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Comparison of *per se* and Test Cross Performance in *Sorghum bicolor* (L.) Moench*

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ABSTRACT

In the study of evaluation of parents *per se* performance and its relation to test cross performance over three locations, high phenotypic correlation coefficients were observed for most of the characters at all locations which revealed that line *per se* performance could be profitably utilized as an effective preliminary test for potential parents. Subsequent evaluation could be based on test crosses. The *per se* of parents was better under favourable environments, while hybrids could performed uniformaly under different environments suggesting parents selected under favourable environment, could result in hybrids of general superiority over varying environments.

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INTRODUCTION

Positive identification of superior germplasm is probably the most important pre-requisite for genetic progress in any breeding project. *Per se* performance of lines, one of the methods used for screening inbred lines has been advocated for this purpose (Genter and Alexander, 1962; Lonnquist and Castro, 1967; Gebrekidan and Rasmusson, 1970). Singhania and Rao (1975) suggested that the general combining ability and line *per se* performance were relatively more important for evaluating the parents of hybrids in sorghum. They also suggested that the *per se* performance of males could profitably be utilized as an effective preliminary test for potential parent and subsequent evaluation could be based on test crosses. The parents selected on the basis of their performance under favourable considerations of a single environment could result in hybrids of general superiority over varying environments (Falconer and Latyszewski, 1952). The present study is essentially an evaluation of parents for their *per se* performance and its relationship with test cross.

MATERIAL AND METHODS

Experimental material comprising of 33 males, 3 females and 99 F_1 single cross hybrids were tested in randomized block design with three replications. These were evaluated at three locations namely Navsari (L_1), Broach (L_2) and Surat (L_3) in Gujarat during *kharif*, 1978. Individual plots consisting of three rows each having 3m length, were

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spaced 45 cm apart. Intrarow spacing was maintained at 15 cm by thinning and gap filling.

Following observations were recorded on 5 randomly-choosen competitive plants; days to 50 per cent bloom (X_1), plant height (cm) (X_2), earhead length (cm) (X_3), grain yield per plant (g) (X_4), 100-grain weight (g) (X_5) and number of grains per plant (X_6). Standard statistical procedures were followed to analyse the data.

RESULTS AND DISCUSSION

The data on the performance of parents and the corresponding values of the resulting hybrids averaged overall the males and females as well as their correlation coefficients are presented in Tables 1 and 2 respectively. The phenotypic correlation coefficient between

TABLE 1

Mean performance of parents and their crosses.

Genotypes	*Days to 50% bloom*		*Plant height (cm)*		*Panicle length (cm)*		*Grain yield per plant (g)*		*Hundred grain weight (g)*		*Grains per plant*	
	Line Per se	*Test cross*	*Line Per se*	*Test cross*	*Line Per se*	*Test cross*	*Line Per se*	*Test cross*	*Line Per se*	*Test cross*	*Line Per se*	*Test cross*
Females												
ms 2219	58	63	101.2	176.6	24.1	27.9	41.1	74.8	2.174	2.911	1909	2555
ms 36	80	74	109.5	186.0	18.7	22.8	76.1	125.4	3.405	3.781	2157	3275
ms 2077	76	71	131.9	207.2	29.3	33.3	75.1	126.0	3.190	3.452	2343	3585
Males												
1	75	69	133.3	167.8	25.8	31.8	84.8	142.2	2.349	3.427	2454	2960
2	74	69	216.5	236.9	23.5	26.3	64.8	88.9	2.493	3.167	2539	2681
3	75	69	211.6	238.5	22.7	25.5	69.0	86.9	3.106	3.032	2218	2845
4	77	71	177.0	173.8	23.5	23.5	63.8	101.8	2.543	3.259	2469	3059
5	74	69	135.1	175.7	23.1	29.9	68.9	113.6	3.193	3.370	2079	3224
6	77	69	121.2	168.0	21.8	29.5	72.2	129.3	3.359	3.502	2134	3693
7	70	68	233.2	235.3	22.3	26.5	65.6	96.8	3.265	3.471	2023	2712
8	73	69	189.8	236.1	24.5	25.8	80.8	93.7	3.109	3.331	2595	2736
9	74	68	195.6	220.0	22.3	27.5	100.4	99.3	3.976	3.681	2519	2680
10	69	67	192.8	216.0	26.9	27.2	61.0	89.6	3.020	3.225	2062	2768
11	74	69	118.5	165.6	25.3	30.8	86.3	148.9	3.314	3.511	2595	4083
12	78	70	187.1	214.3	22.9	26.9	72.5	98.1	2.949	3.435	2615	2940
13	74	70	114.4	159.9	24.6	30.6	86.3	160.5	3.466	3.738	2530	4196
14	74	69	161.4	163.9	22.6	26.6	77.9	100.6	2.430	3.309	3186	2878
15	74	70	128.3	176.3	21.4	27.0	69.2	107.0	3.108	3.573	2190	2882
16	78	71	121.6	166.6	21.8	28.1	65.2	118.8	2.782	3.547	2248	3307
17	74	69	144.1	177.7	21.5	30.3	62.1	110.5	3.003	3.281	2099	3270
18	76	70	181.7	225.4	22.3	27.8	65.2	95.2	3.155	3.455	2021	2740

1	3	4	5	6	7	8	9	10	11	12	13	14
19	78	69	174.6	182.8	23.8	29.3	68.5	107.7	3.302	3.478	2099	3129
20	77	70	157.0	171.0	21.9	27.9	78.7	89.6	2.827	3.238	2627	2723
21	75	68	191.5	207.1	24.4	27.1	62.7	88.7	3.214	3.342	1953	2667
22	75	69	209.4	234.7	23.2	28.4	69.7	105.8	2.537	3.214	2706	3131
23	73	69	202.9	242.6	22.8	26.8	87.7	97.9	2.879	3.271	3023	3040
24	74	69	128.2	167.2	22.4	28.5	63.3	105.3	2.968	3.217	2171	3167
25	75	70	126.1	274.7	23.6	28.2	96.7	149.4	4.152	3.957	2309	3665
26	75	67	92.6	159.1	19.6	26.1	63.2	100.5	2.789	3.240	2324	3136
27	75	70	134.0	180.5	21.3	27.9	79.3	100.3	3.003	3.133	2395	3104
28	77	69	134.3	160.3	29.4	33.8	102.4	162.6	3.205	3.564	3151	4409
29	69	67	140.8	174.1	26.0	25.7	49.0	81.3	2.796	3.054	1995	2685
30	70	68	151.2	167.1	26.8	28.9	67.2	90.2	2.889	3.332	2369	2695
31	75	68	112.4	157.4	21.7	28.5	65.3	120.1	2.708	3.380	2392	3547
32	75	70	110.8	159.9	23.8	29.5	91.7	127.8	3.445	3.567	2665	3411
33	75	65	245.7	214.5	19.2	21.6	75.3	78.9	3.088	3.280	2561	2403

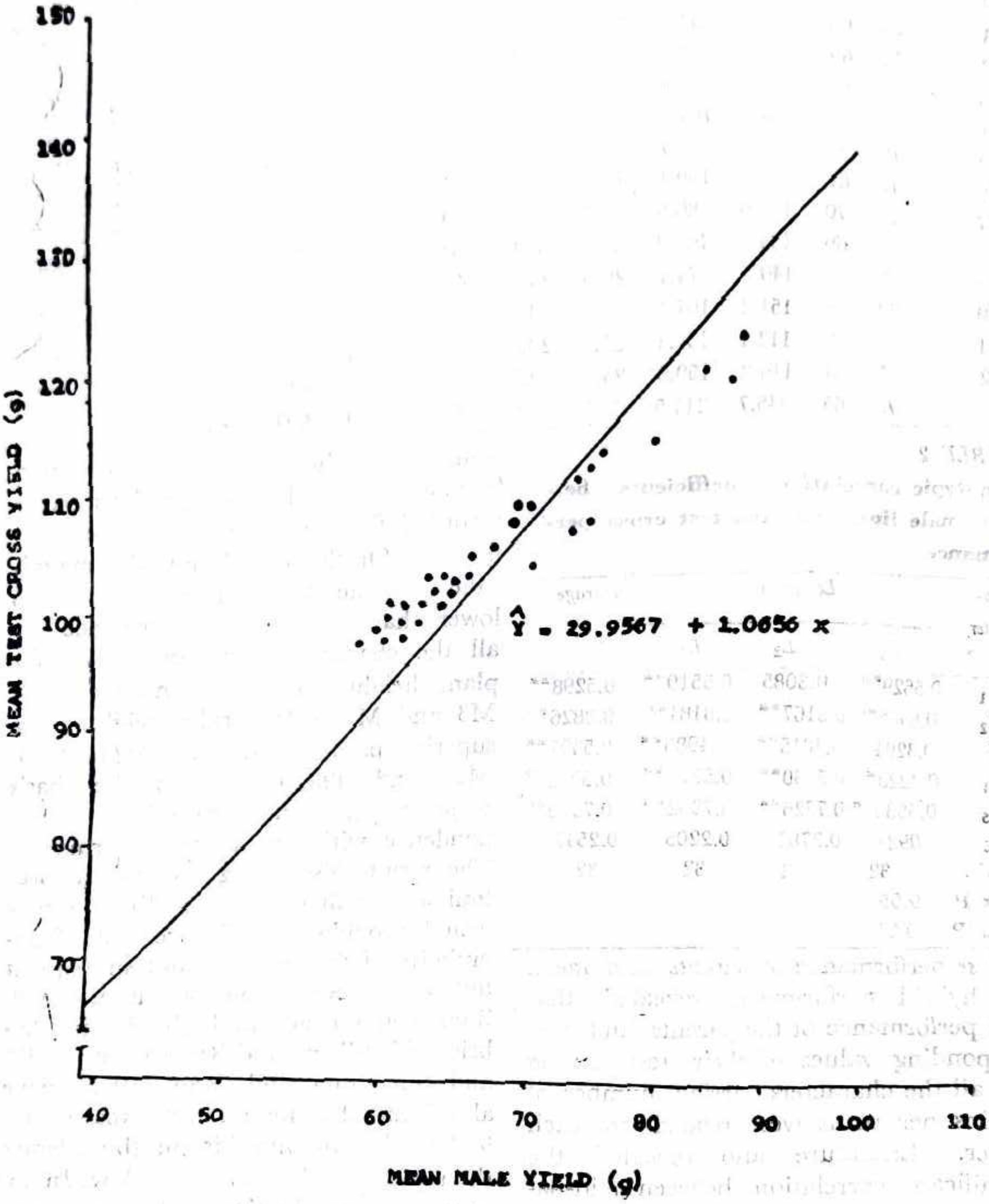
TABLE 2

Phenotypic correlation coefficients between male line *per se* and test cross performance.

Character	Location			Average
	L_1	L_2	L_3	
X_1	0.5629**	0.3085	0.5519**	0.5298**
X_2	0.8985**	0.8167**	0.8181**	0.8826**
X_3	0.3294	0.4815**	0.4986**	0.5397**
X_4	0.4228*	0.5660**	0.5277**	0.5952**
X_5	0.5330**	0.7726**	0.7392**	0.7360**
X_6	0.0924	0.2782	0.2205	0.2547
D.F.	32	32	32	32
* P	0.05			
** P	0.01			

per se performance of parents and mean of hybrid performance revealed that the performance of the parents and corresponding values of their test crosses for all the characters barring number of grains per plant were related to each other. Literature also revealed the significant correlation between mid-parent value and hybrid performance. (Kirby and Atkins, 1968). *Per se* performance revealed that, in general, male parents were later in flowering as compared to the test cross average performance. Similar observations were recorded for female parents except for ms 2219. On the other hand, the magnitude of line *per se* performance was lower than test cross performance for all the characters excepting M 33 for plant height and grains number and M3 and M 25 for grain weight. The superior parents viz., M1, M11, M13, M25, and M28 judged on the basis of *per se* performance revealed correspondence with test cross performance. The results also bring out that a preliminary evaluation of a line *per se* would provide an effective test of potentiality of the parents and subsequent test cross evaluation of high x high lines would result in high yielding hybrids. Upadhyay and Rasmusson (1967) and Singhania and Rao (1975) nave also found that high x high crosses gave higher yielding hybrids on the average than high x low or low x low. In the present investigation, the high performing male lines M1, M11, M13, M28 had showed high heterotic response when crossed with high perform-

FIG. 1 REGRESSION OF MEAN YIELD ON MEAN TEST CROSS PERFORMANCE



ing female ms 2077.

In present study phenotypic correlation coefficients between *per se* performance of parents and mean test cross performance revealed that there was a close relationship between male performance and yield performance at each of the locations. However, more pronounced at L_3 location, while the hybrid performance was consistent over all the locations which indicated that the parents selected on the basis of their *per se* performance under ideal conditions could yield superior hybrids (Fig. 1). The validity of the assumption that more accurate evaluation of gca effects can be made among early generation inbred on the basis of progeny performance than on the basis of test cross depends largely on the nature of the gene action involved in the expression of heterosis. It is generally accepted that if the heterosis results primarily from additive effect of dominant genes, progeny performance of early generation inbred lines should be used to evaluate their gca better than test crosses.

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