the formation of new alleles or by the increased recombination by breaking linkages.

The estimations of heritability in broad sense and the genetic advance as percentage of mean for different characters were higher in most of the populations in M2 than in the untreated populations. High heritability combined with high genetic advance observed in all the treated populations in both the varieties for plant height, productive tillers and plant yield except at 120 mM EMS in Co 33 for productive tillers indicated that the variation was due to additive genetic effect. The magnitude and heritable portion of the induced variations were found to differ depending upon the genotype, character and mutagen (Rao and Siddiq, 1977; Das *et al.*, 1979). High heritability was reported in M2 and subsequent generations in rice (Anandakumar and Sree Rangasamy, 1986 and Chaudhury *et al.*, 1980). High heritability with high genetic advance was observed for productive tillers and plant yield in rice (Rao and Siddiq, 1977).

All the mutagen treated populations produced mutants with extreme values in respect of all characters and such an enlarged variability would offer ample scope of selection for improvement of yield and yield characters. Mutants with plus and minus values were also observed for plant height in one and the same treatment, particularly in ADT 31. All the mutagen treated population in Co 33 had more number of mutants with significantly reduced mean plant height.

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COMBINING ABILITY IN GRAIN SORGHUM

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ABSTRACT

A diallel set of 10 varieties of grain sorghum **Sorghum bicolor** (L.) Moench was studied to estimate the combining ability for yield and yield contributing traits. The **sca** variance was higher than **gca** variance for almost all the characters. Entry M - 209 was better general combiner for earliness, GJ-35 for dwarfness, DMYT 231 for panicle length, DR 23, for grain yield and M-209 for stover yield. Hybrids GJ - 36 x DR - 20 and GJ-35 x DMYT-231 had high sca effect for days to 50% flowering, GJ-36 x DR-23 and GJ-35 x DMYT-231 for earliness, M-209 x DR3-1 and GJ-36 x DR-10 for dwarfness, GJ-35 x M-209 and GJ-35 x DR-10 for panicle length, GJ-36 x M-229 and M-211 x DR-10 for grain yield.

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Table 1 Analysis of variance for combining ability in grain sorghum.

Characters /Source	d.f.	Mean sums of squares					
		Days to 50% bloom	Days to maturity	Plant height	Panicle length	Grain yield/plant	Stover yield/plant
G C A	9	17.59**	10.88**	643.89**	12.52**	0.003**	0.09**
S C A	45	24.85**	17.89**	893.80**	15.18**	0.017**	0.12**
Error	54	0.34	0.65	54.42	0.81	0.0009	0.02
$\sigma^2 g$		-0.61	-0.58	-20.83	-0.22	-0.001	-0.003
$\sigma^2 s$		24.51	17.24	839.38	14.37	0.016	0.10
$\sigma^2 e$		0.34	0.65	54.42	0.81	0.0009	0.02

* P = 0.05, ** P = 0.01.

MATERIALS AND METHODS

The material comprising a diallel set of 10 parents and their resultant 45 F_1 hybrids was sown in 1986 in RBD with 3 replications. The plots consisted of three rows, each 3 m long, spaced 45 cm. apart with a plant-to-plant spacing of 15 cm. Observations recorded on five randomly selected plants in each treatment for all the replications were days to 50% bloom, days to maturity, plant height panicle length grain yield/plant and stover yield/plant. The data were analysed using Griffing's (1956 Method- 2 and Model-I for estimation o combining ability and gene action.

RESULTS AND DISCUSSION

The variances due to general anc specific combining ability was significan for all the characters under study, indicatec that additive and non-additive gene action: were predominent for these traits ir sorghum (Table 1). Many workers have reported that grain yield was controlled b

Table 2. Estimated effects of general combining ability (gca) in a set of diallel crosses of grain sorghum

Parents	Days to 50% bloom	Days to maturity	Plant height	Panicle length	Grain yield/plant	Stover yield/plant
gca effects						
GJ 35	-0.15	0.03	-9.28**	0.54*	0.02*	0.02
GJ 36	1.02**	0.37	5.05*	-0.48	-0.01	0.13**
M 229	0.85**	0.58*	-4.41*	-0.58*	-0.001	0.01
M 211	0.64**	0.24	-6.74**	-1.68**	-0.001	-0.02
M 209	-1.94**	-1.72**	10.88**	1.27**	-0.01	0.15**
DR 10	-1.23**	0.03	-9.12**	0.34	-0.01	0.02
DR 23	-1.40**	-1.01	5.30*	-1.27**	0.03**	-0.10*
DR 20	1.60**	1.53**	3.63	0.55	-0.03**	-0.07
DR 3 - 1	1.02**	0.78**	7.47**	-0.13	-0.01	-0.07
DMYT 231	-0.40*	-0.84**	-2.78	1.44**	0.02*	-0.03
S.E. ±	0.16	0.22	2.02	0.25	0.008	0.04

was sown in 1986 in RBD with 3 replications. The plots consisted of three rows, each 3 m long, spaced 45 cm. apart with a plant-to-plant spacing of 15 cm. Observations recorded on five randomly selected plants in each treatment for all the replications were days to 50% bloom, days to maturity, plant height panicle length grain yield/plant and stover yield/plant. The data were analysed using Griffing's (1956) Method- 2 and Model-I for estimation of combining ability and gene action.

RESULTS AND DISCUSSION

The variances due to general and specific combining ability was significant for all the characters under study, indicated that additive and non-additive gene actions were predominent for these traits in sorghum (Table 1). Many workers have reported that grain yield was controlled by both additive and nonadditive genetic variance (Liang and Walter, 1968, Vasudeva Rao and Goud, 1977, and Desai *et al.* 1985).

The parents M 209 and DR 23 had significant *gca* effects for days to 50% bloom and days to maturity indicating additive gene action for earliness. The data suggested the presence of additive gene action for dwarfness in GJ 35 and M 211 (Table 2). For panicle length, DMYT 231 and M 209 had high *gca* effect, whereas DR 23 and M 209 exhibited the highest *gca* effect for grain yield and stover yield, respectively.

Estimates of specific combining ability for best cross combinations (Table 3) indicated that the hybrids m 209 x DR 3-1 and GJ 36 X DR 10 showed highest *sca* effects. The hybrids GJ 35 x M 209 and GJ 35 x DR 10 recorded the highest *sca* effect for panicle length. The cross combinations GJ 36 x M 229 and M 211 x DR 10 had highest *sca* effect for grain yield, whereas highest *sca* effect was exhibited for stover yield in M 229 x M 211 and M 211 x DR 3-1.

Table 3. Estimated effects of general combining ability (gca) in a set of diallel crosses of grain sorghum.

Characters	Best combinations	gca effects
Days to 50% bloom	GJ 36 X DR 20	-8.96
	GJ 35 X DMYT 231	-7.80
Days to maturity	GJ36 X DR 23	-6.64
	GJ 35 X DMYT 231	-6.47
Plant height	M 209 X DR 3 - 1	57.52
	GJ 36 X DR 10	53.61
Panicle length	GJ 35 X M 209	8.16
	GJ 35 X DR 10	6.55
Grain yield/plant	GJ 36 X M 229	0.22
	M 211 X DR 10	0.22
stover yield/plant	M 229 X M 211	0.58
	M 211 X DR 3 - 1	0.55

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