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Studies on Combining Ability for Yield and Its Component Traits in Rabi Sorghum [*Sorghum bicolor* (L.) Moench]

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A B S T R A C T

The study was carried out to assess the general combining ability of the parents and specific combining ability of the hybrids, using line x tester mating design. Fifty hybrids (derived from mating two testers with twenty-five lines in L x T design) along with their parents and checks (M35-1, BJV 44 and PKV Kranti) were evaluated during the *rabi* 2018-19. The ratio of σ^2 GCA/σ^2 SCA was less than unity for all the characters except for panicle indicating preponderance of non-additive gene action. Among female parents M 31-2A was the best combiner for grain yield per plant, number of seeds per plant and 100 seed weight and 104A for panicle length. Among male parents, IS 995, IS 19450, IS 23590 and IS 23891 were found to be the best general combiner for grain yield per plant and number of seeds per panicle. The cross combinations *viz.*, M 31-2A × IS 11619 and M 31-2A × IS 32439 exhibited highest and positive *sca* effects for grain yield per plant.

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is one of the important cereal crop cultivated globally for food, fodder, feed and fuel. It ranks fifth after wheat, rice, maize and barley in area and production. It is the second cheapest source of energy and micronutrient after pearl millet. It is mainly grown in semi-arid tropics of Asia, Africa, America and Australia, In Africa and Asia sorghum grain is mainly used as food, while in the United States and Australia it is used to feed cattle (Reddy *et al.*, 2013). Globally, sorghum is grown in an area of 42.50 million hectares to produce 59.91 million tonnes, with the productivity of around 1.60 tonnes per hectare.

Sorghum has wide range of adaptability to various agroecological situations of the region. Combining ability studies provide useful information regarding the selection of suitable parents for effective hybridization programme (Sprague and Tatum, 1942). It also indicates the nature and magnitude of various types of gene action involved in the expression of quantitative characters. Such information is of potential use in formulating and executing an efficient breeding programme for achieving maximum genetic gain with minimum resources and time. Hence, this study was conducted with the aim to estimate the combining ability of the selected lines and testers in sorghum.

Materials and Methods

The male sterile lines *viz.*, 104A and M 31-2A representing *milo* and *maldandi* sources of male sterility, respectively were used as testers. Twenty-five diverse germplasm accessions were selected from minicore collection and were crossed to each of these two male sterile lines in line x tester fashion (Kempthorne, 1957) to obtain 50 hybrids. These 50 hybrids along with their parents and three checks *viz.*, M-35-1, BJV 44 and PKV Kranti were grown in randomized block design during *rabi* 2018-19 at Dharwad. The hybrids were grown each in a single row of four meters length in three replications with spacing of 45 cm x 15 cm and all the recommended agronomic practises are followed to raise the good crop.

Biometrical observations was recorded on five randomly selected competitive plants in each replication for the traits *viz.*, days to 50 per cent flowering, plant height (cm), number of leaves per plant, panicle length (cm), panicle width (cm), number of primaries per panicle, number of seeds per panicle, panicle weight (g), 100 seed weight (g) and grain yield per plant(g). The mean values of observations were subjected to statistical analysis to estimate general combining ability (*gca*) and specific combining ability (*sca*) effects of the parents and crosses (Panse and Sukhatme, 1967).

Results and Discussion

The analysis of combining ability variance for yield and yield related traits is presented in Table 1. The mean sum of squares due to crosses was found to be significant for all the traits. The mean sum of squares due to lines was significant for all the traits except for number of primaries per panicle. The traits like plant height, number of leaves, panicle length, panicle weight, grain yield per plant and 100 seed weight have shown peak significant mean sum of squares among the testers. The line × tester effects also shown significant mean sum of squares for all the traits.

The per cent contribution of lines, testers and line × tester along with estimates of GCA and SCA variance are presented in Table 1. The magnitude of SCA variance was higher than GCA variance for all the nine traits studied except for panicle length (Jadhav and Deshmukh 2017) indicating the presence of non-additive variance and non-additive gene action indicates preponderance of non-additive gene action. Prevalence of non-additive gene action in sorghum was reported by Kumar and Chand (2015) and Dehiwal *et al.*, (2017).

It is evident from the table that lines revealed preponderance influencer in the expression all traits studied *viz.*, days to 50 per cent flowering (77.50 %), plant height (57.87%), number of leaves per plant (74.12 %), number of primaries per panicle (53.52 %), panicle length (52.32%), panicle width (53.79 %), panicle weight (58.93 %), grain yield per plant (51.69 %), number of seeds per panicle (71.54 %) and 100 seed weight (71.52 %).

General combining ability (*gca*) effects

Significant and negative *gca* effects are desirable for days to 50 per cent flowering. Out of twenty-five lines, twenty-three lines showed significant *gca* effect for days to 50 per cent flowering. However, eleven were in negative and twelve were in positive direction. IS 19975 (14.03) and IS 26025 (6.83) accounted for high *gca* in negative direction which is desirable. None of the testers was found to be significant in either positive or negative direction for *gca* effect (Table 2).

As regards to plant height the magnitude of variation for *gca* effects for lines ranged from 17.50 (IS 30451) to -29.32 (IS 26617). The lines *viz.*, IS 30451 (17.50) and IS 4581 (17.30) were found to have positive significance. Extreme negative significant *gca* effect was indexed by the line IS 26617. In case of testers, M 31-2A (5.24) had positive significance. With respect to number of leaves per plant estimates of *gca* were significant for 15 lines and out of which seven were found to be in positive direction. The lines *viz.*, IS 31651 (2.92), IS 30451 (2.08) and IS 11619 (1.92) and tester M 31-2A (0.54) were found having significant *gca* positive effect.

The estimates of *gca* effects for panicle width varied from -0.93 (IS 19450) to 0.90 (IS 26025). Out of 25 lines, 16 lines indexed for significant *gca* effects. Of all these, the lines *viz.*, IS 26025 (0.90), IS 30451 (0.78), IS 25989 (0.68) and IS 24462 (0.65) have accounted for highest *gca* effect for panicle width. The magnitude of variation of *gca* effects for panicle length among lines varied from 9.41 (IS 602) to -5.41 (IS 11619). Out of 25 lines, 14 exhibited significant *gca* effects, seven lines exhibited significant positive *gca* effect in positive direction. The line *viz.*, IS 602 (9.41) accounted for highest significant *gca* effect in positive direction. Among testers 104A (2.26) had positive significance.

Among 25 lines, 20 lines accounted for significant *gca* effect for number of primaries per panicle. Out of 9 lines which were showing positive *gca* effects the lines *viz.*, IS 19450 (13.73) and IS 29269 (9.23) accounted for highest significant *gca* effect in positive direction. Among testers, M 31-2A (1.78) was found positively significant.

The range of *gca* effects for panicle weight for lines and testers varied from -21.88 (IS 20679) to 26.83 (IS 32439) and -4.62 (104A) to 4.62 (M 31-2A), respectively. Among lines, IS 32439 (26.83) and IS 19450 (25.36) showed peak positive significant *gca* effect. In contrast, the lines IS 20679 (21.85) and IS 602 (18.50) showed peak negative significant *gca* effect. Among testers, M 31-2A exhibited positive significant *gca* effect.

Grain yield per plant is very important yield contributing trait Among lines, the magnitude of variation of *gca* effects for grain yield per plant varied from -13.13 (IS 20679) to 13.58 (IS 19450). The lines *viz.*, IS 19450 (13.58), IS 23590 (11.94) and IS 23891(11.39) accounted for highest significant positive *gca* effects. Among testers, M 31-2A (3.79) exhibited significant positive *gca* effect. For number of seeds per panicle the *gca* effects among lines varied between -561.88 (IS 4581) to 819.94 (IS 23891).

Nine lines recorded significant *gca* effects in positive direction. The line IS 23891 recorded highest significant positive *gca* effects followed by IS 995 (722.11). On the other hand the lines IS 4581 (561.88) and IS 29654 (538.72) recorded highest significant negative *gca* effects. Among testers, M 31-2A (76.56) exhibited significant positive *gca* effects.

Among lines, the estimates of *gca* effect for hundred seed weight varied from -0.63 (IS 23891) to 1.23 (IS 4581). Out of 25 lines, eight were found to have significant effect for *gca*. The line IS 4581 (1.29) topped the list showing positive *gca* effect, whereas the line IS 23891 (0.63) exhibited highest significant *gca* in negative direction. The tester M 31-2A (0.10) recorded significant positive *gca* effect.

Specific combining ability (*sca*) effects

Among 50 crosses, 15 crosses exhibited significant *sca* effects in negative desirable direction for days to 50 per cent flowering.

Table.1 ANOVA for combining ability for yield and yield components in *rabi* sorghum

Source of variation		1	2	3	4	5
	df	Days to 50% flowering	Plant height(cm)	Number of leaves per plant	Number of primaries panicle^{-1}	Panicle length (cm)
Replication	2	0.88	1.047	0.060	0.34	5.87
Crosses	49	103.52**	590.41**	8.44**	163.44**	63.91**
Lines effect	24	163.81**	676.60*	12.77**	178.62	68.21*
Testers effect	1	2.16	4129.12**	44.82**	478.82	770.16**
Lines × Testers effect	24	47.45**	335.77**	2.59**	135.11**	30.11**
Error	98	2.41	19.94	0.64	3.40	6.26
Total	149	35.64	207.29	3.20	55.99	25.14
σ^2 GCA		2.00**	59.21**	0.700**	8.03*	10.24**
σ^2 SCA		15.17**	106.92**	0.717**	43.89**	8.64**
σ^2 GCA/ σ^2 SCA		0.13	0.55	0.98	0.18	1.18
Contribution (%) of Lines		77.50	57.87	74.13	53.52	52.32
Contribution (%) of Testers		0.04	14.27	10.83	5.97	24.59
Contribution (%) of Line × Tester		22.45	27.85	15.02	40.49	23.07

Source of variation		6	7	8	9	10
	df	Panicle width (cm)	Panicle Weight (g)	Grain yield per plant (g)	Number of seeds per panicle	100 Seed weight (g)
Replication	2	0.11	1.44	14.59	10874.33	0.08
Crosses	49	1.35**	789.60**	336.02**	570629.30**	0.80**
Lines effect	24	1.49	950.08	354.62	833580.90**	1.17**
Testers effect	1	0.12	3213.68**	2158.76**	879215.10	1.77*
Lines × Testers effect	24	1.27**	528.12**	241.48**	294819.90**	0.39**
Error	98	0.06	0.52	5.10	8155.11	0.07
Total	149	0.49	260.03	114.06	193166.30	0.31
σ^2 GCA		0.01	51.37**	30.89**	20859.91**	0.03**
σ^2 SCA		0.40**	175.70**	78.68**	94416.16**	0.11**
σ^2 GCA/ σ^2 SCA		0.025	0.29	0.39	0.21	0.27
Contribution (%) of Lines		53.79	58.93	51.69	71.54	71.52
Contribution (%) of Testers		0.19	8.03	13.11	3.14	4.50
Contribution (%) of Line × Tester		46.07	32.75	35.19	25.30	23.97

*,** significant at 5 and 1 per cent respectively

Table.2 Estimates of general combining ability effects of parents for yield and its attributing traits in *rabi* sorghum

Sl. No.	Parents	Days to 50 per cent flowering	Plant height	Number of leaves	Panicle length	Panicle width	Primaries panicle^{-1}	Panicle weight	Number of seeds panicle^{-1}	Grain yield plant^{-1}	100 seed weight
	Testers										
1	104B	-0.12	-5.24**	-0.54**	2.26**	0.029	-1.78**	-4.62**	-76.56**	-3.79**	-0.109**
2	M 31-2B	0.12	5.24**	0.54**	-2.26**	-0.029	1.78**	4.62**	76.56**	3.79**	0.109**
	CD at 5%	0.31	0.88	0.15	0.46	0.05	0.42	0.23	24.64	0.53	0.05
	Lines										
3	IS 602	-3.03**	-7.87**	-1.58**	9.41**	-0.14	-10.43**	-18.50**	63.13	-6.08**	-0.59**
4	IS 995	-4.70**	13.17**	-3.08**	5.36**	0.36**	3.90**	10.60**	722.11**	10.26**	-0.50**
5	IS 4515	5.46**	1.67	-1.58**	-3.04**	-0.17	-0.10	1.06*	-497.55**	-11.43**	0.16
6	IS 4581	7.36**	17.30**	0.25	-0.31	0.25**	6.56**	-10.50**	-561.88**	-6.21**	1.29**
7	IS 4698	-1.03	-1.66	-1.58**	-4.41**	-0.29**	2.06**	2.53**	108.44*	1.44	-0.22*
8	IS 11619	7.636**	15.00**	1.92**	-5.41**	-0.03	-3.26**	7.54**	-163.88**	0.81	0.19*
9	IS 15945	6.96***	7.50**	1.42**	3.73**	0.11	-3.60**	7.54**	258.44**	-0.28	-0.54**
10	IS 19450	3.13**	-4.32**	-2.58**	-1.61	0.90**	13.73**	25.36**	436.94**	13.58**	-0.02
11	IS 19975	-14.03**	-4.82**	0.92**	2.55**	-0.13	-7.43**	-6.67**	-164.72**	-4.50**	-0.07
12	IS 20743	-1.20*	-0.99	0.25	-2.64**	-0.66**	-1.93*	-2.20**	262.94**	1.46	-0.42**
13	IS 20679	-1.36*	-7.99**	0.42	-0.64	-0.74**	-2.43**	-21.85**	-521.88**	-13.13**	0.09
14	IS 22720	-1.70**	-4.49**	-1.58**	-1.89**	-0.08	0.40	-12.67**	-377.88**	-8.76**	0.09
15	IS 23590	3.96**	12.84**	0.75**	-1.61	0.51**	1.23	11.59**	503.94**	11.94**	-0.20*
16	IS 23891	-0.96	-6.82**	0.25	0.23	031**	1.40	16.44**	819.94**	11.39**	-0.63**
17	IS 24462	1.53**	2.00	-0.24	2.35*	0.65**	1.40	-0.05	82.11	1.11	-0.05

Sl. No.	Parents	Days to 50 per cent flowering	Days to maturity	Plant height	Number of leaves	Panicle length	Panicle width	Primaries panicle^{-1}	Panicle weight	Number of seeds panicle^{-1}	Grain yield plant^{-1}	100 seed weight
18	IS 25989	-1.94**	-2.32**	2.34	1.58**	1.03	0.68**	6.56**	4.51**	152.44**	1.61	-0.22*
19	IS 26025	-6.83**	-6.98**	-12.87**	-0.08	2.75**	-0.93**	-4.43**	-6.32**	6.61	-3.06**	-0.27**
20	IS 26617	1.13*	3.18**	-29.32**	-0.58*	-1.09	-0.58**	-4.43**	-9.27**	-132.05**	-2.25*	0.02
21	IS 27887	-5.53**	-5.48**	-0.99	-0.08	-2.06*	0.40**	1.56*	-14.68**	-277.05**	-6.30**	0.04
22	IS 28313	3.96**	2.51**	2.00	0.42	-1.18	-0.59**	-6.26**	-2.42**	-154.22**	-0.43	0.27**
23	IS 29269	-3.86**	-4.98**	4.67**	0.42	-1.38	0.05	9.23**	5.01**	-233.38**	1.04	0.57**
24	IS 29654	8.63**	6.84**	-4.49**	-1.08**	-4.88**	-0.31**	-1.60*	-15.85**	-538.72**	-11.26**	0.39**
25	IS 30451	-1.20*	1.18*	17.50**	2.08**	0.16	0.78**	1.56*	3.36**	23.28	9.98**	0.61**
26	IS 31651	-3.70**	-3.65**	-14.66**	2.92**	1.25	-0.16	-6.26**	-1.42**	119.78**	-0.36	-0.39**
27	IS 32439	1.13*	1.01	5.17**	0.42	3.60**	-0.16	2.56**	26.83**	63.11	9.42**	0.39**
	C.D @ 5 %	1.12	1.03	3.13	0.70	1.65	0.19	1.50	0.81	87.14	1.88	0.17

* and **indicates significant at 5 and 1 per cent, respectively.

Table.3a Estimates of specific combining ability effects of crosses for yield and its attributing traits in *rabi* sorghum

Sl. No.	Crosses	Days to 50 per cent flowering	Plant height	No of leaves	Panicle length	Panicle width
1	104A × IS 602	3.95**	8.74**	0.04	-2.01	-0.22
2	104A × IS 995	2.62**	-16.92**	0.54	-4.83**	0.12
3	104A × IS 4515	-2.88**	2.91	0.04	2.08	0.14
4	104A × IS 4581	-1.38	0.91	-0.12	0.45	0.40**
5	104A × IS 4698	0.28	12.58**	0.04	-2.08	-0.27*
6	104A × IS 11619	0.95	-1.42	0.54	-0.49	0.04
7	104A × IS 15945	-1.71*	-4.58*	0.04	-2.03	-0.82**
8	104A × IS 19450	0.78	8.91**	0.04	5.03**	0.35**
9	104A × IS 19975	0.28	1.74	1.54**	-0.81	0.45**
10	104A × IS 20743	-1.54	0.24	-0.78*	0.48	0.38**
11	104A × IS 20679	-0.04	-4.42	0.04	-0.31	-0.09
12	104A × IS 22720	2.28**	-2.25	0.04	1.60	-0.02
13	104A × IS 23590	0.28	6.41**	-0.28	1.01	0.63**
14	104A × IS 23891	-5.21**	-1.58	-0.78*	-0.86	0.03
15	104A × IS 24462	5.28**	6.24**	-0.28	-0.26	0.40**
16	104A × IS 25989	-0.21	-1.75	0.54	-0.83	-0.02
17	104A × IS 26025	-0.54	-8.25**	-0.45	-1.83	0.48**
18	104A × IS 26617	2.78**	-9.08**	0.04	4.33**	0.33**
19	104A × IS 27887	-2.21**	-0.42	-0.45	1.30	-0.01
20	104A × IS 28313	-6.38**	-1.42	0.04	-1.04	0.02
21	104A × IS 29269	1.45	2.91	0.04	1.68	-0.56**
22	104A × IS 29654	-0.71	7.41**	-1.45**	1.31	0.23
23	104A × IS 30451	-3.21**	-0.58	1.38**	0.03	-0.62**
24	104A × IS 31651	0.28	10.24**	0.54	1.98	-0.01
25	104A × IS 32439	4.78**	-16.58**	-0.95*	-3.83**	-1.37**
26	M 31-2A × IS 602	-3.95**	-8.74**	-0.04	2.01	0.22

Sl. No.	Parents	Days to 50 per cent flowering	Plant height	No of leaves	Panicle length	Panicle width
27	M 31-2A × IS 995	-2.62**	16.92**	-0.54	4.83**	-0.12
28	M 31-2A × IS 4515	2.88**	-2.91	-0.04	-2.08	-0.15
29	M 31-2A × IS 4581	1.38	-0.91	0.12	-0.45	-0.40**
30	M 31-2A × IS 4698	-0.28	-12.58**	-0.04	2.08	0.279*
31	M 31-2A × IS 11619	-0.95	1.42	-0.54	0.49	-0.05
32	M 31-2A × IS 15945	1.71*	4.58*	-0.04	2.03	0.83**
33	M 31-2A × IS 19450	-0.78	-8.91**	-0.04	-5.03**	-0.36**
34	M 31-2A × IS 19975	-0.28	-1.74	-1.54**	0.81	-0.45**
35	M 31-2A × IS 20743	1.54	-0.27	0.78*	-0.48	-0.38**
36	M 31-2A × IS 20679	0.04	4.42	-0.04	0.31	0.09
37	M 31-2A × IS 22720	-2.28**	2.25	-0.04	-1.60	0.03
38	M 31-2A × IS 23590	-0.28	-6.41**	0.28	-1.01	-0.637**
39	M 31-2A × IS 23891	5.21**	1.58	0.78*	0.86	-0.03
40	M 31-2A × IS 24462	-5.28**	-6.24**	0.28	0.26	-0.40**
41	M 31-2A × IS 25989	0.21	1.75	-0.54	0.83	0.03
42	M 31-2A × IS 26025	0.54	8.25**	0.45	1.88	-0.48**
43	M 31-2A × IS 26617	-2.78**	9.08**	-0.04	-4.33**	-0.33*
44	M 31-2A × IS 27887	2.21**	0.42	0.45	-1.30	0.01
45	M 31-2A × IS 28313	6.38**	1.42	-0.04	1.04	-0.02
46	M 31-2A × IS 29269	-1.45	-2.91	-0.04	-1.68	0.56**
47	M 31-2A × IS 29654	0.71	-7.41**	1.45**	-1.31	-0.23
48	M 31-2A × IS 30451	3.21**	0.58	-1.38**	-0.03	0.62**
49	M 31-2A × IS 31651	0.28	-10.24**	-0.54	-1.98	0.01
50	M 31-2A × IS 32439	-4.78**	16.58**	0.95*	3.83**	1.37**
	CD @ 5%	1.59	4.43	0.75	2.34	0.26

* and **indicates significant at 5 and 1 per cent, respectively.

Table.3b Estimates of specific combining ability effects of crosses for yield and its attributing traits in *rabi* sorghum

Sl. No.	Crosses	Primaries panicle^{-1}	Panicle weight	Grain yield per plant	Number of seeds per panicle	100 seed weight
1	104A × IS 602	-5.71**	6.76**	3.29*	242.39**	-0.19
2	104A × IS 995	-0.38	-5.14**	0.68	346.72**	-0.34**
3	104A × IS 4515	2.95**	-13.17**	-3.82**	-77.27	-0.21
4	104A × IS 4581	-4.04**	9.03**	6.16**	198.73**	-0.37**
5	104A × IS 4698	5.79**	-4.17**	-5.34**	-111.61	-0.16
6	104A × IS 11619	-1.54	-6.45**	-16.47**	-408.27**	-0.31*
7	104A × IS 15945	2.12	-3.35**	1.99	128.73*	-0.07
8	104A × IS 19450	-1.55	-3.89**	-0.60	9.23	-0.03
9	104A × IS 19975	6.62**	-16.64**	-6.75**	-287.11**	0.09
10	104A × IS 20743	5.12**	-0.32	0.17	176.56**	-0.26*
11	104A × IS 20679	0.28	10.18**	7.24**	137.39*	0.29*
12	104A × IS 22720	-2.88**	17.76**	7.98**	163.73**	0.26*
13	104A × IS 23590	-0.71	1.96**	2.43	-7.77	0.16
14	104A × IS 23891	1.12	-3.69**	-3.123*	-192.44**	0.07
15	104A × IS 24462	7.12**	17.28**	9.46**	481.73**	-0.29*
16	104A × IS 25989	-1.38	-0.65	0.96	-162.27*	0.34**
17	104A × IS 26025	-0.71	-0.02	-0.89	-214.77**	0.32*
18	104A × IS 26617	6.29**	1.29*	0.46	14.23	-0.008
19	104A × IS 27887	-4.71**	11.48**	7.84**	136.89*	0.31*
20	104A × IS 28313	2.45*	2.24**	3.24*	-71.61	0.44**
21	104A × IS 29269	5.28**	-3.15**	-0.07	88.89	-0.26*
22	104A × IS 29654	2.12	10.24**	4.24**	129.56*	-0.04
23	104A × IS 30451	-4.38**	1.69**	2.29	-89.11	0.41**
24	104A × IS 31651	-10.55**	-15.55**	-9.05**	-289.94**	-0.12
25	104A × IS 32439	-8.71**	-13.77**	-12.31**	-342.60**	-0.04
26	M 31-2A × IS 602	5.71**	-6.76**	-3.29*	-242.39**	0.19

Sl. No.	Parents	Primaries panicle^{-1}	Panicle weight	Grain yield per plant	Number of seeds per panicle	100 seed weight
27	M 31-2A × IS 995	0.38	5.13**	-0.68	-346.73**	0.34**
28	M 31-2A × IS 4515	-2.95**	13.17**	3.82**	77.27	0.21
29	M 31-2A × IS 4581	4.05**	-9.02**	-6.16**	-198.73**	0.37**
30	M 31-2A × IS 4698	-5.79**	4.17**	5.34**	111.61	0.16
31	M 31-2A × IS 11619	1.55	6.45**	16.47**	408.27**	0.31*
32	M 31-2A × IS 15945	-2.12	3.35**	-1.99	-128.73*	0.07
33	M 31-2A × IS 19450	1.55	3.83**	0.60	-9.23	0.02
34	M 31-2A × IS 19975	-6.62**	16.64**	6.76**	287.11**	-0.09
35	M 31-2A × IS 20743	-5.12**	0.32	-0.19	-176.56**	0.26*
36	M 31-2A × IS 20679	-0.29	-10.18**	-7.24**	-137.39**	-0.29*
37	M 31-2A × IS 22720	2.88**	-17.76**	-7.98**	-163.73**	-0.26*
38	M 31-2A × IS 23590	0.71	-1.96**	-2.43	7.77	-0.16
39	M 31-2A × IS 23891	-1.12	3.69**	3.12*	192.44**	-0.07
40	M 31-2A × IS 24462	-7.12**	-17.28**	-9.46**	-481.73**	0.29*
41	M 31-2A × IS 25989	1.38	0.65	-0.96	162.27*	-0.34**
42	M 31-2A × IS 26025	0.71	0.02	0.89	214.77**	-0.32*
43	M 31-2A × IS 26617	-6.29**	-1.29*	-0.46	-14.23	0.008
44	M 31-2A × IS 27887	4.71**	-11.48**	-7.84**	-136.89*	-0.31*
45	M 31-2A × IS 28313	-2.45*	-2.24**	-3.24*	71.61	-0.44**
46	M 31-2A × IS 29269	-5.29**	3.15**	0.07	-88.89	0.26*
47	M 31-2A × IS 29654	-2.12	-10.2**	-4.24**	-129.56*	0.041
48	M 31-2A × IS 30451	4.38**	-1.70**	-2.29	89.11	-0.41**
49	M 31-2A × IS 31651	10.55**	15.5**	9.06**	289.94**	0.12
50	M 31-2A × IS 32439	8.71**	13.77**	12.31**	342.61**	0.04
	CD @ 5%	2.12	1.15	2.67	123.25	0.25

* and ** indicates significant at 5 and 1 per cent, respectively.

The cross 104A × IS 31651 (10.54) exhibited highest *sca* towards negative direction. At the same time 15 crosses noticed positive *sca* effect among them M 31-2A × IS 31651 (10.54) accounted high positive *sca* effect. For plant height, 12 were found to have positive significance. The crosses *viz.*, M 31-2A × IS 995 (16.92) and M 31-2A × IS 32439 (16.58) topped the list of hybrids showing positive *sca* effects for plant height (Table 3).

Among 50 crosses, 12 crosses showed significant for *sca* effects for number of leaves per plant and out of which six were having positive *sca* effects. The crosses *viz.*, 104A × IS 19975 (1.54), M 31-2A × IS 29654 (1.45) and 104A × IS 30451 (1.38) expressed significant positive *sca* effect. For panicle width, out of 50 hybrids evaluated twenty-six recorded significant *sca* effects and of these 13 had positive and other 13 had negative significant *sca* effects. The cross M 31-2A × IS 32439 (1.37) showed peak significant positive *sca* effect.

Eight hybrids accounted for significant *sca* effects for panicle length and of these four had positive and other four had negative *sca* effects. The hybrids *viz.*, 104A × IS 19450 (5.03), 104A × IS 26617 (4.33), M 31-2A × IS 602 (4.83) and M 31-2A × IS 32439 (3.83) were found to have positive *sca* effects. Thirty crosses accounted for significant *sca* effect for number of primaries per panicle of all these 15 crosses showed positive *sca* effects. The crosses *viz.*, M 31-2A × IS 31651 (10.54) and M 31-2A × IS 32439 (8.71) showed highest positive significant *sca* effect. In contrast crosses *viz.*, 104 A × IS 31651 (10.54) and 104 A × IS 32439 (8.71) showed highest negative significant *sca* effects.

For panicle weight, the crosses *viz.*, 104A × IS 22720 (17.76), 104A × IS 24462 (17.29) and M 31-2A × IS 19975 (16.63) accounted for highest significant *sca* effect in positive direction. The values of *sca* variance for number of seeds per panicle varied from -481.72 (M 31-2A × IS 24462) to 481.62 (104A × IS 24462). Among 50 crosses, 17 crosses showed positive and other 17 showed negative significant *sca* effects for number of seeds per panicle. The hybrid 104A × IS 24462 (481.62) have shown the highest positive *sca* effect and was succeeded by M 31-2A × IS 11619 (408.27).

Thirty hybrids accounted for significant *sca* effect for grain yield per plant and of these 15 had positive *sca* effects. The hybrid M 31-2A × IS 11619 (16.47) have shown the highest positive effect succeeded by M 31-2A × IS 32439 (12.31). The hybrid 104 A × IS 11619 (16.47) had shown the highest negative *sca* effect which was succeeded by 104A × IS 32439 (12.31). Twenty-six crosses were found to have significant *sca* effects for 100 seed weight. Out of which the crosses *viz.*, 104A × IS 28313 (0.44), 104A × IS 30451 (0.41), M 31-2A × IS 4581 (0.37) and M 31-2A × IS 995 (0.34) recorded highest values for positive *sca* effects

It is concluded that the female parent M 31-2A observed as a good general combiner for plant height, number of leaves per plant, number of primaries per panicle, panicle weight, number of seeds per panicle, grain yield per plant and 100 seed weight. From the studies it was observed that the hybrids *viz.*, M 31-2A × IS 11619, M 31-2A × IS 32439, M 31-2A × IS 31651 and 104A × IS 24462 were best specific combiners for grain yield per plant. The higher magnitude of SCA variance over GCA variance was observed for all the characters studied except for panicle length which indicates the prevalence of non-additive gene action for these characters Thus, it can be concluded that both inter and intra allelic interactions were involved in the expression of theses quantitative traits. The parental lines in this study were having diverse genetic background of their source populations, and hence their hybrids exhibited high specific combining ability effects.

References

Dehiwal, A. K., Pahuj, S. K., Shafiqurrahaman, M., Kumar, A. and Sharma, P. 2017. Studies on combining ability for yield and its component traits in forage sorghum, Int. J. Pure App. Biosci., 5(5): 493-502.

Jadhav, R. R. and Deshmukh, D. T. 2017. Heterosis and combining ability in sorghum [*Sorghum bicolor* (L.) Moench] over the environments. Int. J. Curr. Microbiol. Appl. Sci., 6(10): 3058-3064.

Kempthorne, O. 1957. An introduction to genetic statistics, Jhon wiley sons, Newyork.

Kumar, S. and Chand, P. 2015. Combining ability and heterosis for grain yield, fodder yield and other agronomic traits in sorghum [*Sorghum bicolor* (L.) Moench]. J. Appl. Nat. Sci., 7 (2): 1001 -1005

Panse, V. G. and Sukhatme, P. V. 1967. Statistical methods for agricultural workers, ICAR, New Delhi.

Reddy, P. S., Patil, J. V., Nirmal, S. V. and Gadakh, S. R. 2013. Improving post-rainy season sorghum productivity in medium soils: does ideotype breeding hold a clue. *Curr. Sci.*, 102 (6): 904-908.

Sprague G. F. and Tatum L. A. 1942. General and specific combining ability in single crosses of corn. *J. Am. Soc. Agron*., 34: 923-932.

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