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Combining Ability Analysis Over Environments in Sorghum

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ABSTRACT

The line × tester analysis in Sorghum revealed that the gca and sca effects were significant for all the aits studied at four locations. 296A and 2077A among females and M 50, M 35 and M 34 among males ere good general combiners for grain yield, number of grains per plant and panicle length. These enotypes also exhibited high sca effect in cross combinations among themselves for number of primaries, anicle length, number of grains and grain yield per plant.

The capacity of a genotype to transmit its superiority to its offspring can be best judged by combining bility analysis. The combining ability analysis also helps the plant breeder in identification of desirable arents as well as superior F_1 hybrids to be used for subsequent selection in segregating generations. The resent study was conducted to estimate combining ability from a line × tester analysis.

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MATERIALS AND METHODS

Five female lines were crossed with twenty-two ansformed male lines adopting line × tester ating design. The resultant 110 F_1 hybrids longwith the 27 parents were grown in a ndomized block design with three replications at our different locations namely Navsari, Surat, agudan and Deesa during *Kharif* 1981. The ndividual plot consisted of three rows, 3.0 m long, paced 45 and 15 cm between row-to-row and plant-o-plant within row, respectively. Observations were ecorded on 5 randomly selected plants from each lot on days to 50 per cent bloom, plant height cm), panicle length (cm), number of *primaries*, 00-grain weight (g) number of grains per plant and rain yield per plant (g). The data were analysed for ombining ability effects and variances following Iempthorne (1957) and Rao *et al.* (1968).

RESULTS AND DISCUSSION

The analysis of variances for combining ability or seven characters over locations are presented in able 1. The data revealed that there were gnificant differences among the locations with spect to all the traits except 100 grain weight. The gnificant differences were observed among both males and males for all the characters.

Females × males interaction was also highly significant. It suggested that females manifested differential behaviour with different males for all the traits. Data further revealed that both males and females interactions with locations were significant for most of the characters. However, males appeared relatively stable over locations. Females × males × locations interactions for most of the attributes were significant indicating differential behaviour of males with different females was not stable over the locations. These results agreed with the findings of Singhania (1972). Development of stable genotypes demands the testing of material over entire range of agroclimatic conditions. This could be particularly true in case of improvement of those characters which are influenced largely by fluctuations in environments.

Estimate of variance components showed predominant role of both additive and non-additive genetic variance in the inheritance of most of the traits. However, estimate of σ^2 gca was smaller in magnitude as compared to that of σ^2 sca for all characters except days to 50 per cent bloom, 100 grain weight and grain yield per plant. Kambel and Webster (1965), Rao 1970c, Thanky *et al.* (1981) and Patel *et al.* (1982) reported significant influence of both the variances σ^2 gca and σ^2 sca on various characters.

TABLE 1
Analysis of variance for various characters over locations.

Source	df	MEAN SQUARES						
		Days to 50% bloom	*Plant height*	*Panicle length*	*Number of primaries*	*100 grain weight*	*Number of grains per plant*	*Grain yield per plant*
Locations	3	31.53**	333583.33**	2196.93**	22634.70**	0.03	16355000**	14115.00**
Replications within locations	8	40.98**	1305.25**	100.59**	298.35**	0.56**	728875**	787.50**
Females	4	5927.40**	18575.25**	3880.80**	10960.40**	16.30**	44256500**	121693.50**
Males	21	140.12**	6028.48**	96.68**	704.68**	1.11**	12574761**	12817.04**
Females × Males	84	47.34**	1034.46**	22.16**	224.07**	0.16**	2600976**	3885.62**
Females × Locations	12	4.38	1522.75**	223.50**	273.56**	0.07*	252583*	707.42**
Males × Locations	63	6.70	462.51**	10.56**	103.09**	0.03	292952*	651.81**
(Females × Males) location	252	7.09*	282.17*	8.29**	78.32**	0.03	188179	619.86*
Error	872	6.29	254.60	6.07	40.86	0.04	208185	526.81
σ^2 gca		18.44	65.17	3.26	33.94	0.05	158828	390.80
σ^2 sca		13.81	83.59	4.77	48.58	0.04	268089	362.86
σ^2 gca × locations		0.03	19.49	20.10	2.72	0.01	2092	1.49
σ^2 sca × locations		0.82	25.18	2.83	25.14	0.03	107104	93.16

*P = 0.05, **P = 0.01

TABLE 2

General combining ability effects for parents.

Characters	*Days to 50% bloom*	*Plant height*	*Panicle length*	*Number of primaries*	*Hundred grain weight*	*Number of grains/ plant*	*Grain yield/ plant*
Females							
ms 296	3.37**	0.47	4.47**	8.92**	0.24**	303.97**	20.68**
ms 323	3.40**	4.00**	-2.15**	-1.07**	0.19**	-120.05**	3.78**
ms 2077	1.96**	9.57**	3.85**	3.90**	-0.01	537.34**	18.14**
ms 2219	-7.90**	-13.15**	-2.78**	-6.63**	-0.39**	-446.95**	-30.41**
ms 3660	-0.82**	-0.89	-3.40**	-5.11**	-0.04**	-274.32**	-12.18**
SE (gj) ±	0.124	0.787	0.128	0.329	0.015	27.383	1.235
Males							
M 34	1.25**	-10.27**	1.82**	6.32**	-0.08**	516.30**	13.47**
M 35	-0.47	-7.72**	2.39**	5.27**	-0.01	640.82**	25.48**
M 36	-0.65	-2.87	-1.15**	-1.25	-0.01	-54.27	-1.14
M 37	0.53	-6.62**	0.12	-3.65**	0.23**	-640.65**	-19.29**
M 38	0.12	2.06	0.26	1.04	-0.12**	278.35**	-13.93**
M 39	0.70	6.43**	-0.69	-3.07**	-0.20**	162.22**	-1.24
M 40	0.26	5.08**	0.75**	-0.44	-0.01	-131.30	-5.39
M 41	-2.19**	19.80**	-0.40	-2.08**	-0.01	-391.03**	-12.22**
M 42	1.44**	1.88	-0.82**	-0.44	-0.04	-121.95	-6.12
M 43	0.28	2.80	1.37**	4.19**	-0.08**	877.88**	28.17**
M 44	-0.94**	21.13**	-1.56**	-1.43	0.13**	-457.97**	-12.74**
M 45	2.19**	-5.69**	0.41	0.15	0.09**	12.97	1.63
M 46	1.44**	-3.34	-0.90**	0.83	-0.16**	-44.02	-8.41**
M 47	0.46	-2.49	0.63	1.23	-0.07**	266.78**	7.33**
M 48	2.57**	2.10	0.39	-0.54	0.01	-488.82**	-3.38
M 49	0.77**	20.96**	-1.34**	-1.49	0.42**	-646.82**	-11.70**
M 50	-0.30	-6.47**	3.12**	8.82**	0.01	1050.53**	34.15**
M 51	-4.48**	+15.02**	0.32	-3.61**	-0.15**	-44.18	-6.63
M 52	-0.67	-7.94**	-0.72	-1.00	-0.09**	-149.30	+10.53**
M 53	-1.75**	-4.35	-1.31**	-4.66**	-0.07**	-341.38**	-16.80**
M 54	-0.37	-11.22**	-0.82**	-3.18**	-0.09**	-250.17**	-3.75
M 55	-0.20	1.76	-0.89**	-0.99	-0.04	-47.00	-4.01
SE (gj) ±	0.283	1.803	0.278	0.753	0.023	62.783	2.830

*P = 0.05 **P = 0.01.

TABLE 3

Specific combining ability effects for different characters of 5 best hybrids.

Sr. No.		Days to 50% bloom (for earliness)	Plant height (for dwarfness)	Panicle length	Number of primaries	100 grain weight	Number of grains/ plants	Grain yield per plant
1.	F_1	3660 A × M 53	323 A × M 49	2077 A × M 50	2077 A × M 34	2219 A × M 45	366 A × M 45	323 A × M 48
	SCa	-5.36	-24.05	3.48	0.92	0.30	1023.75	48.20
2.	F_1	2077 A × M 55	3660 A × M 46	2219 A × M 53	296 A × M 35	2219 A × M 38	296 A × M 34	2077 A × M 34
	sca	-3.97	-19.19	3.12	8.38	0.22	948.96	33.27
3.	F_1	3660 A × M 51	3660 A × M 47	2077 A × M 34	296 A × M 50	323 A × M 52	296 A × M 50	3660 A × M 45
	sca	-3.69	-18.62	3.07	8.18	0.21	936.89	32.36
4.	F_1	323 A × M 37	296 A × M 44	2077 A × M 35	2077 A × M 43	2077 A × M 34	296 A × M 34	296 A × M 50
	sca	-3.52	-17.44	2.96	7.68	0.19	718.84	31.76
5.	F_1	2219 A × M 45	2219 A × M 44	296 A × M 43	296 A × M 43	296 A × M 39	323 A × M 54	296 A × M 35
	sca	3.43	-14.74	2.47	7.38	0.28	718.28	30.04

The relative magnitude of gca and sca also varied with the change in the genetic architecture of the parental population involved, sca assuming greater importance in combination of greater diversity. But in the study of interaction of gca and sca with locations, there were fluctuating results. Kambel and Webster (1965) observed gca to be stable over environments while Liang *et al.* (1968) found sca to be more stable.

An overall appraisal of gca effects revealed that female lines 296 A and 2077 A were good general combiners for grain yield per plant, panicle length and number of primaries. For earliness, 2219 A was the best general combiner among females. Similarly among males, M 34, M 35 and M 50 were good general combiners for dwarfness, grain yield and number of grains per plant. On the contrary, M 49 was a good general combiner for grain weight. Specific combining ability of most promising hybrids for different characters are given in Table 3. Results indicated that crosses of 296 A and 2077 A with M 50, M 34 and M 35 exhibited desirable sca effects. Among better parents, 296, M 50 and M 35 had high gca effects and also exhibited high sca effect in cross combination among themselves for number of primaries, panicle length, number of grain and grain yield per plant. It indicated that these parents have highest yielding potentiality in hybrid breeding programme (Srihari and Nagur. 1980).

The hybrids 296 A × M 50 and 2077 A × M 35 could be used for commercial planting after evaluating for diseases and pests.

REFERENCES

Kambel, A. E. and Webster, O. J. (1965). Estimates of general and specific combining ability in grain sorghum. Sorghum vulgare pers. *Crop Sci.* **5** : 521-523.

Kempthorne, O. (1957). "An introduction to genetic statistics". John Wiley and Sons, Inc. Newyork.

Liany, G. H. L., Heyne, E. G., Chung, J. M. and Koh, Y. O. (1968). The analysis of heritable variation for three agronomic traits in a 6-variety diallel of grain Sorghum (*Sorghum vulgare* Pers.) *Can. J. Genet. Cytol.* **10** : 460-469.

Patel, R. H., Desai, K. B. and Dabholkar, A. R. (1982). Combining ability for grain yield and its components in Sorghum. *Indian J. Agric. Sci.* **52** : 713-717.

Rao, N. G. P. (1968). Some consideration in breeding for higher yield. *Indian. J. Genet.* **28 A** : 31-42.

Srihari, A. and Nagur, T. (1980). Combining ability studies in Sorghum. *Sorghum news letter* **23** : 12.

Thankey, H. H., Desai K. B. and Tikka, S. B. S. (1981). Heterosis and combining ability in grain sorghum. *GAU Res. J.* **6 (2)** : 65-71.