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COMBINING ABILITY IN NEWLY DEVELOPED PARENTS OF *KHARIF* SORGHUM [*SORGHUM BICOLOR* (L) MOENCH]

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Abstract

Five lines and ten testers were crossed in line x tester fashion and the resultant 50 hybrids were evaluated along with the checks for yield and yield components using combining ability analysis. The study revealed that the females AKMS-27A and AKMS-40A and the male AKR-496 were the best general combiners for grain yield and some of its components. The crosses AKMS-40A × AKR-497, AKMS-27A × AKR-456 and AKMS-14A × AKR-496 showed high mean performance, significant *sca* effects and involved at least one parent with significant *gca* effects for grain yield per plant and hence appeared to be best for further exploitation.

Key words : Combining ability analysis, *gca*, line × tester, *sca*, *Sorghum*.

Introduction

Sorghum has good potential for grain yield. Development of the varieties/hybrids of grain *Sorghum*, making them popular among the cultivators will therefore, be definitely helpful for increasing and improving the grain production. Exploitation of heterosis and genetic improvement of grain *Sorghum* depend upon the choice of the parents. Hence, combining ability is a useful tool with plant breeder for formulating an efficient breeding programme to evolve superior genotypes and also helps in deciding the breeding strategies.

Materials and Methods

In the present investigation, by using five lines *viz.*, AKMS 27-A, AKMS-30 A, AKMS-40 A, AKMS-90 A, AKMS-14 A and ten restorers *viz.*, AKR-493, AKR-494, AKR-495, AKR-496, AKR-497, AKR-498, AKR-499, AKR-500, AKR-422 and AKR-456, crosses were made in Line × Tester fashion and all the resulting fifty crosses and their fifteen parents were sown in randomized block design (RBD) with three replications during *kharif* season of 2009 on the field of *Sorghum* Research Unit , Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (M.S), India. The material was sown in single row of 4 meter length and spaced 45 cm apart and plant to plant distance kept at 15 cm. The observations were recorded on five random plants for each treatment in each replication on days to 50% flowering, days to maturity, number of primaries per panicle, number of grains per panicle, 1000 seed weight (g), plant height (cm), panicle length (cm), panicle breadth (cm), grain yield per plant (g) and fodder yield per plant (g). The data on all the above characters were subjected to combining ability analysis by following Kempthorne (1957) method. CSH 14 was used as check for two characters *i.e.* days to fifty percent flowering and days to maturity while for rest of the characters CSH 9 was used as the check.

Results and Discussion

Analysis of variance showed that the parents differed significantly for all the characters under study except panicle length and breadth indicating sufficient variability in the parental lines. Similarly hybrids also showed highly significant differences for all the traits. Analysis of variance for combining ability (table 1) revealed that the variance due to lines was highly significant for all the characters indicating that these female lines are highly diverse. The variance due to testers was highly significant for 1000 seed weight, panicle length and non significant for all other remaining traits. However, the magnitude of variance was higher in females as compared to that in

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Table 1: Analysis of variance for combining ability.

Source of variation	df	Days to 50 % flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Panicle breadth (cm)	Number of primaries per panicle	Number of grains per panicle	1000 seed weight(g)	Grain yield per plant(g)	Fodder yield per plant (g).
Replications	2	16.26**	30.93**	953.51**	1.08	1.30	9.43	132.05**	519325.19**	739.48**	867.59**
Lines	4	623.27**	470.6**	10856.42**	197.79**	5.44**	63.32**	811.15**	3691109.5**	6179.03**	17286.97**
Testers	9	13.38	11.29	362.17	19.59**	1.59	6.54*	97.10	272940.03	275.76	794.05
Line xTester	36	24.46**	23.90**	176.34*	5.52	0.78	2.97	51.14**	340057.94**	317.99**	434.85**
Error	98	3.23	3.70	114.55	5.78	0.65	3.10	14.13	76286.14	145.63	125.17

* significant at 5 % level of significance ** significant at 1 % level of significance

Table 2: General combining ability effects of parents

Parents	Days to 50 % flowering	Days to maturity	Plant height (cm)	Panicle length (cm)	Panicle breadth (cm)	No. of primaries /panicle	No. of grains/ panicle	1000 seed weight(g)	Grain yield per plant(g)	Fodder yield per plant (g).
Female (lines)										
AKMS 27 A	-2.00**	-2.18**	22.97**	4.33**	0.25	8.48**	147.51**	1.53**	10.42**	31.24**
AKMS 30 A	2.20**	1.74**	18.45**	0.32	0.39**	-4.71**	-287.50**	0.23	-5.17*	11.21**
AKMS 40 A	5.06**	4.74**	-13.03**	-1.17**	-0.46**	-1.33	437.88**	0.62	19.51**	3.24
AKMS 90 A	1.53*	1.24*	-12.44**	-1.74**	0.28**	0.92	126.39*	-0.00	-13.05**	-31.44**
AKMS 14 A	-6.80**	-5.55**	-15.95**	-1.74**	-0.45**	-3.36**	-424.28**	-2.37**	-11.70**	-14.26**
SE(gi)	0.51	0.53	2.018	0.39	0.13	0.69	49.718	0.33	2.17	1.99
CD at 5%	1.02	1.06	4.00	0.79	0.23	1.37	98.66	0.66	4.32	3.95
CD at 1%	1.36	1.41	5.30	1.04	0.36	1.18	130.60	0.87	5.72	5.22
Male (testers)										
AKR-493	1.86*	1.11	-4.35	1.15*	0.52**	-0.21	-83.24	1.13*	0.80	-11.92**
AKR-494	0.86	0.44	-7.52**	0.50	-0.46*	-0.68	-253.65**	0.22	-1.66	-9.61**
AKR-495	0.26	0.11	-3.97	0.60	0.50	-1.82	69.89	0.11	4.56	-3.73
AKR-496	-0.06	-0.47	10.17**	2.03**	0.33	1.37	74.52	0.14	6.57*	14.17**
AKR-497	0.06	-0.28	1.18	-0.21**	-0.25	-3.08**	-66.29	-0.58	-2.71	-0.09
AKR-498	-0.66	-0.68	1.67	-1.96**	0.22	0.13	-24.56	0.09	-5.96	1.16
AKR-499	1.13	-0.28	1.20	-0.61**	-0.30	1.17	-17.06	-0.15	-1.80	2.82
AKR-500	-0.93	-0.28	3.18	0.04	-0.26	1.68	-58.94	0.54	5.83	2.88
AKR-422	-0.86	-1.28	0.86	-1.05**	-0.09	-3.62**	245.7**	-1.35**	-1.84	2.35
AKR-456	0.60	1.64**	-2.43	-0.46**	0.16	5.06**	113.61	-0.15	-3.79	1.95
SE(gi)	0.73	0.76	2.85	0.56	0.19	0.97	70.31	0.47	3.08	2.81
CD at 5%	1.45	1.50	5.66	1.11	0.39	1.93	139.53	0.93	6.11	5.58
CD at 1%	1.92	1.99	7.49	1.48	0.51	2.56	184.70	1.24	8.09	7.39

* Significant at 5% level of significance, ** significant at 1 % level of significance.

Table 3 : Mean performance and specific combining ability effects of top ranking five crosses with *gca* effects and mean performance of their parents for grain yield per plant.

S. no.	Crosses	Grain yield (g)	SCA	GCA of parents		Mean performance of parents (g/plant)	
				P 1	P2	P 1	P2
1	AKMS- 40A × AKR-- 500	159.92	9.619	19.51**	5.83	80.45	101.67
2	AKMS- 40A × AKR-- 497	156.57	14.815*	19.51**	-2.71	80.45	93.52
3	AKMS- 27A × AKR-- 456	150.51	19.323**	10.42**	-3.79	96.29	110.62
4	AKMS- 14A × AKR-- 496	149.06	29.237**	-11.70**	6.57*	106.50	104.97
5	AKMS- 27A × AKR-- 493	147.14	10.958	10.42**	0.80	96.29	85.07

* Significant at 5% level of significance, **Significant at 1 % level of significance.

males for all the traits. The variance due to females × males was highly significant for all the traits except for 1000 seed weight, panicle length and panicle breadth indicating the presence of significant differences between males and females.

The data on *gca* estimates for yield and yield components (table 2) indicated that none of the parents showed significant and desirable *gca* effects for all the characters. However, among lines AKMS-27 A *gca* effects in desirable direction for eight out of the ten characters *viz.*, fodder weight per plant (g), days to 50% flowering, days to maturity, number of primaries per panicle, 1000 seed weight (g), plant height (cm), panicle length (cm) and panicle breadth (cm). Another female AKMS-40 A showed desirable *gca* effects for grain yield along with number of grains per panicle. Similarly, among testers, AKR-496 exhibited significant *gca* effects for the characters grain yield per plant, fodder yield, panicle length and plant height. Singhania (1980), Patil (2000), Tiwari *et al.* (2003) in their combining ability studies pointed out good combiners on the basis of *gca* effects which supports the inference drown above. From the results on *gca* effects, it is apparent that the use of female parents AKMS-27 A and AKMS-40 A and male parent AKR-496 in the hybrid breeding or to generate more number of transgressive segregants in the subsequent generations for grain yield and its components, which may be exploited.

The cross AKMS-14 A × AKR-496 exhibited highest significant *sca* effects for grain yield per plant in desired direction followed by the cross AKMS-27A ×AKR-456 and AKMS-40 A × AKR-497. The top ranking five crosses on the basis of grain yield per plant with their *sca* effects and *gca* effects and *per se* performance of their parents are presented in table 3. The examination of table 3 clearly indicated that most of the promising crosses had significant sca effects and involved atleast one parent with better combining ability and high per se performance. All the top ranking five cross combinations involved high x low gca effects of the parents involved in the crosses. The proper choice of the parents based on combining ability and per se performance of the parents thus is necessary for heterosis breeding. Similar findings have also been reported by Patil and Mistry (1997). However, Hariprasanna *et al.* (2012) reported that some of the crosses with positive significant *sca* for grain yield involved even low x low combination of parents. Out of these top ranking crosses, three crosses *viz.*, AKMS-40A × AKR-497, AKMS-27A × AKR-456 and AKMS-14A × AKR-496 showed high mean performance, significant *sca* effect and involved atleast one parent with significant *gca* effects for grain yield per plant and hence appeared to be best for further exploitation.

Thus, the present study may be useful for selecting good combiners for grain yield per plant. The lines AKMS-27 A and AKMS-40 A and tester AKR-496 showed good general combining ability for grain yield per plant for other yield contributing characters. These parents can be further utilized in *Sorghum* experimental hybrid development programme for the exploitation of their good general combining ability. Similarly, the crosses AKMS-40 A × AKR-497, AKMS-27 A × AKR-456, AKMS-14 A × AKR-496 showed superior performance for grain yield per plant along with positive significant *sca* effects. So, these crosses can be commercially exploited using heterosis breeding after their thorough evaluation in multilocation trials.

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