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Combining ability studies for quality, yield and yield components in groundnut [*Arachis hypogaea* L.]

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Abstract
Five lines were crossed with four testers in a line x tester mating fashion to study combining ability for fifteen yield attributing and three quality characters in groundnut. ANOVA revealed the existence of substantial variance among the breeding material for all the eighteen traits studied. The estimates of mean sum of squares due to lines, testers, crosses and their interaction showed significant variation for all the traits. The extent of *sca* was more than *gca* variance indicated the influence of non-additive gene action in the inheritance of characters. Based on the mean performance and *gca* effects, the lines Kadiri-6 and Narayani, and the testers ICGV-171377 and ICGV-06188 were resulted as superior parents for yield, yield attributing and quality traits. On the basis of mean performance and *sca* effects of twenty crosses, four cross combinations *viz.,* Dheeraj x ICGV 171377 was ideal cross for yield. Whereas, Narayani x ICGV-06188, Kadiri-6 x ICGV-95165 and Kadiri-6 x ICGV-171377 were considered as best crosses in improving yield along with quality characters and could be utilized in further breeding programmes to isolate desirable segregants with low oil content, high protein content and high sucrose content.

Keywords: Groundnut, combining ability, yield, oil, protein and sucrose

Introduction

Groundnut (*Arachis hypogaea* L.) is the primary source of dietary protein, minerals and vitamins for vegetarians and one of the main sources of vegetable oils used widely for cooking purposes around the world. The main goal in groundnut breeding programs were to increase the genetic potential for pod and oil production. According to most recent estimates only 49% of its total produce is crushed for oil and the rest is used for sowing and direct consumption. Peanut butter, roasted and salted groundnuts are preferred form of food for consumers and export (Ajay *et al.,* 2012) [2]. Improvement of yield with quality traits may have positive impact on farming community livelihood.

Due to attainability of genetic variability for oil, protein and sucrose content, Now-a-days groundnut varieties can be make use as dual-purpose lines *i.e.* suitable for direct consumption as seed or as for extraction of oil. But, quality of groundnut varies for confectionary and oil purposes (Mahatma *et al.,* 2016) [9]. Characters favoured for confectionery grade varieties were with high protein (30.22%) and sucrose (53 mg/g and 69 mg/g in virginia and spanish) with low oil content (37.42%). Hence, the simultaneous evaluation of genotypes focusing on improving quality characters along with yield potential shall form the basis and prioritization in groundnut breeding programme.

Material and Methods

The base material for the present research comprised of nine groundnut genotypes which includes five lines (Dharani, Dheeraj, Kadiri Amaravathi, Narayani and Kadiri-6) and four testers (ICGV-06188, ICGV-171377, ICGV-95165 and Bheema) with their 20 F_1s derived through hybridization in a LxT mating fashion (*kharif*, 2020).

Twenty F_1 s along with their parents were sown in a Randomized block design (RBD) with two replications during *rabi*, 2020 at dry land farm of S.V. Agricultural College, Tirupati, ANGRAU. Each entry was sown in 2 rows of 3 mts length with a spacing of 30 cms between the rows and 10 cms between the plants. Recommended crop production and protection measures were followed to maintain good crop growth.

Observations were recorded on 5 randomly tagged competitive plants from the centre of row in each genotype in each replication for all the yield, yield components and quality traits *viz.,* plant height, number of primary branches plant^{-1}, number of secondary branches plant^{-1}, number of pods plant^{-1}, number of matured pods plant^{-1}, 100 pod weight, 100 kernel weight, sound mature kernel %, shelling per cent, dry haulm weight plant^{-1}, pod yield plant^{-1}, kernel yield plant^{-1}, harvest index (%), oil content (%), protein content (%) and sucrose content (%) except 50% flowering and maturity that were noted per plot basis. Statistical analysis was done with the procedure given by Kempthorne (1957) [8] for combining ability analysis using LxT mating design. The recorded mean data of 5 plants were subjected to LxT analysis using the software TNAUSTAT statistical package.

Results and Discussions

Analysis of variance for combining ability

Sufficient amount of variability of parents and F_1s were noted for all the traits studied (Table.1 and 2). Results revealed that all the characters of F_1s showed genotypically significant variance due to parents except number of pods plant^{-1}, sound mature kernel (%) and harvest index (%) indicating the exsistence of sufficient variability in the research material. Mean squares due to parents *vs* crosses were significantly different for all the characters except for shelling per cent and dry haulm weight plant^{-1} revealing manifestation of differences among parents and their F1 crosses in all the characters. The mean squares due to lines and mean squares due to testers was significant for all characters except for number of pods plant^{-1} in lines, suggesting larger contribution of lines and testers towards general combining ability variance components for the traits studied. The mean squares due to Line × Tester interaction effects were significant for all characters except for number of primary branches plant^{-1}, number of pods plant^{-1}and kernel yield plant^{-1} revealed the significant contribution of crosses for specific combining ability variance components in the respective testing condition.

Estimates of Combining Ability Variances

The estimates of general combing ability and specific combining ability variances specify the type of gene action and the relative importance on the trait expression in breeding programme. From the analysis, the extent of *sca* variance was more than *gca* variance for all the eighteen characters representing the preponderance of non-additive gene action involved in the inheritance of characters. thus, offers good scope for exploitation of hybrid vigour. Predominance of *sca* variance for yield attributing traits were reported in earlier findings of Boraiah *et al.* (2015) [3], Waghmode *et al.* (2017) [19], Sowmya *et al.* (2018) [16], Kakeeto *et al.* (2020) [7] and Abady *et al.* (2021) [1]. Similar findings of predominance of *sca* variance for quality traits in peanut was documented by Pramesh *et al.* (2017) [12] for oil, John and Reddy (2015) [6] for oil and protein and Gor *et al.* (2013) [4] for oil, protein and sucrose.

General combing ability effects (*gca*) of parents and Specific combining ability effects of F_1 crosses (*sca*)

The results of *gca* and *sca* effects were presented in Table.3 and 4 respectively. The line Dharani showed significant and positive *gca* effect for number of secondary branches per plant^{-1}, 100 kernel weight, protein content, and sucrose content. Next line, Dheeraj exhibited desirable significant *gca* effect for days to 50% flowering, maturity, 100 pod weight, 100 kernel weight, dry haulm weight plant^{-1} and kernel yield plant^{1}. Similarly, Kadiri-6 registered desirable significant *gca* effect for days to 50% flowering, number of matured pods plant^{-1}, sound mature kernel%, shelling per cent, pod yield plant^{-1}, kernel yield plant^{-1}, harvest index, oil content, protein content and sucrose content followed by Narayani for days to 50% flowering, days to maturity, number of matured pods plant^{-1}, 100 pod weight, 100 kernel weight, pod yield plant^{-1}, kernel yield plant^{1}, harvest index and oil content.

Among testers, ICGV-06188 reported significant and positive *gca* effect for number of secondary branches per plant^{-1}, shelling per cent, dry haulm weight plant-1, pod yield plant^{-1}, kernel yield plant^{-1}, oil content and sucrose content, ICGV-171377 for days to 50% flowering, days to maturity, number of pods plant^{-1}, number of matured pods plant^{-1}, 100 pod weight, 100 kernel weight, SMK %, shelling per cent, dry haulm weight plant-1, pod yield plant^{-1} and kernel yield plant^{-1}, ICGV-95165 for number of primary branches per plant^{-1}, number of secondary branches per plant^{-1}, 100 pod weight, 100 kernel weight and harvest index and Bheema for maturity and plant height. Similar studies of positive and significant *gca* effect was earlier reported by Vaithiyalingan (2015) [17], John and Reddy (2015) [6], Patil *et al.* (2017) [13], Shaibu *et al.* (2018) [15], Nayak *et al.* (2020) [11] and Mourad *et al.* (2021) [10] for yield and yield components. Whereas, desirable negative estimates of *gca* for oil content was earlier reported by Wilson *et al.* (2013) [20] and Rajesh *et al.* (2011) [14], positive estimates of *gca* for protein and sucrose by Wang *et al.* (2021) and Gor *et al.* (2013) [4].

A perusual and *per se* performance and *sca* effects of 20 F_1 s revealed that Dheeraj x ICGV-171377 and Narayani x ICGV-06188 were identified as best specific combiners for early flowering and maturity. The crosses, Dheeraj x ICGV-171377, Narayani x ICGV-06188 and Dheeraj x ICGV-95165 were found as good specific combinations for number of pods plant-1. Similarly, Dheeraj x ICGV-171377, Narayani x ICGV-06188 and kadiri-6 x ICGV-95165 were registered as the superior combinations for number of matured pods plant-1. The best crosses for 100 pod weight, 100 kernel weight were Dheeraj x ICGV 171377, Narayani x Bheema, Dharani x ICGV 171377, Narayani x ICGV 06188, Kadiri-6 x ICGV 95165 and Kadiri-6 X ICGV 171377.

Five F_1 crosses *viz.*, Dheeraj x ICGV 171377, Narayani x ICGV 06188, Dharani x ICGV 171377, Dharani x Bheema and Kadiri-6 x ICGV 95165 were spotted as superior crosses for sound mature kernel %. High *sca* effects of crosses for shelling per cent were recorded by Narayani x ICGV 06188, Dheeraj x ICGV-06188 and Kadiri-6 x ICGV 95165. Similarly, the superior crosses for dry haulm weight plant-1 were Dheeraj x ICGV-06188, Narayani x ICGV-171377, Kadiri-6 x ICGV-06188 and Kadiri Amaravathi x ICGV-95165. For pod yield plant^{-1}, Kadiri-6 x ICGV 171377, Narayani x ICGV 06188, Dheeraj x ICGV 171377 and Kadiri-6 x ICGV 95165 were emerged out as superior crosses. For kernel yield plant^{-1}, Kadiri-6 X ICGV 171377, Narayani x ICGV 06188 and Kadiri-6 x ICGV 95165 were resulted as best specific combinations. The crosses *viz.*, Narayani x ICGV 95165, Kadiri-6 x ICGV 171377, Narayani x ICGV 06188 and Dheeraj x Bheema were shown desirable performance for harvest index (%).

Based on *sca* effects of crosses, it is inferred that, Narayani x Bheema, Dheeraj x ICGV 95165 and Kadiri-6 x ICGV 171377 were recorded desirable negative *sca* effect for oil content. The best performing crosses for protein content were Dharani x ICGV 171377, Kadiri-6 x ICGV 171377, Dharani x

Bheema and Narayani x ICGV 06188. Whereas, Kadiri-6 x ICGV 95165, Kadiri-6 x ICGV 171377, Narayani x ICGV 06188, Dharani x ICGV 95165 and Dharani x ICGV 06188 were identified as the best crosses for sucrose content. Similar positive estimates of *sca* for yield and its contributing traits has been reported by Boraiah *et al.* (2015) [3] and Vishnu prabha *et al*. (2021) [18]. Similar findings also cited for quality traits by Gor *et al.* (2013) [4] identified crosses with desirable negative *sca* effect for oil and positive *sca* effect for protein and sucrose. Whereas, positive sca effect only for Protein reported earlier by John and Reddy (2015) [6] and Hosar *et al.* (2016) [5].

In the present research, Majority of the cross combinations with high *sca* effects involved in poor x good, good x poor and poor x poor *gca* groups as a result of complementation of high and low combining loci. Another reason may be because of genetic diversity in the form of number of heterozygous loci of the parents involved in the cross combinations. Reciprocal recurrent selection or Biparental mating followed by single plant selection is advocated as a good breeding strategy to handle these crosses further. Whereas, the crosses with high *sca* effects arising from parents with good x good *gca* values might be as a result of the cumulative effect of high combining loci and no mutual annulment of gene effects between high general combining loci. Hence, parents of these crosses could be exploited by pedigree breeding method to get desirable transgressive segregants

Summary and Conclusion

Summarizing the above discussion, the lines *viz*., Kadiri-6 and Narayani and the testers, ICGV-171377 and ICGV-06188 were identified as good general combiners for most of the yield attributing and quality characters. Hence, these parents have good potential for improving respective characters and could be used in crossing programme to integrate active population with accumulated favorable genes. Similarly, four crosses viz., Dheeraj x ICGV-171377, Narayani x ICGV-06188, Kadiri-6 x ICGV-95165 and Kadiri-6 x ICGV-171377 reported positive and significant *sca* effect for most of the yield and quality traits with low oil, high protein and high sucrose contents and could be utilized in selection of elite confectionary genotypes in advanced generations.

Table 1: Analysis of variance for combining ability in a Line x Tester analysis for pod yield and yield attributes in groundnut

Source of variation	df	Mean sum of squares														
		DFF	DM	PH (cm)	NPB	NSB	NPP	NMP	100 PW (g)	100 KW (g)	SMK (%)	SP (%)	DHW (g)	PYPP (g)	KYPP (g)	HI (%)
Replications	1	0.43	0.01	3.24	0.01	0.01	13.59	0.70	7.89	0.54	1.54	8.66	13.72	0.14	1.68	16.46
Entries	28	32.02 **	34.76**	40.55**	2.28**	2.58**	16.69**	44.94**	139.30**	102.47**	106.40**	85.28**	33.74**	32.37**	41.50**	44.97**
Parents	8	40.00**	51.93**	17.81*	1.78**	4.66**	6.65	13.99**	225.36**	75.79**	13.26	40.27**	9.49*	14.56**	2.37*	2.91
Lines	4	46.69**	76.71**	54.02**	2.53**	1.55**	5.18	80.71**	118.23**	102.85**	100.76**	198.85**	38.20**	89.74**	125.91**	85.85**
Testers	3	46.33**	31.20**	38.36**	2.75**	5.79**	52.01**	145.87**	128.55**	41.43**	282.45**	162.56**	72.16**	44.35**	70.47**	27.42**
L vs T	1	18.02**	12.18**	46.20*	1.80*	0.94**	12.02	18.41*	73.05**	80.05**	129.25*	61.37*	40.31**	18.91**	28.84**	58.65**
Crosses	19	28.53**	28.77**	46.61**	2.10**	1.83**	16.90**	51.65**	91.32**	78.75**	147.45**	106.29**	44.89**	37.84**	55.85**	59.44**
Lines in crosses	4	46.69**	76.71**	54.02**	2.53**	1.55**	5.18	80.71**	118.23**	102.85**	100.76**	198.85**	38.20**	89.74**	125.91**	85.85**
Testers in crosses	3	46.33**	31.20**	38.36**	2.75**	5.79**	52.01**	145.87**	128.55**	41.43**	282.45**	162.56**	72.16**	44.35**	70.47**	27.42**
L vs T in crosses	12	18.02**	12.18**	46.20**	1.80**	0.94**	12.02**	18.41**	73.05**	80.05**	129.25**	61.37**	40.31**	18.91**	28.84**	58.65**
Parents vs Crosses	1	34.48**	11.34**	107.33**	9.74**	0.22*	92.99**	165.11**	362.44**	766.66**	71.54**	46.25	15.71	70.83**	82.03**	106.42**
Error	28	1.57	2.09	7.40	0.39	0.03	3.30	3.47	6.66	5.14	9.04	11.71	4.13	1.76	1.01	4.01

DFF: Days to 50% flowering, DM: Days to maturity, PH: Plant height, NPB: Number of primary branches plant^{-1}, NSP: Number of secondary plant^{-1}, NPP: Number of pods plant^{-1}, NMP: Number of pods plant^{-1}, 100 PW: 100 pod weight, 100 KW: 100 kernel weight, SMK: Sound mature kernel, SP: Shelling percent, DHW: Dry haulm weight plant^{-1}, PYPP: Pod yield plant^{-1}, KYPP: Kernel yield plant^{-1}, HI: Harvest index

Table 2: Analysis of variance for combining ability in a Line x Tester analysis for quality characters in groundnut

Source of variation	df	Mean sum of squares		
		Oil content (%)	Protein content (%)	Sucrose content (%)
Replications	1	6.02	2.47	0.11
Entries	28	7.91**	11.61**	2.64**
Parents	8	4.63**	4.93**	2.27**
Lines	4	19.11**	19.32**	7.03**
Testers	3	8.66*	3.17**	1.51**
L vs T	1	6.59	8.28**	1.80**
Crosses	19	9.54**	9.80**	2.85**
Lines in crosses	4	19.11**	19.32**	7.03**
Testers in crosses	3	8.60**	3.17**	1.51**
L vs T in crosses	12	6.59**	8.28*	1.80**
Parents vs Crosses	1	3.22	99.52**	1.59**
Error	28	1.54	0.65	0.18

Table 3: Estimates of general combining ability (*gca*) effects of parents and specific combining ability (*sca*) effects of crosses for pod yield and yield attributes in groundnut

S. No.	Genotypes	DF	DM	PH (cm)	NPB	NSB	NPP	NMP	100 PW (g)	100 KW (g)	SMK (%)	SP (%)	DHW (g)	PYPP (g)	KYPP (g)	HI (%)
	Lines															
1.	Dharani	1.50**	0.22	1.83*	-0.49*	0.70**	0.33	-1.81*	-1.19	2.02*	-2.46	1.16	-0.81	-0.32	0.02	0.58
2.	Dheeraj	-1.13*	-1.65**	0.61	0.09	-0.08	-0.92	0.47	4.71**	1.98*	2.36	1.43	3.59**	0.76	1.01**	-2.63**
3.	Kadiri Amaravathi	3.50**	5.10**	2.76**	0.83**	-0.12	-0.55	-4.40**	-3.18**	-5.10**	-4.87**	-8.67**	0.07	-5.51	-6.66**	-4.03**
4.	Narayani	-1.75**	-3.03**	3.63**	-0.55**	-0.51**	1.15	3.55**	3.39**	3.45**	1.31	1.93	-2.29**	1.87**	1.88**	3.73**
5.	Kadiri-6	-2.13**	-0.65	1.57	0.12	0.00	-0.01	2.21**	-3.73**	-2.34**	3.66**	4.15**	-0.55	3.21**	3.75**	2.34**
	Testers															
6.	ICGV 06188	-0.40	0.20	1.87*	-0.03	0.46**	-1.45*	-1.56*	-4.07**	-2.06**	1.40	2.20*	2.05**	1.23*	1.65**	-1.35
7.	ICGV 171377	-2.30**	-1.00*	0.78	-0.10	-0.67**	3.22**	5.49**	3.44**	1.67*	4.74**	4.32**	2.38**	1.54**	2.79**	-1.51*
8.	ICGV 95165	2.90**	2.40**	0.08	0.70**	0.83**	-0.01	-0.64	2.54**	1.83*	-7.62**	-4.68**	-1.23	0.28	-1.60**	1.46*
9.	Bheema	-0.20	-1.60**	-2.72**	-0.57**	-0.63**	-1.77**	-3.29**	-1.92*	-1.44*	1.48	-1.84	-3.20**	-3.05**	-2.84**	1.41
	S.E. (g_i)	0.41	0.50	0.86	0.19	0.07	0.63	0.71	0.84	0.72	1.20	1.13	0.76	0.53	0.34	0.76
	S.E. (g_j)	0.37	0.45	0.77	0.17	0.06	0.56	0.64	0.76	0.65	1.08	1.01	0.68	0.48	0.30	0.68
	F_1 crosses															
10.	Dharani x ICGV 06188	0.40	-0.32	2.91	-0.91*	1.60**	0.57	-0.81	-0.92	-0.96	0.67	-4.89*	-0.69	1.02	-1.24	1.21
11.	Dharani x ICGV 171377	0.30	1.38	0.51	-0.19	-0.88**	-0.10	2.23	4.64*	3.86*	5.45*	3.50	-0.12	-0.53	0.85	-0.15
12.	Dharani x ICGV 95165	-0.40	0.47	2.07	0.16	-0.79**	-1.36	-2.44	1.84	-2.14	-14.82**	-3.93	-1.41	-2.05	-2.64**	0.30
13.	Dharani x Bh eema	-0.30	-1.52	-5.49**	0.93*	0.08	0.89	1.01	-5.55**	-0.77	8.70**	5.32*	2.21	1.56	3.03**	-1.36
14.	Dheeraj x ICGV 06188	-2.47**	-0.95	7.03**	-0.30	-0.32*	-5.68**	-4.10**	1.01	3.43*	0.07	5.65*	3.96*	-1.41	1.03	-4.46**
15.	Dheeraj x ICGV 171377	-3.08**	-2.25*	-1.31	-0.52	0.20	3.15*	2.95*	4.24*	3.35*	5.91*	2.14	2.63	4.05**	3.69**	-0.04
16.	Dheeraj x ICGV 95165	4.22**	1.85	-3.62*	0.87*	0.20	2.88**	1.08	-1.86	-2.22	-4.22	-5.22	-0.06	-1.61	-3.10**	-1.68
17.	Dheeraj x Bheema	1.33	1.35	-2.11	-0.05	-0.09	-0.36	0.06	-3.40	-4.55**	-1.75	-2.57	-6.54**	-1.03	-1.62*	6.19**
18.	Kadiri Amaravathi x ICGV 06188	2.40**	2.80*	-3.86*	0.07	-0.28*	2.15	1.02	5.65**	-8.84**	-6.56*	-1.46	-4.08*	-0.48	-0.96	4.10*
19.	Kadiri Amaravathi x ICGV 171377	2.30*	1.00	0.09	0.54	0.34*	-1.12	-3.98*	-5.12**	0.60	-4.92	-6.74**	-2.80	-1.09	-3.31**	2.28
20.	Kadiri Amaravathi x ICGV 95165	-1.40	-0.40	-4.27*	-1.11**	0.14	-0.89	-0.10	-1.02	2.27	7.73**	4.93*	4.71**	0.09	1.92**	-4.78**
21.	Kadiri Amaravathi x Bheema	-3.30**	-3.40**	8.03**	0.51	-0.20	-0.13	3.05*	0.49	5.97**	3.75	3.27	2.17	1.48	2.34**	-1.60
22.	Narayani x ICGV 06188	-3.35**	-3.57**	-1.87	-0.45	-0.49**	2.75*	3.92*	4.57*	6.88**	5.42*	6.26*	-2.38	4.22**	5.82**	4.22**
23.	Narayani x ICGV 171377	-0.95	-0.37	2.33	-0.07	0.53**	-1.92	-0.23	-7.44**	-11.78**	0.79	-0.40	6.06**	-5.41**	-4.15**	-9.55**
24.	Narayani x ICGV 95165	1.35	1.23	-0.35	1.13**	-0.17	-0.69	-2.03	-4.04*	-1.02	1.09	-2.04	-5.08**	0.98	-0.38	6.64**
25.	Narayani x Bheema	2.95**	2.73*	-0.11	-0.61	0.14	-0.13	-1.40	6.92**	5.93**	-7.31**	-3.82	1.40	0.20	-1.29	-1.30
26.	Kadiri-6 x ICGV 06188	3.03**	2.05	-4.22*	1.58**	-0.50**	0.21	-0.04	-10.30**	-0.51	0.40	-5.56*	3.20*	-3.35**	-4.65**	-5.06**
27.	Kadiri-6 x ICGV 171377	1.42	0.25	-1.63	0.25	-0.18	-0.01	-0.99	3.68*	3.97*	-7.24**	1.49	-5.78**	2.98*	2.91**	7.47**
28.	Kadiri-6 x ICGV 95165	-3.78**	-3.15**	6.17**	-1.05**	0.61**	0.07	3.74*	5.08**	3.11*	10.22**	6.27*	1.83	2.59*	4.20**	-0.47
29.	Kadiri-6 x Bheema	-0.68	0.85	-0.33	-0.78*	0.08	-0.27	-2.71	1.54	-6.58**	-3.38	-2.20	0.75	-2.22*	-2.46**	-1.93
	S.E. (g_{ij})	0.82	0.99	1.72	0.37	0.13	1.25	1.41	1.68	1.44	2.40	2.25	1.51	1.06	0.67	1.52

Table 4: Estimates of general combining ability (*gca*) effects of parents and specific combining ability (*sca*) effects of crosses for quality characters in groundnut

S.No.	Genotypes	Oil content (%)	Protein content (%)	Sucrose content (%)
1.	Dharani	0.89*	2.06**	0.35*
2.	Dheeraj	0.14	-0.98**	-0.69**
3.	Kadiri Amaravathi	2.02**	-0.78*	-1.10**
4.	Narayani	-1.53**	-1.53**	0.15
5.	Kadiri-6	-1.53**	1.23**	1.30**
6.	ICGV 06188	-0.96*	0.08	0.39*
7.	ICGV 171377	1.27**	0.70	-0.31*
8.	ICGV 95165	-0.13	-0.66*	0.28
9.	Bheema	-0.17	-0.12	-0.35*
	S.E. (g_i)	0.42	0.30	0.16
	S.E. (g_j)	0.38	0.27	0.14
10.	Dharani x ICGV 06188	-0.11	-3.70**	0.70*
11.	Dharani x ICGV 171377	-0.44	1.31*	-0.82*
12.	Dharani x ICGV 95165	0.50	0.89	0.90*
13.	Dharani x Bh eema	0.05	1.50*	-0.78*
14.	Dheeraj x ICGV 06188	1.08	1.28*	-0.09
15.	Dheeraj x ICGV 171377	0.86	-1.29*	0.56
16.	Dheeraj x ICGV 95165	-2.74**	-0.87	-0.48
17.	Dheeraj x Bheema	0.80	0.88	0.01
18.	Kadiri Amaravathi x ICGV 06188	0.71	-0.09	-0.49
19.	Kadiri Amaravathi x ICGV 171377	0.48	0.87	-0.31
20.	Kadiri Amaravathi x ICGV 95165	-0.12	0.38	0.20
21.	Kadiri Amaravathi x Bheema	-0.18	-1.16	0.60
22.	Narayani x ICGV 06188	-0.41	3.18**	1.06**
23.	Narayani x ICGV 171377	1.53	-2.90**	-0.16
24.	Narayani x ICGV 95165	1.42	0.13	-1.55**
25.	Narayani x Bheema	-2.54**	-0.42	0.64
26.	Kadiri-6 x ICGV 06188	-1.28	-0.67	-1.17**
27.	Kadiri-6 x ICGV 171377	-2.43**	2.00**	0.72*
28.	Kadiri-6 x ICGV 95165	0.94	-0.53	0.93**
29.	Kadiri-6 x Bheema	2.77**	-0.80	-0.48
	S.E. (s_{ij})	0.83	0.59	0.31

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

References

1. Abady S, Shimelis H, Janila P, Deshukh D, Wankhade A, Chaudhari S. Combining ability analysis of groundnut (*Arachis hypogaea* L.) genotypes for yield and related traits under drought stressed and non-stressed conditions. *Euphytica*. 2021;217(11):1-19.
2. Ajay BC, Godwa MVC, Rathnakumar AL, Kusuma VP, Fiyaz RA, Holajjer P, *et al*. Improving genetic attributes of confectionary traits in peanut (*Arachis hypogaea* L.) using multivariate analytical tools. Jounal of Agricultural Sciences. 2012;4(3):247-253.
3. Boraiah KM, Shanker G, Kotreshi G, Konda CR, Prashauth BH. Heterosis for yield and yield attributing traits in groundnut (*Arachis hypogaea* L.). Legume Research-An International Journal. 2012;35:119-125.
4. Gor HK, Dhaduk LK, Raval L. Genetics of major biochemical components in groundnut (*Arachis hypogaea* L.). Electronic Journal of Plant Breeding. 2013;4(4):1292-1297.
5. Hosary AAEL, Sedhom SA, Sawy GYHWA, Shawky AAAEL. Inhertance of yield and quality characters in peanut under two sowing dates. Egypt. J Plant Breed. 2016;20(4):511-529
6. John K and Reddy PR. Genetic analysis of oil and protein contents in groundnut (*Arachis hypogaea* L.). International Journal of Current Research Biosciences and Plant Biology. 2015;2(5):56-68.
7. Kakeeto R, Meils R, Biruma M and Sibiya J. Gene action governing the inheritance of drought tolerance and selected agronomic traits in Ugandan groundnut (*Arachis hypogaea* L.) lines under drought environment. Euphytica. 2020;216:1.
8. Kempthorne O. An Introduction to Genetic Statistics. John Wiley and Sons Inc., New York; c1957. p. 545.
9. Mahatma MK, Thawait LK, Bishi SK, Khatediya N, Rathnakumar AL, Lalwani HB, *et al*. Nutritional Composition and Antioxidant activity of Spanish and Virginia Groundnuts (*Arachis hypogaea* L.): A Comparative Study. Journal of Food Science and Technology. 2016;53(5):2279-2286.
10. Mourad KhA. Diallel Analysis of Seed Yield, its Components and Oil Content in peanut. Journal of Plant Protection. 2021;12(1):1-9.
11. Nayak PG, Venkataiah, Revathi P. Combining Ability and Heterosis Studies for Yield and Yield Contributing Characters in Groundnut (*Arachis hypogaea* L.). Current Journal of Applied Science and Technology. 2020;39(48):566-573.
12. Pramesh KH, Chanu HP, Sharma PHR. General and Specific Combiningg ability Analysis for Yield and Yield Contributing Characters in Groundnut (*Arachis hypogaea* L.). Electronic Journal of Plant Breeding. 2017;8(3):973-979.
13. Patil KS, Kenchanagoudar PV, Kulmi MRM. Combining

ability studies for yield and its component traits in groundnut (*Arachis hypogaea* L.). International Journal of Current Microbiology and Applied Science. 2017;6(8):336-342.
14. Rajesh AP. Genetic analysis of yield, physiological and confectionery traits in groundnut (*Arachis hypogaea* L.). Ph.D. Thesis. Andhra Pradesh Agricultural University, Hyderabad, India; c2011.
15. Shaibu AS, Faiza MS, Motagi BN. Combining Ability Analysis for Growth and Yield Components of Groundnut (*Arachis hypogaea* L.) in Sudan Savannah. Advances in Agricultural Science. 2018;6(4):12-18.
16. Sowmya HC, Savithramma DL, Latha HC. Combining ability studies for yield and water use efficiency related traits in groundnut (*Arachis hypogaea* L.). Journal of Pharmacognosy and Phytochemistry. 2018;7(1):1722-1726.
17. Vaithiyalingan M. Combining ability studies for yield and yield components in groundnut (*Arachis hypogaea*). Electronic Journal of Plant Breeding. 2015;11(9):78-85.
18. Vishnuprabha RS, Viswanathan PL, Manonmani S, Rajendran L, Selvakumar T. Estimation of Heterosis and Combining Ability of Yield Traits in Groundnut (*Arachis hypogaea* L.). Indian Journal of Agricultural Research. 2021;55(3):310-316.
19. Waghmode BD, Kore AB, Navhale VC, Sonone NG, Thaware BL. Genetic analysis of promising crosses and good combiners for developing new genotypes in groundnut (*Arachis hypogaea* L.). Int. J Curr. Microbiol. App. Sci. 2017;6(7):324-331.
20. Wilson JN, Baring MR, Burow MD, Rooney WL, Simpson CE. Generation mean analysis of oil concentration in peanut. Journal of Crop Improvement. 2013;27(1):85-95.