0 (Table 6). Coefficients for millet ranged from 0.43 to 1.23.

Millet did not respond like sorghum to the favorable environments in 1981. This lack of response is indicated by all millet hybrids regression coefficients significantly less than 1.0.

Millet response in 1982 was very similar to that in 1980, however, with greater yields (Table 7). Millet regression coefficients ranged from 0.49 to 1.05. Only six hybrids had coefficients significantly less than 1.0, indicating similar response to changing environments.

Because the same millet and sorghum hybrids were used in 1981 and 1982, a combined analysis could be made to estimate the sorghum yield levels over

TABLE 6

Response parameters for pearl millet, 1980

Hybrid†	b	r^2	Across-location mean yield (kg ha^{-1})
79-2208×79-4140	0.55*	0.70	1493
79-2208×78-7024	0.69	0.77	1997
79-2201×79-4104	0.48*	0.72	1818
79-2201×78-7024	0.79	0.89	2091
79-2017×79-4104	0.53*	0.79	1659
79-2017×78-7024	0.75	0.80	2124
79-2156×78-7024	1.14	0.91	2287
79-2221×78-7024	0.79	0.85	1966
79-2221×79-4104	1.23	0.86	2248
79-2216×78-7024	0.75	0.78	1786
79-2216×79-4104	0.76	0.72	2146
79-2161×78-7024	0.81	0.72	1857
79-2161×79-4104	0.68	0.86	2232
79-2157×78-7024	0.69	0.81	2174
79-2157×79-4104	0.77	0.71	2031
79-2148×79-4104	1.21	0.78	2588
79-2148×78-7024	0.86	0.79	2222
79-2059×79-4104	0.97	0.83	2217
79-2059×78-7024	0.93	0.79	2171
79-2055×79-4140	1.05	0.78	2180
79-2055×78-7024	0.78	0.85	1996
79-2024×79-4104	1.02	0.85	2117
79-2042×78-7024	0.98	0.82	2083
Tift 1 23DAE×653+653	0.43*	0.62	1638
Tift 2 23DAE×656+653	ns	ns	1931
Tift 3 23DAE×656+653	0.95	0.71	1732
Tift 8 (23DAE×756)× 656+653	0.85	0.88	1812
	LSD ($P<0.05$)		554

*Significantly ($P<0.05$) different from 1.0.
†The first 23 hybrids were developed at Fort Hays Experiment Station, Hays, Kansas; the others at Tifton, Georgia.

which millet was responsive. Table 8 lists the quadratic model parameters for those hybrids with a significant model and the sorghum yield level where millet reached maximum yield. The sorghum average yield level above which millet did not respond was 5828 kg ha^{-1}. In 1980 and 1982 sorghum averages were below this level and millet responded to improved environments, although not always to the yield level of sorghum. In 1981, sorghum averages were above

TABLE 7

Response parameters for pearl millet, 1981 and 1982

Hybrid†	1981			1982		
	b	r^2	Yield (kg ha^{-1})	b	r^2	Yield (kg ha^{-1})
80-2113×78-7024	−0.09*	ns	2594	0.61*	0.71	2693
79-2081×78-7024	−0.06*	ns	2311	0.58*	0.57	2558
70-2094×78-7024	−0.02*	ns	2320	0.74	0.63	2604
79-2150×78-7024	0.07*	ns	2811	0.64*	0.72	2972
23 DAE×78-7024	0.16*	ns	2946	0.88	0.78	2655
78-224 ×78-7024	0.14*	ns	2573	0.83	0.68	2608
80-2113×78-7088	0.38*	0.63	3968	0.75	0.80	2946
79-2081×78-7088	0.17*	ns	3692	0.88	0.87	2657
79-2094×78-7088	0.24*	ns	3219	0.98	0.86	2843
79-2150×78-7088	0.25*	ns	3892	0.80	0.87	3124
80-2113×79-1137	0.36*	ns	3317	0.70	0.81	3014
79-2081×79-1137	0.17*	ns	3247	0.73	0.83	2812
80-2203×79-1137	0.50*	ns	3362	0.99	0.85	2810
79-2150×79-1137	0.35*	ns	3401	0.85	0.85	3035
79-2059×79-4104	0.45*	0.56	3166	0.55*	0.74	2821
79-2081×79-4104	0.31*	ns	3275	0.49*	0.79	2536
79-2094×79-4104	0.10*	ns	2492	0.67	0.93	2733
79-2150×79-4104	0.37*	0.64	3692	0.51*	0.78	3037
23 DAE×756+10% 756	0.01*	ns	2591	1.05	0.63	2609
23 DAE×656+10% 653	0.31*	ns	3169	0.68	0.55	2347
23 DAE×28R83D	0.28*	ns	3130	0.92	0.68	2698
23 DA×28R83D	0.03*	ns	1795	0.53*	ns	2172
23 DAE×64(756×RMP)	0.40*	ns	3575	0.77	0.69	2806
23 DAE×655 (756×B39)	0.34*	ns	2785	0.90	0.80	2354
LSD ($P<0.05$)			1116			524

*Significantly ($P<0.05$) different from 1.0.
†The first 18 hybrids were developed at Fort Hays Experiment Station, Hays Kansas; the others at Tifton, Georgia.

this level and millet hybrid regression coefficients were all below 1.0, indicating a lack of response.

CONCLUSIONS

Millet yields averaged 65% of sorghum yields over all locations and years with the top 6 millets averaging 80%. Sorghum average yield across locations

TABLE 8

Model[1] parameters and sorghum yield at pearl millet maximum yield, 1981-82 combined

Hybrid	Intercept a	Linear b_1	Quadratic b_2	R^2	Maximum millet yield (kg ha^{-1}) (kg ha^{-1}) (Y)	Sorghum yield for millet maximum yield (X)
80-2113×78-7024	−1540	1.81	−0.00017	0.41	3277	5323
79-2081×78-7024	−2143	2.02	−0.00019	0.45	3225	5315
79-2094×78-7024	−3073	2.41	−0.00022	0.48	3527	5471
79-2150×78-7024	−2222	2.17	−0.0002	0.65	3664	5425
23-DAE×78-2024	−2410	2.15	−0.00018	0.54	4010	5972
78-224 ×78-7024	−4148	2.83	−0.00025	0.73	3861	5660
79-2094×78-7088	−2991	2.30	−0.00019	0.58	3969	6052
79-2081×79-1137	−1532	1.71	−0.00014	0.71	3689	6107
79-2094×79-4104	−2406	2.12	−0.00019	0.54	3507	5578
79-2150×79-4104	−345	1.21	−0.000082	0.80	4119	7380

[1]Model $Y = a + b_1X + b_2X^2 + e$.

was greater than that of pearl millet for all three years; however, sorghum did not yield more than pearl millet at all locations. During 1980 the overall yield of sorghum was higher than that of millet, although not at every location nor for every hybrid at each location. Regression coefficients were not significantly different from 1.0, indicating similar responses.

In 1981 millet did not respond as much to the favorable environments as did sorghum. Yields for both crops were the highest of all years and the range between the crops was the largest.

During 1982, sorghum yielded more than millet, but the range between the yields was not as large as in 1981. Only seven hybrids had regression coefficients that were significantly different from 1.0.

Sorghum had significantly greater seed weights than millet. Sorghum seed weight was reduced by poor environments to a greater extent than that of millet.

Due to poor plant establishment, millet plant populations were lower than those of sorghum. Millet had better establishment in lighter soils than in heavier soils; smaller-seeded millet had the lowest populations. Low plant populations did not tend to affect the yield because millet tillered more than sorghum. However, the top-yielding millets did not always produce the greatest number of heads ha^{-1} nor seeds m^{-2}.

The greatest deterrent to millet yield was floral sterility. Millet hybrids had an across-years-and-locations average of 45% seed set. This low seed-set rating

was probably related to the low temperatures during flowering. There was also no apparent difference in bird damage between millet and sorghum.

Pearl millet has the potential of being an alternate crop in the semi-arid, grain producing areas. Further research and hybrid selection must be done to improve millet's seed set in cool temperatures. Weed control can be obtained through cultivation and application of several commercial herbicides.

At present there is no market for pearl millet grain in the U.S.A. However, pearl millet is an excellent protein source and increasingly important ration for livestock (Christensen et al., 1984).

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