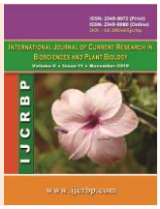
EXCELLENT PUBLISHERS

International Journal of Current Research in Biosciences and Plant Biology

Volume **6** • Number **11** (November-2019) • ISSN: 2349-8080 (Online)

Journal homepage: www.ijcrbp.com



Original Research Article **doi:** https://doi.org/10.20546/ijcrbp.2019.611.003

Combining ability studies in rabi sorghum by using line × tester analysis

Snehal A. Tambe*[1], D. V. Kusalkar[2], G. C. Shinde[1] and M. S. Shinde[3]

[1]Department of Botany, Mahatma Phule Krishi Vidyapeeth, Rahuri, Ahmednagar, Maharashtra – 413 722, India
[2]Associate Director of Research ZARS, Igatpuri, MPKV, Rahuri, Ahmednagar, Maharashtra– 413 722, India
[3]All India Coordinated Sorghum Improvement Project, MPKV, Rahuri, Ahmednagar, Maharashtra– 413 722, India

*Corresponding author; e-mail: avinash.jondhale51@gmail.com

Article Info

Date of Acceptance:
13 September 2019

Date of Publication:
06 November 2019

Keywords

General Combining Ability
Line × testers
Rabi sorghum
Specific Combining Ability

ABSTRACT

Combining ability studies for grain yield and its components was studied using four male sterile lines and twelve testers at Sorghum Improvement Project, MPKV, Rahuri, Maharashtra. The mean squares due to lines, testers and lines x tester were highly significant indicating the presence of variability for most of the characters. Estimates of general combining ability (GCA) and specific combining ability (SCA) variances indicated the predominance of non-additive gene action for most of the characters. The line 104 A, RMS 2010-10A and testers RSR 986, RSR 1012, RSR 1019, RSR 1003 and RSR 955 were observed good general combiner for grain yield and yield contributing characters. The hybrid viz., 104A x RSR 1003, RMS 2010-10A x RSR 1013, RMS 2010-10A x RSR 955, 185A x RSR 1027, 185A x RSR 1020, RMS 2010-24A x RSR 1019, RMS 2010-24A x RSR 1012, 185A x RSR 986, RMS 2010-24A x RSR 1020 and RMS 2010-24A x RSR 986 etc. exhibited with highly significant and positive SCA effects for grain yield which could be exploited for development of hybrids.

Introduction

Sorghum [*Sorghum bicolor* (L.) Moench] is an important cereal crop which is grown globally for food and fodder purpose. It is most widely grown in the semi-arid tropics where water availability is limited and frequently subjected to drought. India ranks first in terms of area under sorghum (5.82 M ha), while it ranks second in production i.e. 4.5 MT. The productivity of sorghum in India (854 kg ha^{-1}) is much less than the world average of 1457 kg ha^{-1} (FAO, 2016). Combining ability studies provide useful information regarding the selection of suitable parents for effective hybridization program. It also provides information on various types of gene action involved in the expression of quantitative characters. It is also used for reducing the number of crosses to be advanced. Line × Tester analysis developed by Kempthorne (1957) and modified by Arunachalum (1974) appeared to be the most useful tool for screening large number of parental lines with rapidity and has practical utility in hybrid development breeding programme.

Materials and methods

Erect The present investigation was conducted at Sorghum Improvement Project, MPKV, Rahuri, Maharashtra during rabi2015-16. Four male sterile

lines (185A, RMS2010-10A, RMS2010-24A, 104 A) were crossed with twelve testers (RSR 950, RSR 1012, RSR 1013, RSR 984, RSR 1014, RSR 1019, RSR 986, RSR 987, RSR 1020, RSR 1027, RSR 1003, RSR 955) in line × testers mating design used to develop 48 F_1's hybrids. The resulting 48 F_1's along with their 16 parents and one check (CSH-15 R) were evaluated for grain yield and yield contributing traits in rabi sorghum during 2015-16.

The parents and hybrids were grown in separate block in a Randomized Block Design (RBD) with two replications. Each entry was consisted two rows having 3 m length with inter and intra spacing at 45 cm and 15 cm, respectively. Data were recorded on five randomly selected plants in each replication for the characters viz., days to 50% flowering, days to physiological maturity (cm), plant height, 1000 grain weight (g), dry fodder per plant, harvest index and grain yield per plant (g). Data were subjected to statistical analysis as per Arunachalam (1974) to understand the magnitude of general combining ability (GCA) effects of parents and specific combining ability (SCA) effects of F1's.

Results and discussion

The analysis of variance for combining ability (Table 2) revealed the presence of significant differences due to lines, testers and lines x testers for all the characters studied indicating the existence of variability among parents and hybrids. The testers contributed a major share of variance for all the characters. The estimates of components of variance for GCA were larger in magnitude than SCA for the characters days to 50% flowering, days to physiological maturity and plant height indicating predominance of additive gene action. While the estimates of specific combining ability (σ^2 SCA) variance were higher than general combining ability (σ^2 GCA) variance for the characters 1000 grain weight, harvest index, dry fodder/plant and grain yield/plant indicates predominance of non-additive gene action (Jadhav and Deshmukh, 2017).

The combining ability helps in selection of potential parents and to know the magnitude of general and specific combining ability variances. The relative magnitude of GCA and SCA variances and GCA effects of parents and SCA effects of their crosses provides valuable guidelines for choice of parents and for planning suitable breeding methodology.

Mean performance and General Combining Ability (GCA) Effects

The mean performance and GCA effects of parents for yield and yield contributing traits in rabi sorghum are presented in Tables 1 and 3. Estimates of GCA effects indicated that, none of the parents was a good general combiner for all the traits studied. The line 104 A showed most promising for all the studied characters. Among the line 185 A and from testers RSR 986 showed good general combining ability for days to flowering. The line 185 A, 104 A and tester RSR 986 also exhibited highly significant GCA in desirable direction for days to flowering and days to maturity. However, it showed negative GCA effect for grain yield per plant. The line RMS 2010-10 A and RMS 2010-24 A were bad combiners for days to maturity since they showed significant GCA effects in non-desirable direction. The lines RMS 2010-10 A and 104 A was showed significant positive GCA effects and hence it was best general combiner for grain yield per plant. While testers namely RSR 1012, RSR1019, RSR 1014 and RSR 955 were the best general combiners they showed higher magnitude of positive GCA effects for grain yield per plant. The GCA effects of parents and their *per se* performance indicated that the parent showing high mean performance also showed high general combining ability for grain yield per plant. However, 104 A was good combiner for physiological maturity, 1000 grain weight, plant height, dry fodder yield per plant and grain yield per plant (Jadhav and Deshmukh, 2017) and the female line 2010-10A was found good combiner for plant height, 1000 grain weight, harvest index and grain yield per plant.

As regards GCA effects of male parents, RSR 986 was good general combiner for days to 50 per cent flowering, days to physiological maturity and 1000 grain weight, RSR 1012 for plant height, grain yield per plant, dry fodder yield and harvest index while RSR 1019 was good general combiner for plant height and dry fodder yield, harvest index and grain yield per plant.

Table 1. Mean performance of parents and hybrids for yield and yield contributing characters in rabi sorghum (L × T).

Sr. No.	Name of parents/ crosses	Days to 50% flowering	Days to physic. Maturi.	Plant height (cm)	1000 grain weight (g)	Harvest index (%)	Dry fodder yield/plant (g)	Grain yield/ plant (g)
	Female (Lines)							
1	185A	73.8	114.1	119.1	25.9	20.5	75.5	21.5
2	RMS2010-10A	80	120.2	112.3	21.99	33.9	47	22.2
3	RMS2010-24A	75.3	115.3	122.3	25.2	28	40.7	27.2
4	104A	70	109.5	147.3	28	34.9	44.5	30.3
	Lines mean	**74.8**	**114.8**	**125.3**	**25.27**	**29.33**	**51.93**	**25.3**
	Male (Testers)							
5	RSR 950	88.5	124.9	121	29.3	34	49.5	46.2
6	RSR1012	88.4	128.2	176.5	25.13	33.6	47.5	50.2
7	RSR1013	87.1	127.2	146.3	27.7	31.2	41	33.2
8	RSR984	88.6	128.6	126.9	30.8	30.1	42.5	34.6
9	RSR1014	88.1	128.1	170.5	27.3	38.8	44.2	48.3
10	RSR1019	86.1	126.2	191.6	28.6	27.4	88.0	43.7
11	RSR986	63.7	104.1	132.8	24.1	21.4	70.0	26.9
12	RSR987	89.0	129	187.9	22.7	29.5	97.3	47.7
13	RSR1020	88.3	128.3	175.6	25.6	34.1	96.3	64.1
14	RSR1027	89.0	129.1	200.6	26.1	40.3	36.5	51.6
15	RSR1003	87.6	127.7	221.8	24.8	40.0	59.4	72.2
16	RSR955	89.1	129.1	189.2	27.1	36.2	80.0	49.9
	Testers mean	**86.13**	**125.9**	**170.1**	**26.6**	**33.05**	**62.68**	**47.38**
	Hybrids							
17	185 A x RSR 950	72.7	113.2	118.9	23.3	29.4	62.5	24.5
18	185 A x RSR 1012	71.1	111.6	178.2	24.3	43.3	50.0	52.5
19	185 A X RSR 1013	72.9	113.5	166.7	22.8	36.8	36.5	35.8
20	185 A X RSR 984	65.9	107.6	154.9	22.9	32.2	36.5	30.0
21	185 A X RSR 1014	74.1	114.6	155.0	22.7	26.4	43.5	31.5
22	185AXRSR1019	73.6	113.6	194.9	24.5	33.7	94.0	54.5
23	185AXRSR 986	64.5	105.0	180.1	27.2	26.9	103.5	37.5
24	185AXRSR987	74.3	114.7	121.5	22.8	30.9	41.5	28.0
25	185AXRSR1020	74.7	115.5	132.4	24.0	32.8	61.0	46.5
26	185AXRSR1027	74.2	114.6	162.8	24.9	39.4	59.5	43.0
27	185AXRSR1003	74.3	114.9	147.4	25.8	26.4	82.5	31.5
28	185AXRSR 955	69.9	110.6	165.7	23.4	31.4	80.5	40.5
29	2010-10AxRSR 950	72.6	112.9	155.5	23.9	36.1	52.5	39.5
30	2010-10AxRSR1012	74.6	114.9	206.5	25.7	34.6	80.5	54.5
31	2010-10AxRSR1013	75.1	115.2	182.9	28.0	40.5	77.5	66.9
32	2010-10AxRSR 984	77.7	117.9	200.4	27.7	36.7	86.5	58.5
33	2010-10AxRSR1014	77.0	117.5	169.5	24.5	42.2	53.5	63.5
34	2010-10AxRSR1019	79.1	119.2	187.4	26.5	33.7	66.0	48.5
35	2010-10AxRSR 986	67.8	108.6	175.7	29.8	30.7	55.5	35.0
36	2010-10AxRSR 987	74.9	115.8	168.4	26.9	38.3	55.5	55.5
37	2010-10AxRSR1020	75.2	115.6	131.8	23.6	36.9	49.0	45.5
38	2010-10AxRSR1027	79.3	119.6	173.4	27.9	34.3	75.5	49.0
39	2010-10AxRSR1003	79.0	119.4	185.5	24.9	37.4	49.5	44.5
40	2010-10AxRSR955	73.9	114.4	182.8	31.2	35.8	78.5	69.0
41	2010-24AxRSR950	81.2	121.7	140.4	22.6	33.6	41.5	37.3
42	2010-24AxRSR1012	76.5	116.6	171.2	26.6	43.6	49.4	60.0
43	2010-24AxRSR1013	80.5	121.1	160.2	22.5	41.5	35.0	41.0
44	2010-24AxRSR984	82.5	122.9	136.9	24.5	33.0	45.5	37.5
45	2010-24AxRSR1014	76.8	117.2	155.8	28.9	34.5	59.5	55.5
46	2010-24AxRSR1019	81.5	121.8	192.3	25.5	36.3	67.5	47.0
47	2010-24AxRSR 986	67.1	107.5	156.9	29.6	39.9	43.0	42.5
48	2010-24AxRSR 987	82.4	123.0	122.0	26.9	35.6	58.5	44.5
49	2010-24AxRSR1020	82.0	122.5	142.5	22.8	36.6	59.0	51.5
50	2010-24AxRSR1027	82.2	122.0	111.3	24.7	31.9	37.5	32.5
51	2010-24AxRSR1003	81.6	122.9	142.0	28.2	27.5	83.0	34.0
52	2010-24AxRSR 955	81.9	122.1	155.6	24.6	27.8	86.5	38.5

Contd...

Table 1. Cntd....

Sr. No.	Name of parents/ crosses	Days to 50% flowering	Days to physic. Maturi.	Plant height (cm)	1000 grain weight (g)	Harvest index (%)	Dry fodder yield/plant (g)	Grain yield/ plant (g)
53	104A x RSR 950	76.2	116.4	149.5	26.2	28.8	100.5	48.5
54	104A x RSR 1012	70.5	110.5	200.6	25.7	36.2	94.0	76.5
55	104A X RSR 1013	70.0	110.1	160.4	26.4	28.2	96.0	42.5
56	104A X RSR 984	74.5	114.7	198.0	30.0	36.0	81.5	58.5
57	104A X RSR 1014	75.6	116.0	190.6	26.7	31.0	102.5	60.0
58	104A X RSR 1019	75.9	116.1	214.0	28.6	44.9	79.5	71.0
59	104A X RSR 986	80.0	120.2	158.6	27.0	33.5	32.0	30.7
60	104A X RSR 987	75.3	115.3	194.7	23.4	33.1	64.1	44.2
61	104A X RSR 1020	75.3	115.6	164.1	27.7	37.2	40.5	31.1
62	104 A X RSR 1027	74.7	114.7	172.9	26.4	32.7	63.5	33.5
63	104 A X RSR 1003	74.8	175.2	207.4	24.6	39.9	70.5	70.0
64	104 A X RSR 955	66.0	106.3	195.0	31.6	37.7	54.5	55.5
65	**CSH 15R (Ch)**	**66**	**106.4**	**170.7**	**25.9**	**28.6**	**61.5**	**41**
	Hybrid mean (HM)	**75.28**	**116.9**	**166.5**	**25.85**	**34.75**	**64.09**	**46.45**
	SE ±	3.39	3.44	2.82	0.71	1.72	4.29	3.26
	CD at 5 %	6.82	6.92	5.68	1.42	3.46	8.63	6.55
	CD at 1 %	9.10	9.24	7.59	1.90	4.61	11.52	8.75

Table 2. Analysis of variance for combining ability and estimates of GCA and SCA variances in rabi sorghum.

Sources	D F	Days to 50% flowering	Days to physio. maturity	Plant height (cm)	1000 grain weight (g)	Harvest index (%)	Dry fodder yield per plant(g)	Grain yield per plant(g)
Replication	1	0.25	1.81	3.78	13.28	2.41	0.01	0.20
Treatments	63	87.87**	82.61**	1548.62**	10.95**	51.03**	819.62**	349.40**
Parents	15	132.69**	128.29**	2371.15**	10.89**	68.49**	900.13**	432.41**
Line	3	34.21*	38.66*	478.79**	12.62**	87.79**	507.44**	35.11*
Testers	11	101.30**	97.19**	2013.74**	10.48**	60.12**	1025.92**	314.08**
Line vs.Tester	1	773.44**	739.26**	11979.60**	10.26**	102.61**	694.45**	2926.04**
Parent vs.hybrid	1	1540.24**	1321.65**	1393.85**	3.37*	129.62**	403.44**	537.23**
Hybrids	47	42.66**	41.68**	1289.41**	11.12	43.79**	802.78**	318.91**
Error	63	10.36	10.83	6.86	0.50	3.19	16.50	9.24
Estimates								
σ^2GCA		8.81	8.66	273.61	1.61	3.07	53.37	50.83
σ^2SCA		5.49	4.87	238.64	3.59	20.29	426.17	95.02
σ^2A		17.62	17.32	547.23	3.22	6.14	107.34	101.67
σ^2D		5.49	4.86	238.64	3.59	20.29	426.17	95.02
σ^2A/ σ^2D		3.21	3.56	2.29	0.89	0.30	0.25	1.07

* Significant at 5% level; ** Significant at 1% level.

RSR 1003 for plant height and dry fodder yield, whereas RSR 955 was good general combiners for plant height, 1000 grain weight, dry fodder yield and grain yield per plant. (Table.3).These studies would help the selection of parents for the incorporation of the specific characters in the new progeny (Kale, 2012). The studies on general combining ability effects indicates that the parents showing good general combining ability for grain yield also possess either average or good general combining abilities for two or more yield contributing characters.

Specific Combining Ability (SCA) effects

Specific combining ability effects are indicative of heterosis. Similarly, they represent both dominant and epistatic gene actions. The two cross combinations viz., 185A x RSR 984 (good x average) and104 A x RSR 955 (average x average) were displayed significant negative SCA effects for days to 50 per cent flowering. For physiological maturity highly significant SCA effects in the desirable direction were observed in the crosses viz; 104A x RSR 955 (average x average), 185A x

RSR 984 (good x average) indicating the presence of dominance or non-allelic interactions (Prabhakar et al., 2013).

For plant height, twenty-two cross combinations were showed significant positive SCA effects. The crosses, 104A x RSR 987 (good x poor), 185A x RSR 986 (poor x average), 104A x RSR 1003 (good x good), RMS 2010-10A x RSR 984 (good x good), RMS 2010-10A x RSR 1027 (good x poor), RMS 2010-10A x RSR 1020 (good x poor), RMS 2010-24A x RSR 950 (poor x poor), RMS 2010-24A x RSR 1019 (poor x good), RMS 2010-24A x RSR 1013 (poor x average) and 185 A x RSR 1013 (poor x average) were showed higher magnitude of positive SCA effects (Kumar and Chand, 2015).

For 1000 grain weight, seventeen cross combinations were showed significant positive SCA effects. The crosses RMS 2010-24A x RSR 1014 (average x average), RMS 2010-24A x RSR 1003 (average x average), 104A x RSR 984 (good x average) and 104A x RSR 955 (good x good),RMS 2010-10A x RSR 1012(good x average), RMS 2010-24A x RSR 987(average x poor),RMS 2010-10A x RSR 955(average x good),104A x RSR 1020(good x poor),185A x RSR 1003(poor x average),were expressed significant positive SCA effects (Samdur et al.,2013).

For harvest index, out of forty-eight crosses, twelve cross combinations 104A x RSR 1019 (average x good), 185A x RSR 1027 (poor x average), RMS 2010-10A x RSR 1014 (good x poor), 104A x RSR 1003 (average x poor), RMS 2010-24A x RSR 986 (good x poor), 185A x RSR 1012 (poor x good), RMS 2010-10A x RSR 1019 (good x good), 104A x RSR 955 (average x poor) and RMS 2010-24A x RSR 1013(good x poor), were showed high magnitude of positive SCA effects (Jadhav and Deshmukh, 2017).

For dry fodder yield per plant, eighteen cross combinations were showed significant positive SCA effects. The crosses, 185A x RSR 986 (average x poor), 104A x RSR 1014 (good x average), 104A x RSR 950 (good x average), 104A x RSR 1013 (good x average), RMS 2010-10A x RSR 984 (average x average), RMS 2010-24A x RSR 1003 (poor x good), RMS 2010-24A x RSR 955 (poor × good) and 185 A x RSR 1019 (average x good) were showed high magnitude of positive SCA effects (Dehinwal et al., 2017).

Table 3. General combining ability effects of parents for yield and yield contributing characters in rabi sorghum.

Sr. No	Parents	Days to 50% flowering	Days to physiological maturity	Plant height (cm)	1000 grain weight (g)	Harvest index(%)	Dry fodder yield per plant(g)	Grain yield per plant(g)
	Female							
1	185A	-3.43**	-3.25**	-9.94**	-1.67**	-2.27**	-1.47	-8.610**
2	RMS2010-10A	0.24	0.24	10.17**	0.83**	1.69**	0.91	5.90**
3	RMS2010-24A	4.40**	4.43**	-17.56**	-0.28	0.39	-8.60**	-3.11**
4	104A	-1.213	-1.42*	17.33**	1.12**	0.20	9.17**	5.82**
	SE±	**0.69**	**0.70**	**0.58**	**0.14**	**10.35**	**0.88**	**0.67**
	Males							
5	RSR950	0.396	0.37	-25.41**	-1.91**	-2.78**	0.16	-9.14*
6	RSR 1012	-2.10	-2.28	22.64**	-0.30	4.69**	4.38**	14.28**
7	RSR1013	-0.65	-0.70	1.07	-0.98**	2.03**	-2.84	0.21
8	RSR 984	-0.13	0.096	6.07**	0.41	-0.23	-1.59	-0.47
9	RSR 1014	0.60	0.65	1.24	-0.21	-1.24*	0.66	6.031**
10	RSR 1019	2.25	1.99	30.67**	0.36	2.38**	12.66**	8.66**
11	RSR 986	-5.43**	-5.35**	1.34	2.50**	-2.04**	-5.59**	-10.17**
12	RSR 987	1.45	1.52	-14.83**	-0.89**	-0.28	-9.19**	-3.54**
13	RSR 1020	1.52	1.57	-23.78**	-1.38**	-1.12	-11.72**	-1.44*
14	RSR 1027	2.32	2.05	-11.38**	0.10	-0.08	-5.09**	-7.09**
15	RSR 1003	2.15	2.42	4.09**	0.003	-1.98**	7.28**	-1.59
16	RSR 955	-2.35	-2.33	8.29**	2.29**	-1.60**	10.91**	4.28**
	SE±	**1.20**	**1.22**	**0.99**	**0.25**	**0.61**	**1.52**	**1.15**

* Significant at 5% level; ** Significant at 1% level.

Table 4. Specific combining ability (SCA) effects for yield and yield contributing characters in 48 crosses of rabi sorghum.

Sr. No.	Crosses	Days to 50% flowering	Days to physiological maturity	Plant height (cm)	1000 grain weight (g)	Harvest index (%)	Dry fodder yield per plant(g)	Grain yield per plant(g)
1	1X5	0.45	0.40	-12.23**	0.96	-0.32	-0.28	-4.34
2	1X6	1.35	1.45	-0.98	0.44	6.14**	-17.01**	0.24
3	1X7	1.70	1.77	9.09**	0.39	2.34	-23.28**	-2.39*
4	1X8	-5.82*	-4.92**	-7.71**	-1.68**	-0.02	-24.53**	-7.515**
5	1X9	1.65	1.52	-2.78	-1.31*	-4.88**	-19.78**	-12.52**
6	1X10	-0.50	-0.83	7.69**	-0.11	-1.16	18.72**	7.86*
7	1X11	-1.92	-2.08	22.22**	0.44	-3.60*	46.47**	9.69**
8	1X12	1.00	0.75	-20.21**	-0.56	-1.34	-11.93**	-6.44**
9	1X13	1.33	1.30	-0.36	1.15*	-0.79	10.09**	9.96**
10	1X14	0.03	0.12	17.64**	0.65	7.30**	1.97	12.11**
11	1X15	0.30	0.05	-13.23**	1.52**	-4.13**	12.59**	-4.89*
12	1X16	0.40	0.50	0.87	-1.13*	0.47	6.97**	-1.78
13	2X5	-3.31	-3.39	4.26*	-0.85	2.47*	-12.66**	-3.85
14	2X6	1.19	1.26	7.21**	-0.72	-6.51**	11.12**	-12.27**
15	2X7	0.24	-0.01	5.18*	2.28**	2.07	15.34**	14.20**
16	2X8	2.31	1.89	17.68**	0.57	0.53	23.09**	6.48**
17	2X9	0.89	0.94	-8.39**	-2.04**	6.97**	-12.16**	4.98*
18	2X10	1.34	1.29	-19.92**	-0.58	5.17**	-11.66**	-12.65**
19	2X11	-2.29	-1.96	-2.29	0.57	-3.70**	-3.91	-7.32**
20	2X12	-2.06	-1.64	6.58**	1.03*	2.18	-0.31	6.55**
21	2X13	-1.84	-1.89	-21.07**	-1.75**	-0.65	-4.28	-5.55*
22	2X14	1.46	1.64	8.13**	1.10*	-2.0	15.59**	3.60
23	2X15	1.34	1.06	4.76*	-1.75**	2.91*	-22.78**	-6.40**
24	2X16	0.74	0.81	-2.14	2.13*	0.91	2.59	12.23**
25	3X5	1.12	1.22	16.88**	-1.15*	1.27	-14.15**	2.96
26	3X6	-1.08	-1.23	-0.37	1.32*	3.75**	-10.47**	2.34
27	3X7	1.47	1.70	10.21**	-2.19**	4.36*	-17.65**	-2.69
28	3X8	2.95	2.70	-18.09**	-1.51**	-1.94	-8.40**	-5.52*
29	3X9	-3.48	-3.55	5.63**	3.44**	0.60	3.35	5.99*
30	3X10	-0.43	-0.30	12.71**	-0.50	-1.20	-0.65	-5.14*
31	3X11	-7.15	-7.25	6.63**	1.50**	6.75**	-6.90	9.19**
32	3X12	1.27	1.37	-12.09**	2.26**	0.72	12.20**	4.56
33	3X13	0.80	0.82	17.36**	-1.41**	0.33	15.23**	9.46**
34	3X14	0.20	-0.15	-26.24**	-1.05*	-3.16*	-12.90**	-3.89
35	3X15	-0.23	0.37	-11.02**	2.61**	-5.73**	20.23**	-7.89**
36	3X16	4.57	4.32	-1.62	-3.33-	-5.75**	20.10**	-9.27**
37	4X5	1.74	1.77	-8.91**	1.04*	-3.42*	27.09**	5.23
38	4X6	-1.46	-1.48	-5.86**	1.04*	-3.38*	16.36**	9.80**
39	4X7	-3.41	-3.45	-24.48**	0.30	-8.76*	25.59**	-9.12**
40	4X8	0.56	0.35	8.12**	2.61**	1.43	9.84*	6.55**
41	4X9	0.94	1.10	5.54**	-0.09	-2.68*	28.59**	1.55
42	4X10	-0.41	-0.15	-0.48	1.18*	7.53**	-6.42*	9.93**
43	4X11	11.36**	11.30	-26.56**	-2.52**	0.55	-35.67**	-11.55**
44	4X12	-0.21	-0.48	25.72**	-2.72**	-1.55	0.04	-4.67*
45	4X13	-0.29	-0.23	4.07*	2.09**	1.11	-21.04**	-13.67**
46	4X14	-1.69	-1.60	0.47	-0.71	-2.14	-4.67*	-11.82**
47	4X15	-1.41	-1.48	19.49**	-2.39**	6.94**	-10.04**	19.18**
48	4X16	-5.71*	-5.63	2.89	2.33**	4.37**	-29.66**	-1.20
	SE±	**2.40**	**2.43**	**1.99**	**0.50**	**1.22**	**3.03**	**2.30**

* Significant at 5% level; ** Significant at 1% level.

Parents: 1. 185A 2. RMS 2010-10A 3. RMS 2010-24A 4. 104A 5. RSR 950 6. RSR 1012 7. RSR 1013 8. RSR 984 9. RSR 1014 10. RSR 1019 11. RSR 986 12. RSR 987 13. RSR 1020 14. RSR 1027 15. RSR 1003 16. RSR 955

Nineteen cross combinations were showed significant positive SCA effects for grain yield per plant. The crosses 104A x RSR 1003 (good x poor), RMS 2010-10A x RSR 1013 (good x average), RMS 2010-10A x RSR 955 (good x good), 185A x RSR 1027 (poor x poor), 185A x RSR 1020 (poor x poor), RMS 2010-24A x RSR 1019 (poor x good), RMS 2010-24A x RSR 1012 (poor x good), 185A x RSR 986 (poor x poor), RMS 2010-24A x RSR 1020 (poor x poor) and RMS 2010-24A x RSR 986 (poor x poor)were showed high magnitude of positive SCA effects (Chaudhary et al., 2006; Premalatha et al., 2006; Kalpande et al., 2019). These crosses also showed high SCA effects for one or more yield contributing characters. When the crosses showing good SCA effects involves either both or one parent with poor/average GCA effects indicating prevalence of non-additive gene action.

The higher magnitude of SCA variance over GCA variance was observed in 1000 grain weight, harvest index, dry fodder/plant and grain yield/plant which indicate the importance of non-additive gene action for these characters (Samdur et al., 2013). The overall gene action studies from combining ability analysis indicated that dominance or non-additive gene action was important for most of the characters studied.

Conflict of interest statement

Authors declare that they have no conflict of interest.

References

Arunachalam, V., 1974. The fallacy behind the use of modified Line x tester design, India. Indian J. Genet. 34(2), 280-287.

Chaudhary, S.B., Patil, J. V., Thombare, B.B., Kulkarni, V.M., 2006. Selection of parents based on combining ability studies in sorghum [*Sorghum bicolor* (L.) Moench]. Ann. Plant Physiol. 20(1), 95-97.

Dehinwal, A. K., Pahuja1, S. K., Shafiqurrahaman, M., Anil Kumar, 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.

FAO, 2016. Production Yearbook. FAO, Rome, Italy.

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

Kale, B. H., 2012. Genetic and stability analysis for yield and yield contributing traits over different seasons in sorghum [*Sorghum bicolor* (L.) Moench]. Doctoral (Ph.D.) Thesis submitted to Navsari Agricultural University, Navsari.

Kalpande, H.V., Ranjana Tiwari., Kalyankar, S.V., 2019. Heterosis studies for yield, it's component and grain mould resistance in sorghum genotype. J. Pharmacogn. Phytochem. 8(3), 2907-2914.

Kempthorne, O., 1957. An introduction to genetic statistics. John Willey and Sons, London. pp 208-221.

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

Prabhakar, Elangovan, M., Bahadure, D.M., 2013. Combining ability of new parental lines for flowering, maturity and grain yield in rabi sorghum. Electronic J. Plant Breed. 4(3), 1241-1218.

Premalatha, N., Kumaravadivel, Veerabadhiran, P., 2006. Heterosis and combining ability for grain yield and its components in sorghum (*Sorghum bicolor* (L.) Moench). Indian J. Genet. 66(2), 123-126.

Samdur, M. Y., Prabhakar, Hariprasanna, K., Mukesh, P., Patil, J. V., 2013. Combining ability studies in rabi sorghum [*Sorghum bicolor* (L.) Moench]. Conference: Global Consultation on Millets Promotion for Health & Nutritional Security, DSR, Hyderabad,p.334.

How to cite this article:
Tambe, S. A., Kusalkar, D. V., Shinde, G. C., Shinde, M. S., 2019. Combining ability studies in rabi sorghum by using line × tester analysis. Int. J. Curr. Res. Biosci. Plant Biol. 6(11), 22-28.
doi: https://doi.org/10.20546/ijcrbp.2019.611.003