GAU Res. J. 1983. 8 (2): 121-124

Short Communications

Heterosis and Inbreeding Depression in Sorghum

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The scope for exploitation of hybrid vigour will depend on the direction and magnitude of heterosis, biological feasibility and the type of gene action involved. After the development of male-sterile lines in sorghum, exploitation of heterosis has become commercially feasible and considerable research has been done on the phenomenon of hybrid vigour in this crop (Quinby, 1963; Rao, 1970 and Singhania and Rao, 1976). As a result, series of hybrids are released for general cultivation. The seed production problem which still persists has limited the scope of the large coverage of area by the hybrids. Goyal and Joshi (1976) studied the feasibility of growing F_2 seeds for commercial cultivation during the years of seed shortage. The present study is an effort to determine the extent of heterosis and inbreeding depression observed in sorghum recombs and to examine the possibility for the use of F_2 seed for general cultivation.

Material comprised 3 females and 8 males, their F_1 and F_2 hybrids, these were grown in a randomised block design, replicated three times during rabi 1978-79 at the College Farm, Gujarat Agricultural University, Navsari Campus, Navsari. Single rows were kept for each parent and F_1, while two rows constituted a plot for each F_2 progeny, keeping 3.50m length of each row, plants were spaced 45 cm x 15 cm apart. Observations on days to 50 per cent bloom, plant height (cm), panicle length (cm), grain yield/plant (g) and 100-grain weight (g) were recorded from five randomly selected plants in parents and F_1s and twenty plants in F_2 populations in each of the replications.

Analysis of the data revealed significant differences among genotypes for all the characters under investigation (Table 1). Significant differences were observed among the parental lines for all characters under investigation which suggested that parental lines were genetically diverse. F_1s also revealed significant differences among themselves for these attributes. Significant differences were also recorded among the means of 24 F_2 populations for all characters. Mean squares for F_1s vs F_2s were highly significant indicating that the mean of F_1s was significantly different from the mean of F_2s. Another comparison, parents vs (F_1+F_2) was also highly significant for all attirubtes, suggesting significant differences between the mean of parents and the recombs.

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TABLE 1

Analysis of variance for parents and hybrids.

Variance due to		*D.F.*	*Days to 50 per cent bloom*	*Plant height*	*Earhead length*	*Grain yield per plant*	*Hundred grain weight*
Replications		2	2.6	311.8	11.6	197.9	0.04
Treatments		58	142.0**	4001.5**	116.8**	5110.2**	0.84**
Parents	10		105.5**	6934.1**	50.2**	392.8**	0.76**
F_1	23		106.9**	3246.8**	133.9**	5698.9**	0.79**
F_2	23		85.2**	3157.5**	131.5**	4099.3**	0.70**
F_1 *vs* F_2	1		340.3**	2644.0**	108.5**	11341.0**	4.26**
Parents vs (F_1+F_2)	1		2555.3**	15091.7**	127.6**	55762.6**	2.65**
Error		116	2.3	76.1	3.5	56.6	0.01

** P = 0.01

Heterosis over mid-parent value and inbreeding depression expressed for different characters (Table 2) revealed that all the hybrids had significant differences over mid-parent values for days to 50 per cent bloom and grain yield per plant. Heterosis ranged from -4.0 to 130.5 per cent for grain yield per plant. The highest heterosis for grain yield, panicle length and 100-grain wt. was recorded in ms 2077 x M 13, ms 2077 x M1 and ms 2219 x M1 crosses respectively. The results available on the manifestation of heterosis in grain sorghum revealed that increase yield was due to the increase in the panicle length, and 100-grain weight (Kambal and Webster, 1966; Goyal and Joshi, 1976) which substantially contributed towards hetrosis in grain yield. In the present study, the hybrids ms 2077 x M13, ms 2077 x M 28, ms 2077 x M 25 and ms 36 x M 25 which produced highest yield had high magnitude of heterosis for panicle length and hundred grain weight. Length of the panicle is the most important yield component though selection has acted in opposite directions in the evolution of this trait (Rao, 1970).

Inbreeding depression in grain yield per plant was observed to be highly significant for all the hybrids except ms 2219 x M 11. Inbreeding depression ranged from 15.5 to 38.6 per cent for grain yield per plant, 3.3 to 19.6 per cent for 100-grain weight and -21.7 to 29.2 per cent for panicle length. For height, inbreeding depression was recorded in ms 36 x M 9, while the highest heterosis was recorded (48.5 per cent) in ms 2077 x M 9. The results revealed that the hybrids which showed maximum heterosis in F_1 did show maximum inbreeding depression in F_2 also for most of the characters under study. However, in some cases though there was little heterosis, a marked inbreeding depression was observed. This may be an indication that the F_2 seeds may not, afterall, be recommended for commercial cultivation.

(Received on June 30, 1980)

TABLE 2

Heterosis (A) over midparental value and inbreeding depression (B) for various characters expressed as per cent.

Hybrids	Days to 50 per cent bloom		Plant height		Panicle length		Grain yield		Hundred grain weight	
	A	B	A	B	A	B	A	B	A	B
ms 2219 x M1	–12.0**	– 1.6	20.8**	1.7	– 0.8	6.5	53.5**	26.9**	23.3**	5.7
ms 2219 x M9	–19.2**	–10.7**	14.6**	– 0.5	15.1*	24.0**	– 4.0	35.1**	– 6.6*	8.1**
ms 2219 x M11	– 5.9**	– 4.3**	34.9**	– 0.4	– 5.2	– 2.4	14.4	15.5*	10.1**	18.2**
ms 2219 x M13	–14.5**	–11.6**	24.6**	– 0.9	12.8**	10.4*	24.7**	27.0**	19.1**	4.2
ms 2219 x M25	–11.1**	– 9.4**	34.7**	9.8**	8.4	– 8.4*	46.5**	28.1**	4.0	19.6**
ms 2219 x M28	–17.6**	– 7.5**	22.3**	–	16.0**	6.2	43.3**	32.3**	8.4**	8.1**
ms 2219 x M32	–10.9**	–10.1**	35.9**	1.1	9.0	– 1.1	11.1	37.3**	– 9.1**	7.7
ms 2219 x M33	– 6.9**	– 1.2	0.7	3.8	6.2	9.4	– 7.7	22.1*	– 0.4	16.0**
ms 36 x M1	– 8.6**	– 2.7	2.0	– 0.5	11.5	15.8**	94.4**	28.2**	6.6*	21.0**
ms 36 x M9	– 9.4**	– 3.2*	35.0**	28.8**	9.3	–18.4**	48.9**	38.6**	4.5**	3.3
ms 36 x M11	– 5.4**	– 0.4	36.4**	9.7**	4.1	12.6*	99.8**	27.6**	12.4**	4.7*
ms 36 x M13	–13.2**	–44.4**	23.7**	1.5	8.1	29.2**	125.3**	19.5**	13.0**	12.5**
ms 36 x M25	– 8.7**	– 6.5**	33.6**	10.6**	– 2.6	–21.7**	130.2**	20.0**	12.9**	6.5**
ms 36 x M28	– 3.3**	– 1.7	14.6**	– 2.0	5.5	24.9**	117.5**	23.0**	7.0**	10.3**
ms 36 x M32	– 5.8**	– 1.4	33.6**	–	5.0	25.8**	60.5**	15.8**	11.8**	8.3**
ms 36 x M33	– 7.0**	– 0.4	10.4*	– 6.7*	– 7.8	–14.6	28.0**	32.2**	– 0.9	6.6**
ms 2077 x M1	–10.5**	– 1.0	26.2**	9.3**	34.6**	11.6**	64.5**	16.5**	– 2.2	11.4**
ms 2077 x M9	–18.6**	– 3.1	48.5*	1.2	28.2**	– 3.0	57.3**	22.4**	2.9	9.4**
ms 2077 x M11	–12.2**	– 0.5	35.0**	15.4**	33.3**	3.3	108.6**	18.8**	– 8.2**	8.3**
ms 2077 x M13	–12.8**	– 1.0	29.0**	9.5**	29.3**	1.1	130.5**	17.9**	14.9**	5.7**
ms 2077 x M25	–12.4**	– 5.4**	34.3**	– 3.8	23.4**	2.1	115.9**	21.7**	14.6**	9.4**
ms 2077 x M28	–11.2**	– 2.9	27.1**	– 0.4	42.3**	9.4**	123.5**	25.3**	10.6**	5.9*
ms 2077 x M32	– 7.0**	– 4.7**	33.4**	14.1**	– 3.1	– 3.7	88.7**	24.6**	7.5**	8.4**
ms 2077 x M33	–10.1**	– 6.5**	24.5**	2.1	4.6	16.9**	48.9**	21.5**	– 5.5**	3.4
SE	±1.072		±6.169		±1.319		±5.318		±0.084	

*P=0.05 **P=0.01

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