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COMBINING ABILITY IN RABI SORGHUM (*SORGHUM BICOLOR* L. MOENCH)

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ABSTRACT

Combining ability effects and variances were estimated in F_1 over three different environments. The mean squares due to gca and sca were highly significant in individual environments as well as pooled over environments, for all the traits. The estimate of interaction component gca x environment and sca x environment was significant for all the traits except days to flowering. However, the interaction component due to gca x environment variances showed higher values as compared to the sca x environment variances. It shows that the additive variance x environment interaction was more as compared to nonadditive variance x environment interaction. The parent Spv-422 and Spv-438 contributed favourable genes for earliness, plant height, while Spv-438, Spv-86 and Spv-41 were good general combiners for grain yield, number of primaries, and secondaries, 250 grain weight, and fodder yield. The crosses involving good x good and good x poor combiners threw more productive lines. Diverse good combiners should be used in hybridization and the resultant material should be exposed to different environments for identifying the stable high yielding genotypes.

Key words: Combining ability, rabi sorghum.

Combining ability helps the breeder in selecting desirable parents for exploitation in breeding programmes. Generally, such studies have been conducted only in kharif sorghum, while such information is limited in rabi sorghum and mostly reported by evaluating the material in rainy season [1, 2]. In view of this, the present study has been conducted in rabi sorghum over three environmental conditions.

MATERIALS AND METHODS

Eight rabi sorghum varieties were selected on the basis of their good yield performance, and crossed (without reciprocals) in diallel fashion. In rabi 1982-83, the parents and 28 F_1s

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were raised in randomized block design with three replications in three diverse environments at the Sorghum Research Station, Marathwada Agriculture University, Parbhani. The environments were: early rabi sowing, normal rabi sowing with irrigation, and normal rabi sowing without irrigation. Each plot of F_1 was single rowed, while that of parents had three rows per replication. The row length was 3 m spaced at 15 cm within and 45 cm between rows. Nonexperimental rows were grown around the experiment to avoid border effects.

Data on days to 50% flowering, plant height, number of leaves, panicle length, panicle breadth, number of primaries and secondaries/panicle, grain yield/panicle, fodder yield/plant, and 250-grain weight were recorded on five random plants in F_1 and on 20 plants in the parents. The character means were used for statistical analysis. The combining ability analysis was carried out following the procedure of Griffing [3] (Methods 2 Model-I) as extended by Singh [4].

RESULTS AND DISCUSSION

The mean squares due to general combining ability (gca) and specific combining ability (sca) were highly significant in pooled environments for the characters, indicating the importance of both additive and nonadditive components of genetic variance controlling these traits (Table 1).

Table 1. ANOVA for combining ability (F_1) for ten quantitative characters pooled over three environments

Source	d.f.	Mean sum of squares									
		days to flowering	plant height	No. of leaves	panicle length	panicle breadth	No. of primaries per panicle	No. of secondaries per panicle	grain yield	fodder yield	250-grain weight
Gca	7	90.5**	2445.8**	1.0**	18.0**	3.3**	113.2**	3036.7**	276.9**	524.6**	2.2**
Sca	28	20.0**	317.0**	0.6**	8.1**	4.0**	103.3**	2451.7**	181.7**	377.6**	1.1**
Environ.	2	153.0**	35257.4**	8.7**	188.7**	35.6**	1131.2**	24235.1**	4522.2**	8339.4**	31.2**
Gca x Environ.	14	1.1	181.6**	0.20**	2.1**	0.2**	12.2**	354.3**	22.8**	80.8**	0.3**
Sca x Environ.	56	1.1	75.9**	0.1**	1.5**	0.4**	9.3**	173.0**	15.1**	39.8**	0.2**
Error	210	0.7	2.6	0.03	0.2	0.1	1.6	15.8	0.8	1.8	0.02

**Significant at 1% level.

The differences between the environments were also highly significant. As regards mean squares due to gca x environments and sca x environments, these estimates were also highly significant for all the characters studied except days to flowering. The magnitude of interaction component due to gca x environment was of higher order.

The estimates of gca effects revealed significant differences between parents for all the characters (Table 2). The parent Spv-422, and Spv 438 were the best general combiners for early flowering and tallness. Thus, these can be utilized in conventional breeding programmes to induce earliness and tallness.

Table 2. Estimates of the general combining ability effects of the parents pooled over three environments for ten quantitative characters in rabi sorghum

Parent	Days to 50% flowering	Plant height	No. of leaves	Panicle length	Panicle breadth	No. of primaries per panicle	No. of secondaries per panicle	Grain yield per panicle	Fodder yield per plant	250-grain weight
Spv-422	-3.19**	9.24**	-0.05**	0.37**	-0.20**	-2.59**	-5.67**	-2.87**	0.86**	0.08**
Spv-271	-0.02**	-13.33**	-0.30**	-0.40**	-0.30**	0.32	-5.53**	-1.76**	-5.54**	-0.25**
Spv-43	3.14**	-9.68**	-0.14**	1.57**	0.01	-0.72**	-10.97**	-3.53**	-6.42**	-0.36**
Spv-86	-0.12**	-1.43**	0.01**	0.05**	0.28**	1.31**	6.70**	2.44**	3.22**	0.12**
Spv-41	0.28	-6.69**	0.01	0.18**	0.02	1.15**	6.87**	3.28**	0.86**	-0.33**
M-35-1	0.76**	6.29**	0.31**	-0.01**	-0.29**	-1.76**	-9.49**	-1.57**	-1.13**	0.30**
Spv-438	-0.54**	7.80**	-0.01**	-0.57**	0.66**	3.41**	18.50**	4.61**	5.53**	0.21**
Spv-440	-0.32	7.99**	0.17**	-0.18**	-0.17**	-1.13**	-0.40	-0.59**	2.61**	0.22**
SE (gi) ±	0.02	0.08	0.01	0.00	0.01	0.05	0.46	0.02	0.05	0.00
SE (gi-gj) ±	0.05	0.17	0.01	0.01	0.01	0.11	1.05	0.05	0.12	0.00

The magnitude and direction of the gca effects points to Spv- 438, Spv-86 and Spv-41 as excellent general combiners with high (per se) mean and they contributed maximum favourable genes for grain yield. They were also good general combiners for number of primaries, secondaries, and 250-grain weight. Venkateswarlu and Singh [5] also reported that the choice of parents should not only be based on one main component but on its merit in a cross with other major components. Thus, these parental lines can be used as a potential source for improving these characters. A composite of these lines or an intermating population involving all possible crosses among them subjected to biparental progeny selection will be expected to offer the maximum promise in breeding for higher yield.

Most of the crosses showing significant positive sca effects were derived from good and one poor general combiner. This indicated that in heterosis breeding, at least one good combining parent is essential. Three crosses Spv-438 x Spv 440, Spv-43 x Spv-86 and Spv-43 x Spv-440 were the best specific crosses for grain yield with the sca estimates of 12.52, 12.19 and 8.80, respectively. In respect of fodder yield, the tall parents Spv-438 and Spv-440 produced best specific crosses. The cross Spv-438 x Spv-440 was the best specific cross (0.86 sca effect) for 250-grains weight in all the three environments. These include poor x high gca parents, indicating dominance gene action.

Based on these results it is concluded that the selection of the parents should be done on the basis of combining ability tests over different environments. The magnitude of gca and sca effects and their interaction with environments provide a valuable information for conventional as well as hybrid breeding programmes. The close relationships between sca and heterosis and between gca and parents indicate considerable scope for improvement in the parent lines. Thus, these associations could provide valuable guidelines for the development of varieties as well as hybrids for future breeding programme for rabi sorghum.

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