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Estimation of combining ability for yield and yield components traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

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Abstract
General combine ability and specific combine abilities were estimated in eighteen inbred lines and fort-five hybrids of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Results indicate significant variabilities in the sixty-three genotypes population (parents and hybrids). The investigation was undertaken with eighteen varieties of bottle gourd using Line x Tester mating design at the Horticultural Research Centre, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut (250110) Uttar Pradesh, in Randomized Complete Block design (RBD) with three replications, was carried out during summer, seasons 2020 and 2021. The analysis of variance for combining ability mean square due to line x tester were highly significant for days to first flower initiation, days to 50% flowering, and the lines for days to first flower initiation, days to 50% flowering, Whereas the tester for days to first flower initiation, days to 50% flowering. The genotypes IC- 394736, IC-385816, Narendra Rashmi, and Pusa Naveen exhibited significant GCA effects out of twelve characters with respect to yield (q/h) in bottle gourd. On basis of the specific combining ability effect of different crosses IC-394736 x Pusa Naveen, IC-310188 x Narendra Rashmi, Vallabh Saral x Narendra Madhuri, and IC-336820 x Narendra Madhuri were found maximum SCA effect. All these crosses promise for improvement of respective component characters in specific environments and ultimately fruit yield. These cross combinations can be utilized for the further breeding programme for crop improvement in bottle gourd.

Keywords: Combining ability, yield attributing traits, bottle gourd

Introduction
Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is a crucial vegetable crop belonging to the Cucurbitaceae family, subfamily cucurbitoideae, and tribe benincaseae (Richardson, 1972) [10]. It has a diploid chromosome (2n=2x=22) and belongs to the genus *Lagenaria* with a genome size of 334 Mb (Beevy and kuriachan, 1996; Achigan-Dako *et al.*, 2008) [2].
The names "*lagenaria*" and "*siceraria*" are derived from the Latin words "lagena" for bottle and "sicera" for drinking utensils. Its fruit is available in the market throughout the year. It is believed to originate in Southern Africa and is widely grown in South and Southeast Asia, China, and Africa (Erickson *et al.*, 2005) [3]. In India, it is grown in the kitchen garden and commercial fields also. India is a wealth of bottle-gourd germplasm and presented both types of wild and cultivated species. The genus *Lagenaria* consists of five other wild species, namely *L. brevifilora* (Benth) Roberty, *L. rufa* (Gilg) C. Jeffery, *L. sphaerica* E. Mey, *L. abyssinia* (Hook. F.), C. Jeffery and *L. guineensis* (G Den) C. Jeffery. Which *L. siceraria* is the most cultivated (Erickson *et al.*, 2005) [3].
Bottle gourd is also known as Calabash or white flower gourd, Alabu in Sanskrit, Kaddu, Lauki, and Tumari in Hindi, Sorkaya in Telugu, Shorakkai in Tamil, Sorekayi, Halagumbala in Kannada, Lau in Bengali and Assamese, and Ghiya in Punjab. Its name "bottle gourd" is probably derived from its bottle-shaped variants it is grown in both rainy and summer season crops. India occupies is the second-largest producer of vegetables next to China in the world. A vegetable is grown in an area of 10.85 million hectares with a production of 200.45 million tonnes which contributes to 15% of the total world production of vegetables. In India, bottle gourd occupies an area of 1.93 million hectares with a production of 31.71 million tonnes. Uttar Pradesh holds about 1.64 million hectares of land under bottle gourd with the production of 493.85 metric tonnes (Anonymous, 2020-21) [1].

The bottle gourd fruit contain vitamin C (11.00mg), thiamine (0.044mg), riboflavin (0.023mg), niacin (0.330mg), protein (0.200g), carbohydrate (2.50g) and trace of mineral-like calcium (20.00mg), phosphorus (10.00mg) and iron (0.700mg) in 100gm of fruit (Thamburaj and Singh 2000) [11].
General combining ability is the average performance of lines in hybrid combinations, the specific combining ability refers to the deviation of certain crosses from expectations on the basis of the average performance of the line evolved (Sprague and Tatum, 1942). General combining ability includes additive variance and variance arising due to additive x additive interaction, while specific combining ability includes non-additive genetic variances arising from dominance and epitasis. However, very little systemic attention has been paid by plant breeders to study per se performance for earliness, yield, and its related traits. Hence, the present investigation was undertaken to determine the mechanism of gene action involved in the inheritance of yield components in bottle gourd further, the select elite parental lines can be utilized for future hybridization programmes

Materials and Methods

The investigation was undertaken to estimate the ability for growth and its component trais in bottle gourd with eighteen varieties of bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] under environments. The material of the study consisted of fifteen genetically diverse bottle gourd lines viz., IC- 539711, IC- 336757, IC- 394736, IC- 321410, IC- 398541, IC- 321460, IC- 541393, IC- 394857, IC- 310188, Vallabh Saral, IC- 385816, IC- 336820, IC- 418491, Pant Louki-1, Arka Bahar with three tester Narendra Madhuri, Narendra Rashmi and Pusa Naveen. The lines were crossed with a tester as per the lines x tester mating design. The parent and their offspring were evaluated in a completely randomized block design with three replications for twelve characters viz., days to first flower initiation, days to 50% flowering, days of fruit set, days to first fruit harvest, fruit weight (g), fruit length (cm), fruit girth (cm), number of fruits per plant, vine length (m), number of primary branches per plant, duration of crop and fruit yield (q/h), using Line x Tester mating design at the Horticultural Research Centre, College of Horticulture, Sardar Vallabhbhai Patel University of Agriculture & Technology, Modipuram, Meerut (250110) Uttar Pradesh, in Randomized Complete Block design (RBD) with three replications.

Result and Discussion

The result revealed that significant differences existed among the genotypes and parents of all the characters in table- 1. The analysis variance showed highly significant values for lines for days to first flower initiation, days to 50% flowering, days to first fruit set, days to first fruit harvest, duration of crop, fruit length, fruit girth, number of primary branches, vine length, average fruit weight, fruit yield. Whereas the tester exhibited highly significant values for days to first flower initiation, days to 50% flowering, days to first fruit set, days to first fruit harvest, duration of crop, fruit length, fruit girth, number of primary branches, vine length, average fruit weight, fruit yield.
The combining ability analysis revealed that the GCA and SCA variances were significant for the characters in each environment, indicating the importance of both additive and non-additive genetic control of all the characters under study.
The estimates of the general combining ability (GCA) are in table -2. The lines IC- 398541 showed good combiner for days to the first initiation and the tester was Narendra Rashmi. (-1.50**). For days to 50% flowering were positive and significant lines for IC- 336820 (3.99**) and Tester was Pusa Naveen (0.61**). For the days to the first fruit set of lines IC-336820 (3.10**) was positive and highly significant and the tester was Narendra Madhuri (1.03**). For Vine length (m), lines were, IC-541393 (0.94**) showed positive and highly significant and the tester was Narendra Rashmi (0.19*). For a number of primary branches, the lines IC-321410 (2.11**) showed a positive and highly significant value and the tester was Pusa Naveen (0.60**). For days to first fruit harvest for was observed in lines IC- 394857 (3.21**), and the tester was Narendra Madhuri (1.18**). For fruit length (cm) with positive and highly significant values of lines for IC-385816 (4.80**) and testers was Pusa Naveen (3.39**). For fruit girth (cm) parents positive and highly significant general combined ability effects were found for lines IC- 336820 (2.21**) and was tester Narendra Madhuri (4.02**). For the average fruit weight (gm) for line, IC- 321410 (185.84**) and testers was Pusa Naveen (12.18**). For the number of fruits per plant among the parents, Positive and highly significant general combining ability effects were found for the line IC- 541393 (2.99**) and the tester was Pusa Naveen (0.86**). For the duration of crops, lines for Vallabh Saral (3.95**) and the tester was Narendra Rashmi (2.24**). For the yield (q/h) the lines IC- 310118 (40.53**) and tester Narendra Rashmi (14.75**) were identified as good combining ability for yield (q/h) due to positive and highly significant. The estimates of the specific combining ability (SCA) effect of 45 hybrids for twelve characters are presented in table -3. For days to first flower initiation the hybrid which has positive significant values of SCA effects was in IC- 310188 x Pusa Naveen (3.77**) For the days to 50% flowering in Arka Bahar x Narendra Rashmi (3.19**). For the days to the first fruit set in IC- 394736 x Pusa Naveen (4.81**). For the Vine length was obtained in IC- 321460 x Narendra Rashmi (0.90**). For the number of primary branches in Vallabh Saral x Narendra Rashmi (0.90*). For fruit length was Pant Louki x Pusa Naveen (4.68**).
For the average fruit weight was Vallabh Saral x Narendra Madhuri (298.49**). For the days to the first fruit harvest were obtained by the crosses namely, IC- 539711 x Narendra Madhuri (6.42**). For the duration of the crosses was Arka Bahar x Pusa Naveen (5.96**), crosses that exhibited positive and highly significant SCA effects for yield, Arka Bahar x Pusa Naveen (20.84**).
These parents could use the breeding programme to improve yield along with yield and contributing characteristics. It may be inferred that the yield contributing genotypes can maintain their superiority in combining ability effects. Considering the above criteria Raju *et al.,* (2021) [9] and Quamruzzaman *et al.,* (2020) [8] in bottle gourd also reported common parents for yield and yield components. Pusa Naveen was recognized GCA effect for days to first flower initiation, days to 50% flowering, days of fruit set, days to first fruit harvest, fruit weight, fruit length, fruit girth, number of primary branches, number of fruits per plant, duration of crop and fruit yield. These results conform to the findings by Kumar *et al.,* (2014) [6], Janaranjan *et al.,* (2016) [4], Quamruzzaman *et al.,* (2020) [8], Kumar *et al.,* (2013) [7], Raju *et al.,* (2021) and Kumar *et al.,* (2019).

Table 1: Analysis of variance for combining ability with respect to twelve characters of bottle gourd 45 F_1 hybrids

Characters	d. f.	Days to first flower initiation	Days to 50 % flowering	Days to first fruit set	Days to first fruit harvest	duration of crop	Fruit length (cm)	Fruit girth (cm)	Number of primary branches	Vine length (m)	Number of fruits per plant	Average fruit weight (gm)	Fruit yield q/h
Replication	2	20.54	1.02	20.05	22.24	28.54	0.37	14.74	0.89	1.18	0.70	130.61	33.15
CROSS	44	13.31**	16.31**	19.85**	32.06**	51.19**	61.63**	41.94**	3.55**	1.40**	13.55	109338.78**	3448.81**
LINE(c)	14	13.59**	23.27**	20.20**	35.01**	42.18**	70.19**	24.33**	7.03**	2.24**	31.15	127356.76**	8927.90**
TEST(c)	2	84.40**	46.03**	67.70**	99.32**	548.73**	710.98**	605.43**	12.94**	1.21**	25.43	12735.38**	8026.73**
LXT (c)	28	8.09**	10.71**	16.26**	25.77**	20.15**	10.97**	10.50**	1.13**	0.99**	3.90	107230.03**	382.27**
ERROR	88	0.14	0.64	0.41	0.26	0.31	0.52	0.68	0.54	0.26	0.69	2.25	1.02
Total	134	4.77	5.79	7.09	11.03	17.44	20.59	14.44	1.53	0.78	4.92	35905.71	1133.61

Table 2: Estimation of GCA effects of parents for twelve characters of bottle gourd

S. No	Parents	Days to first flower initiation	Days to 50 % flowering	Days to first fruit set	Days to first fruit harvest	duration of crop	Fruit length (cm)	Fruit girth (cm)	Number of primary branches	Vine length (m)	Number of fruits per plant	Average fruit weight (gm)	Fruit yield q/h
	Line												
1	IC- 539711	0.86 **	2.14 **	-0.25	-1.99 **	-1.48 **	0.65 **	-2.70 **	0.4	0.01	1.21 **	-49.43 **	8.84 **
2	IC- 336757	0.91 **	-0.88 **	-0.94 **	-0.17	-0.03	1.51 **	-2.59 **	-0.18	0.07	2.43 **	109.22 **	24.64 **
3	IC- 394736	0.68 **	1.41 **	0.57 **	-0.90 **	-0.43 *	-3.95 **	-0.73 **	0	-0.77 **	-1.26 **	-68.89 **	30.24 **
4	IC- 321410	1.62 **	0.3	0.66 **	1.77 **	2.86 **	-1.09 **	0.32	2.11 **	-0.08	-0.3	185.84 **	28.33 **
5	IC- 398541	-1.83 **	-2.92 **	-1.99 **	-0.77 **	-0.99 **	0.09	2.05 **	0.04	0.65 **	-1.57 **	-30.69 **	29.60 **
6	IC- 321460	-1.67 **	-0.57 *	-2.05 **	-2.94 **	-2.05 **	2.09 **	0.96 **	0.60 *	-0.24	-0.08	-5.16 **	-9.67 **
7	IC- 541393	-1.25 **	-0.95 **	-1.83 **	-1.90 **	1.46 **	0.91 **	1.21 **	-0.02	0.94 **	2.99 **	98.35 **	-64.76 **
8	IC- 394857	0.99 **	0.81 **	2.26 **	3.12 **	2.83 **	-1.51 **	-0.33	-1.38 **	-0.22	-0.72 *	73.93 **	9.73 **
9	IC- 310188	-0.27 *	-0.19	0.75 **	-0.03	0.43 *	1.74 **	-1.26 **	-0.02	0.67 **	2.70 **	-34.34 **	40.53 **
10	Vallabh Saral	-0.56 **	-0.23	-0.14	1.52 **	3.95 **	-4.91 **	0.32	-1.07 **	0.52 **	-0.19	-181.23 **	-8.18 **
11	IC- 385816	-1.05 **	-0.79 **	0.12	2.17 **	-3.92 **	4.80 **	0.96 **	-1.02 **	-0.51 **	-1.77 **	184.24 **	10.13 **
12	IC- 336820	2.26 **	3.99 **	3.10 **	2.90 **	-1.39 **	1.23 **	2.21 **	0.33	0.14	-1.57 **	-51.07 **	-12.72 **
13	IC- 418491	-0.16	-0.66 *	-0.43 *	-1.99 **	-0.50 **	0.71 **	0.98 **	0.78 **	-0.44 *	1.81 **	58.86 **	-44.49 **
14	Pant Louki-1	-0.98 **	-0.41	-1.05 **	-1.85 **	1.39 **	2.56 **	1.18 **	0.42	-0.42 *	-3.35 **	-223.45 **	-47.40 **
15	Arka Bahar	0.46 **	-1.06 **	1.26 **	1.06 **	-2.12 **	-4.84 **	-2.58 **	-0.98 **	-0.33	-0.35	-66.18 **	5.20 **
	Tester												
16	Narendra Madhuri	1.19 **	0.56 **	1.03 **	1.18 **	1.79 **	-4.37 **	4.02 **	-0.16	-0.11	-0.32 *	7.02 **	-11.27 **
17	Narendra Rashmi	-1.50 **	-1.17 **	-1.36 **	-1.67 **	2.24 **	0.99 **	-3.16 **	-0.44 **	0.19 *	-0.54 **	-19.20 **	14.75 **
18	Pusa Naveen	0.31 **	0.61 **	0.33 **	0.49 **	-4.02 **	3.39 **	-0.86 **	0.60 **	-0.07	0.86 **	12.18 **	-3.48 **
	SE (gca line)	0.123	0.268	0.214	0.171	0.187	0.241	0.274	0.244	0.169	0.278	0.500	0.336
	SE (gca tester)	0.055	0.120	0.096	0.076	0.084	0.108	0.123	0.109	0.076	0.124	0.224	0.150
	SE (bet gca line)	0.173	0.378	0.302	0.241	0.264	0.341	0.388	0.345	0.239	0.393	0.708	0.475
	SE (bet gca tester)	0.078	0.169	0.135	0.108	0.118	0.153	0.173	0.154	0.107	0.176	0.316	0.212

Table 3: Estimation of SCA effects of F_1 for twelve characters of bottle gourd

S.N.	Hybrids	Days to first flower initiation	Days to 50 % flowering	Days to first fruit set	Days to first fruit harvest	Duration of crop	Fruit length (cm)	Fruit girth (cm)	Number of primary branches	Vine length (m)	Number of fruits per plant	Average fruit weight (gm)	Fruit yield q/h
1	IC- 539711 x N. Madhuri	2.57 **	1.20 *	4.39 **	6.42 **	0.44	-0.25	2.47 **	0.36	-0.57	-1.28 **	-38.84 **	2.78 **
2	IC- 539711 x N. Rashmi	-1.61 **	-1.61 **	-0.89 *	-1.20 **	0.52	0.19	-1.22 *	-0.56	0.26	1.20 *	47.84 **	9.63 **
3	IC- 539711 x P. Naveen	-0.96 **	0.41	-3.51 **	-5.22 **	-0.95 **	0.05	-1.25 *	0.2	0.32	0.07	-9.00 **	-12.41 **
4	IC- 336757 x N. Madhuri	0.53 *	0.55	-0.72	-3.47 **	-0.21	1.22 **	-0.98 *	-0.13	-0.24	0.57	-146.88 **	8.12 **
5	IC- 336757 x N. Rashmi	-0.46 *	-0.25	-0.27	2.25 **	-2.13 **	1.73 **	-0.33	-0.59	0.06	-0.75	144.20 **	-5.04 **
6	IC- 336757 x P. Naveen	-0.07	-0.3	0.98 **	1.22 **	2.33 **	-2.95 **	1.31 **	0.71	0.19	0.19	2.69 **	-3.08 **
7	IC- 394736 x N. Madhuri	-1.05 **	-2.47 **	-4.10 **	-4.80 **	-1.41 **	0.15	0.29	-0.57	-0.46	-1.08 *	-236.17 **	5.78 **
8	IC- 394736 x N. Rashmi	-0.17	0.12	-0.71	0.25	-0.46	-0.47	-1.40 **	0.1	-0.17	0.34	87.04 **	-10.57 **
9	IC- 394736 x P. Naveen	1.22 **	2.35 **	4.81 **	4.56 **	1.87 **	0.32	1.11 *	0.47	0.63 *	0.74	149.13 **	4.79 **
10	IC- 321410 x N. Madhuri	1.15 **	0.84	-0.12	1.06 **	-1.16 **	-0.51	1.51 **	0.72	-0.82 **	-1.23 *	63.16 **	0.56
11	IC- 321410 x N. Rashmi	-0.17	-1.37 **	-1.67 **	-1.42 **	-0.68 *	0.26	-0.84	0.13	0.21	0.11	187.11 **	-5.13 **
12	IC- 321410 x P. Naveen	-0.98 **	0.52	1.78 **	0.36	1.85 **	0.25	-0.67	-0.84 *	0.61 *	1.12 *	-250.27 **	4.57 **
13	IC- 398541 x N. Madhuri	0.19	-0.47	-1.67 **	-1.60 **	2.61 **	-2.69 **	-0.62	0.25	-0.15	1.70 **	4.23 **	8.23 **
14	IC- 398541 x N. Rashmi	-0.39	-0.41	0.58	-0.49	0.96 **	3.01 **	0.89	-0.54	0.08	-0.62	3.91 **	-9.46 **
15	IC- 398541 x P. Naveen	0.2	0.88	1.09 **	2.09 **	-3.58 **	-0.32	-0.27	0.29	0.07	-1.08 *	-8.13 **	1.24 *
16	IC- 321460 x N. Madhuri	0.50 *	2.11 **	3.06 **	4.51 **	2.15 **	1.97 **	-0.07	-0.71	0.60 *	0.28	231.56 **	-13.91 **
17	IC- 321460 x N. Rashmi	0.19	-0.1	0.11	0.22	0.29	-0.39	0.51	0.3	0.90 **	-1.24 *	148.57 **	14.34 **
18	IC- 321460 x P. Naveen	-0.69 **	-2.01 **	-3.17 **	-4.73 **	-2.44 **	-1.59 **	-0.45	0.4	-1.50 **	0.96 *	-380.13 **	-0.43
19	IC- 541393 x N. Madhuri	-0.99 **	-0.45	0.7	-0.54	-0.83 *	-0.58	-2.38 **	-0.02	0.09	0.81	-106.15 **	1.45 *
20	IC- 541393 x N. Rashmi	1.30 **	-0.39	-0.64	-0.69 *	-0.22	-0.14	1.60 **	-0.21	-0.41	-1.31 **	14.00 **	-3.57 **
21	IC- 541393 x P. Naveen	-0.31	0.83	-0.06	1.22 **	1.05 **	0.72	0.78	0.22	0.32	0.5	92.16 **	2.12 **
22	IC- 394857 x N. Madhuri	0.70 **	1.73 **	0.15	0.51	-0.41	-0.63	2.29 **	0.41	0.11	1.06 *	273.27 **	-15.84 **
23	IC- 394857 x N. Rashmi	0.05	-1.21 *	-0.13	-0.71 *	0.81 *	0.21	-0.73	-0.32	0.15	-0.46	-106.38 **	-2.73 **
24	IC- 394857 x P. Naveen	-0.76 **	-0.52	-0.02	0.2	-0.4	0.41	-1.56 **	-0.09	-0.26	-0.59	-166.89 **	18.57 **

25	IC- 310188 x N. Madhuri	-2.83 **	-1.73 **	-2.67 **	-4.20 **	0.06	-1.07 *	1.75 **	0.25	0.43	0.37	-19.20 **	4.29 **
26	IC- 310188 x N. Rashmi	-0.95 **	-1.48 **	-0.35	2.25 **	-1.46 **	0.5	-1.40 **	-0.07	-0.61 *	-0.35	27.28 **	-3.80 **
27	IC- 310188 x P. Naveen	3.77 **	3.21 **	3.03 **	1.96 **	1.40 **	0.57	-0.36	-0.18	0.19	-0.01	-8.09 **	-0.5
28	Vallabh Saral x N. Madhuri	-0.74 **	-0.02	0.41	0.24	-1.12 **	1.51 **	-1.22 *	-0.37	0.85 **	0.99 *	298.49 **	-11.20 **
29	Vallabh Saral x N. Rashmi	0.41	0.43	0.33	-1.11 **	-0.37	-0.59	-0.84	0.90 *	-0.45	-0.46	-169.36 **	3.98 **
30	Vallabh Saral x P. Naveen	0.33	-0.41	-0.75 *	0.87 **	1.49 **	-0.92 *	2.06 **	-0.53	-0.39	-0.53	-129.13 **	7.21 **
31	IC- 385816 x N. Madhuri	0.81 **	1.00 *	-0.19	1.00 **	0.48	-1.00 *	1.80 **	-0.35	0.47	0.7	-97.51 **	9.63 **
32	IC- 385816 x N. Rashmi	1.10 **	1.06 *	1.00 **	-1.09 **	1.96 **	-0.16	-1.02 *	0.73	0.23	0.25	38.97 **	-0.33
33	IC- 385816 x P. Naveen	-1.91 **	-2.05 **	-0.82 *	0.09	-2.44 **	1.17 **	-0.78	-0.38	-0.70 *	-0.95	58.53 **	-9.30 **
34	IC- 336820 x N. Madhuri	-1.63 **	-2.71 **	-2.76 **	-1.87 **	0.88 **	0.44	-1.38 **	0.43	-0.24	-1.30 **	-6.73 **	3.14 **
35	IC- 336820 x N. Rashmi	-1.48 **	2.28 **	1.76 **	0.78 **	1.23 **	-0.52	0.54	-0.83	0.12	0.85	-11.58 **	8.52 **
36	IC- 336820 x P. Naveen	3.11 **	0.43	1.01 **	1.09 **	-2.11 **	0.08	0.84	0.4	0.12	0.45	18.31 **	-11.65 **
37	IC- 418491 x N. Madhuri	0.66 **	1.40 **	1.70 **	2.55 **	1.79 **	-0.65	-0.16	-0.35	-0.13	-0.88	-94.80 **	8.32 **
38	IC- 418491 x N. Rashmi	1.68 **	0.66	1.02 **	0.33	3.41 **	0.13	0.56	0.86 *	0.23	0.27	-67.98 **	-0.77
39	IC- 418491 x P. Naveen	-2.34 **	-2.05 **	-2.73 **	-2.89 **	-5.20 **	0.52	-0.4	-0.51	-0.1	0.61	162.78 **	-7.54 **
40	Pant Louki-1 x N. Madhuri	-0.59 **	1.89 **	0.19	-0.05	-2.03 **	-0.56	-4.49 **	0.74	0.11	-1.25 *	-156.62 **	6.16 **
41	Pant Louki-1 x N. Rashmi	0.1	-0.92 *	0.45	0.13	0.85 *	-4.12 **	2.22 **	-0.19	-0.52	0.63	-54.80 **	8.27 **
42	Pant Louki-1 x P. Naveen	0.49 *	-0.97 *	-0.64	-0.09	1.18 **	4.68 **	2.26 **	-0.55	0.41	0.63	211.42 **	-14.43 **
43	Arka Bahar x N. Madhuri	0.70 **	-2.87 **	1.61 **	0.24	-1.25 **	2.64 **	1.19 *	-0.66	-0.04	0.55	32.18 **	-17.51 **
44	Arka Bahar x N. Rashmi	0.39	3.19 **	-0.6	0.49	-4.71 **	0.35	1.45 **	0.28	-0.08	1.56 **	-288.80 **	-3.33 **
45	Arka Bahar x P. Naveen	-1.09 **	-0.32	-1.02 **	-0.73 *	5.96 **	-2.99 **	-2.64 **	0.38	0.12	-2.10 **	256.62 **	20.84 **
	SE (sca effects)	0.212	0.464	0.370	0.296	0.324	0.418	0.475	0.422	0.293	0.481	0.867	0.582
	SE (bet sca effects)	0.300	0.656	0.524	0.418	0.458	0.591	0.672	0.597	0.414	0.680	1.226	0.823

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