

Combining Ability in Pearl Millet Genotypes (*Pennisetum typhoides* S & H.)

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Heterosis and combining ability studies were made in bajra inbreds of different height groups *viz.*, dwarf, medium tall and tall. Heterosis of varying degrees was manifested by the F_1 s for the characters studied. But the magnitude was high for plant height, panicle weight and grain yield. In the combining ability analysis, both the GCA and SCA mean squares were significant indicating the importance of both additive and non-additive gene actions. However, additive gene action was predominant for plant height, days to 50% flowering, stem girth and grain yield.

In bajra available information on the advantage of dwarf inbreds over tall ones is meagre. The present study was undertaken to study heterosis and combining ability in hybrid combinations involving inbred lines of pearl millet of different height groups,

MATERIAL AND METHODS

Nine promising bajra inbred lines were crossed in a diallel fashion adopting the model 1 and method 4 during kharif 1976. The inbreds were classified into the following three height groups.

- i) Dwarf (D): L. S. 369, L. S. 471-8, L. S. 326-1 (upto 120 cm).
- ii) Medium tall (MT): L. S. 400, L. S. 898/1166, L. S. 510-2 (121-150 cm).
- iii) Tall (T): L. S. 70/1, I. P. 1929, L. S. 1777/810-1 (above 150 cm).

The resultant 36 F_1 s along with their parents were sown during 1977 kharif in a randomised block design replicated thrice at Agricultural Research Station, Lam (A. P.). In each row, five plants were selected at random and observations recorded on plant height (cm), number of leaves per plant, days to 50 percent flowering, internodal length (cm), stem girth (cm), panicle length (cm), panicle girth (cm), panicle weight (g), straw yield (g) and thousand grain weight (g). Heterosis in terms of superiority of hybrids over mean of parents and superior parent (heterobeltiosis) were estimated. General and specific combining ability (GCA & SCA) analyses were made as suggested by Griffing (1956).

RESULTS AND DISCUSSION:

Heterosis:

Heterosis of varying degrees was manifested by the F_1 s (Table-I). In

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the case of number of leaves, days to 50% flowering and straw yield, negative heterosis was recorded. Similar results on earliness of hybrids over their parents were reported by Phul *et al.* (1973). The maximum heterosis of 29% over the mid parent and 19% over the better parent was recorded for grain yield, which is a desirable feature for commercial production of hybrids. Significant heterosis in grain and fodder yields was recorded by Krishna rao *et al.* (1951) also. In the present study maximum heterosis for grain yield was recorded in crosses involving dwarf or medium tall inbreds, as one of the parents. Five F_1 s L.S. 369 x L.S. 326-1 (D X D), L.S. 369 x L.S. 400 (D X MT), L.S. 369 x L.S. 1777/810-1 (D X T), L.S. 326-1 x L.S. 898/1166 (D X MT) and L.S. 898/1166 x L.S. 70/1 (MT X T) are outstanding for grain yield with highest heterosis.

In case of panicle weight, which is important yield component 16% heterosis over mean of parents and 6 percent heterobeltiosis was recorded. Twenty nine hybrids manifested heterosis and twenty one exhibited heterobeltiosis. As in the case of grain yield, the parents which contributed to maximum heterosis were either dwarf or medium tall. Heterosis for plant height was 16% and heterobeltiosis was 4%. Heterosis for plant height in bajra was reported by Lal and Singh (1968) also. The hybrids exhibited slight improvement in grain size as recorded in terms of 1,000 grain weight. Heterosis of seven percent over mid-parent was recorded for this character.

COMBINING ABILITY ANALYSIS:

The differences between the crosses for all the characters were statistically

significant. The mean squares from combining ability analysis are given in Table II. GCA mean squares were significant for all the characters while SCA mean squares were significant for all characters except for internodal length, stem girth and panicle weight. GCA mean squares were higher than SCA mean squares for plant height, days to 50% flowering, internodal length, stem girth, panicle weight and grain yield indicating the predominance of additive gene action. Phul *et al.* (1973) noticed significant GCA and SCA variances for plant height, days to 50 per cent flowering, ear length and grain yield in pearl millet which agrees with present findings.

The estimates of GCA effects are given in Table-III. Inbred L.S. 471-8 (D) has the highest effects for grain yield followed by L.S. 369 (D), L.S. 400 (MT) and L.S. 70/1 (T). All these inbreds are good combiners for yield.

The estimated variances of GCA and SCA for different parental genotypes and for different characters are furnished in Table IV. In case of grain yield, GCA variance is high for L.S. 400 (MT) and L.S. 510-2 (MT). Based on the interpretation of SCA and GCA variances (Sprague and Tatum, 1972) these parents should be either better or poorer than other lines. From the estimates of GCA effects, it can be seen that L.S. 400 (MT) has high GCA effects and 510-2 (MT) has the lowest (Table III). In general, for grain yield, GCA variances are higher than SCA variances in different parents studied. In case of panicle weight, GCA variance is the highest for L.S. 510-2 (MT)

and this inbred had the lowest panicle weight. SCA variance was very high in case of L.S. 70/1 (T) and L.S. 1777/810-1 (T). Based on the average performance, L.S. 70/1 (T) recorded high panicle weight and L.S. 1777/810-1 (T) had low panicle weight. SCA variances were found to be greater than GCA variances for panicle length, plant height, days to 50 percent flowering and weight of 1,000 grain suggesting the predominance of dominant gene action for these characters.

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Table I Heterotic effects of F_1 's

Variable	Mean of			Average heterosis as percent of	
	F_1 's	Parents	Superior parent	Mean of Parents	Superior Parent.
Plant height (cm)	173.09	149.75	167.01	16	4
No. of leaves	11.33	11.40	11.69	-1	-3
Days to 50% flowering	46.38	48.32	50.84	-4	-9
Internodal length (cm)	16.54	16.08	16.74	3	-1
Stem girth (cm)	0.73	0.68	0.70	7	4
Panicle length (cm)	22.88	20.98	22.39	9	2
Panicle girth (cm)	1.84	1.82	1.92	1	-4
Panicle weight (g)	38.38	23.05	36.35	16	6
Straw yield (g)	116.87	122.15	132.54	-4	-12
Grain yield (g)	28.56	22.11	23.92	29	19
1000 grain weight (g)	8.38	7.82	8.20	7	2

Table II. Mean squares from combining ability analyses

Source	Df	Plant height	No. of leaves	Days to 50% flowering	Internodal length	Stem girth	Panicle length	Panicle girth	Panicle weight	Straw yield	Grain yield	1000 Grain weight
GCA	8	580.27**	0.21**	26.2325**	3.88**	0.005**	3.60**	0.030**	49.68**	497.13**	28.56**	0.6630**
SCA	27	80.23**	0.21**	10.1570**	0.74	0.0025	3.60**	0.027**	19.11	383.04**	13.33**	1.6477**
Error	70	42.66	0.072	1.8003	0.56	0.0016	1.04	0.007	15.327	46.22	0.277	0.269
GCA/SCA ratio		7:1	1:1	3:1	5:1	3:1	1:1	1:1	3:1	1:1	2:1	0.4:1.0

*Significant at 5% level

**Significant at 1% level

Table III Estimates of general combining ability effects

Selection number	Plant height	Number of leaves	Days to 50% flowering	Internodal length	Stem girth	Panicle length	Panicle girth	Panicle weight	Straw yield	Grain yield	1000 grain weight
L.S. 369	-16.058	-0.086	2.902	-1.528	0.035	0.335	0.109	3.219	2.910	1.299	0.005
L.S. 471-8	6.812	0.047	0.973	-0.418	0.042	-0.052	0.085	1.989	-12.233	2.031	0.290
L.S. 326-1	-1.998	-0.012	-2.013	-0.043	0.0003	1.375	-0.112	-1.048	-7.661	-1.187	0.320
L.S. 400	10.232	0.255	0.059	0.089	-0.093	0.008	-0.005	2.162	17.482	1.022	-0.494
L.S. 898/1166	3.241	-0.088	-1.456	1.108	0.021	-0.830	-0.024	-0.619	-2.614	0.681	-0.0282
L.S. 510-2	-0.472	-0.163	-2.613	0.318	-0.023	-0.802	-0.044	-5.658	-4.423	-4.775	-0.447
L.S. 70/1	11.131	0.277	2.102	0.474	-0.010	0.473	-0.018	2.109	3.100	1.033	-0.1197
IP. 1929	-1.762	-0.010	1.282	-0.425	-0.012	0.208	0.0007	-0.812	3.100	0.080	0.246
L.S. 1777/810-1	-1.498	-0.220	-1.241	0.425	-0.050	-0.716	0.0065	-1.344	0.337	0.185	0.226
^A S.E. (gi)	2.328	0.30	0.478	0.266	0.014	0.363	0.0298	1.394	2.423	0.1875	0.185
^A S.E. (gi - gi)	3.491	0.454	0.720	0.400	0.021	0.545	0.045	2.091	3.634	0.281	0.277

Table IV Estimation of General and Specific Combining Ability Variances Associated with each Parent.

Selection Number	Plant height		Days to 50% flowering		Panicle length		Panicle Weight		Grain yield		Wt. of 1000 grain	
	GCA	SCA	GCA	SCA	GCA	SCA	GCA	SCA	GCA	SCA	GCA	SCA
LS. 369	252.442	105.8855	8.1930	14.1415	-0.0198	1.7475	8.416	-6.001	0.034	-0.197	1.6524	1.0483
LS. 471-8	40.986	83.6393	0.7181	6.6472	-0.1293	1.3048	2.010	-2.761	0.050	-0.170	4.0900	8.1273
LS. 326-1	-1.425	37.5688	3.8236	3.3455	1.7586	4.0704	-0.848	-3.065	0.088	-0.187	1.3716	3.2738
LS. 400	99.277	27.8751	-0.2251	6.1810	-0.1320	1.0479	2.728	9.345	0.210	-0.202	1.0095	17.001
LS. 898/1166	6.087	14.6473	1.8913	9.1871	0.5569	1.6766	-1.563	-1.108	-0.033	-0.098	0.4288	10.633
LS. 510-2	-5.194	39.7441	6.5992	7.0134	0.5112	4.6090	30.067	0.727	0.166	-0.218	22.7656	9.1883
LS. 70/1	118.482	13.2405	4.1898	6.4419	0.0917	0.7421	2.502	20.731	-0.020	-0.210	1.0321	19.810
IP. 1929	-2.212	25.9544	1.4278	6.3355	-0.0887	1.2119	-1.287	-9.618	0.026	-0.196	-0.0286	2.8488
LS. 1777/810/1	-3.573	70.1276	1.3115	5.1689	-0.0807	2.6864	-0.140	16.293	0.018	-0.087	-0.0008	27.090
S.E. (a)*		127.981		3.401		3.116		45.982		0.808		0.820
S.E. (b)**		42.660		1.800		1.039		15.327		0.269		0.277

S.E. (a)* Error on individual basis

S.E. (b)** Error on mean basis