Plant Archives Vol. 25, Supplement 2, 2025 pp. 2479-2485 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
DOI Url : https://doi.org/10.51470/PLANTARCHIVES.2025.v25.supplement-2.315

GENERAL AND SPECIFIC COMBINING ABILITY STUDIES FOR GROWTH, YIELD AND YIELD-ATTRIBUTING TRAITS IN BOTTLE GOURD (*LAGENARIA SICERARIA* MOL. STANDL.)

Randeep Singh[1], D.S. Duhan[1], Uday Singh[1*], Shiv Kumar[1], Swati[3], Vinita Rajput[2] and Amit Kumar[1]

[1]Department of Vegetable Science, CCS Haryana Agricultural University, Hisar (125004), Haryana, India
[2]Krishi Vigyan Kendra Sirsa, C.C.S. Haryana Agricultural University, Hisar (125004), Haryana, India
[3]Department of Biotechnology, G.J.U. Hisar, Haryana, India
*Corresponding author E-mail: udayyadav8053@gmail.com
(Date of Receiving : 20-04-2025; Date of Acceptance : 25-06-2025)

ABSTRACT

The present investigation was carried out at Research Farm and laboratory of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar. Thirteen diverse parents were crossed during Spring summer season of 2019 in a line x tester fashion. The 30 F_1 hybrids, along with their parents, were evaluated during rainy season of 2019 against two standard check hybrids (HBGH-35 and Pusa Hybrid-3). The mean sum of squares due to genotypes was found highly significant for all the 18 characters, suggesting that wide difference among the genotypes used in the present study. Anova for combining ability revealed that the mean sum of squares due to general combining ability as well as specific combining ability were highly significant for most of the traits. The parent IC-92420 was found to be the best general combiner for the characters, namely days to 50% germination, nodes to appearance of first female flower, crop duration, number of fruits per vine, average fruit weight, fruit yield per vine and per hectare. The cross IC-92420 × NDBG-133, IC-92371 × NDBG-133 were depicted to be the best specific cross combination possessing significant *sca* effects for six characters *viz.,* days to first male flower opening, nodes to first male flower, average fruit weight (g), fruit yield per vine and ha (kg, q). The cross IC-92420 × Narendra Rashmi, GH-42 × NDBG-133, and IC-92363 × Arka Bahar were the best specific cross combinations as they showed significant *sca* effects for yield and its attributing traits.
Keywords: Bottle gourd, line x tester, hybrid, combining ability and fruit yield.

Introduction

Bottle gourd [*Lagenaria siceraria* (Mol.) Standl], commonly known as *Lauki*, *Ghiya,* White flower gourd, and Calabash gourd, belongs to the family *Cucurbitaceae,* subfamily *Cucurbitoideae* and tribe *Benincaseae*. The family *Cucurbitaceae* is comprised of 118 genera and 825 species. The genus *lagenaria* included six species, of only one is mainly cultivated. Approximately 38 species of this family are economically important (Yadav and Kumar, 2012). The genus *Lagenaria siceraria is* cultivated as a major cucurbitaceous crop and has a chromosome number 2x=2n=22. The names *lagenaria* and *siceraria* are derived from Latin words *lagena* meaning bottle and *sicera* imparting drinking utensil (Bisognin, 2002). The origin and subsequent dispersal of bottle gourd still perplexes many scientists. (Decker-Walters *et al*. 2004) reinforced Africa as the center of origin. *Lagenaria species* are distributed over Africa, Madagascar, Indo-Malaysia and the Neotropics. The area under this crop cultivation in India is 181 thousand hectares with a total production of 2977 thousand metric tonnes (Anonymous, 2019). As per records of the State Horticulture Department, in Haryana, bottle gourd is cultivated over an area of 20230.8 ha with a production of 309091.1 millon tonnes, while Mewat of Haryana is the leading district in Haryana in terms of area and production (Anonymous, 2023).

Primarily, Sprague and Tatum gave the concept of combining ability in 1942. Combining ability is one of the essential ways for selecting desirable parents and crosses, since high yielding genotype may not

necessarily pass on its superiority to the progeny in cross combination. Out of several methods used to estimate the study of combining ability, the line × tester mating design is helpful in the evaluation of a large number of genotypes. This analysis provides information about the *gca* of parents and *sca* of the hybrids. The combining ability analysis would help to select desirable parents. The concept of combining ability is already exploited by various worker namely Shinde *et al*. (2016), Muthaiah *et al*. (2017), Rani and Reddy (2017), Singh *et al*. (2018), Malav *et al*. (2018), Jayanth *et al*. (2019) and Mishra *et al*. (2019) *etc*. (Mention the crop name in which the study carried out)

Material and Method

The experiment was conducted at the Research Farm of the Department of Vegetable Science, CCS Haryana Agricultural University, Hisar, which is located at latitude of 29º10' North, longitude of 75º46' East, and an altitude of 215.2 meters above mean sea level on the southwestern border of the Haryana.

The experimental material comprised 13 genetically diverse genotypes of bottle gourd involving ten lines and three testers. These lines and testers were crossed using line x tester mating design during the summer season of 2019 with plot sizes of 5.0 × 3.0 m with 2.5 ×0.6 m plant spacing according to ten plants per replication in randomized block design to produce 30 F_1 crosses. The seed of these 30 F_1 along with their parents were harvested separately for the next season evaluation trail during the rainy season of 2019. The genotypes, along with their sources, are presented in Table 1.

Table 1: List of parents and standard checks included in the investigation

Parents	**Sources**
IC 42345, IC 92363, IC 92371, IC 92420, IC 92404, IC 92414	NBPGR, New Delhi
GH-40, GH-41, GH-42, GH-43	Dept. of Veg. Science, CCS HAU, Hisar
Testers (Male)	
NDBG 133	NDUAT, Faizabad
Arka Bahar	IIHR, Bangalore
Narendra Rashmi	NDUAT, Faizabad
Standard Check	
Pusa Hybrid-3 (National hybrid)	IARI, New Delhi
HBGH- 35(Local hybrid)	Dept. of Veg. Science

Observations were recorded on five randomly selected and tagged plants in each replication for different traits *viz.,* days to 50% germination, days to first female flower opening, nodes to appearance of first male and female flower, leaf length and width (cm), days to first fruit harvest, length and diameter of fruit (cm), Number of primary branches at final harvesting, vine length at the time of final harvest (m), number of fruits per vine, average fruit weight (g), fruit yield per vine and hectare (Kg/plot, q/ha), crop duration (days), total soluble solids (%). Data of the above traits were recorded in each replication and their average value was computed.

Result and Discussion

Analysis of variance for combining ability

The analysis of variance for general and specific combining ability indicated highly significant differences among the 13 parents and 30 F_1 hybrids. The data were subjected to the line x tester analysis for combining ability estimates. The mean squares due to general as well as specific combining ability were highly significant for all the traits, indicating the suitability of the genotypes for further study. Significant effects for both *gca* and *sca* were earlier reported by Radharani *et al*. (2013), Ray *et al*. (2015), Doloi *et al*. (2018), and Jayanth *et al*. (2019).

Combining ability effect

The statistics about *gca* effects of the parents are of most importance as it help in the successful estimation of genetic potential of crosses. Specific combining ability is associated with the interaction of dominance and an epistatic component of variation, which are non-fixable. This helps in the identification of superior cross combinations for the development of promising varieties/ hybrids. The crosses showing high *sca* effects involving parents with high *gca* effect, may give rise to desirable segregates in future generation. Since *sca* effect of the cross is an estimate while the *per se* performance is the realized value, the latter should also be given due consideration while selecting the best cross combination.

General combining ability

The *gca* effects are directly disposed by the mean performance of the genotypes. General combining ability

analysis and mean performance analysis is an effective tool by which we can identify the most desirable parents.

Genotype IC-92404 for 50% germination, GH-43 for days to first male flower opening and days to first fruit harvest, IC-92371 for days to first female flower opening, and NDBG-133 for nodes to appearance of first male flower are noted for high negative *gca* value for earliness traits. Singh *et al*. (2018), Iqbal *et al.* (2019), and Jayanth *et al*. (2019) reflected the same results in that parent have the highest significant *gca* effects for days to first female flower opening, early picking, and nodes to appearance of first female flower in bottle gourd crops. The highest significant *gca* effects for early male flowering and node number to first male flowering were also testified by Podder *et al*. (2010) in snake gourd. Ray *et al*. (2013) identified Pusa Naveen as the best general combiner for nodes to first male and female flower.

The parent IC-92420 showed the high positive *gca* value for some primary branches at final harvesting per vine while IC-92363 informed highest *gca* effects but non-significant for vine length. The highest significant positive *gca* effects for leaf length and leaf width were detected in the parent GH-43 followed by GH-40. Malav *et al*. (2018), Singh *et al*. (2018), and Iqbal *et al*. (2019) identified the best general combiner for a number of primary branches and vine length in bottle gourd. The parents Pusa Samridhi and Bhagirathi were reported to have the highest significant *gca* effects for vine length and several primary branches by Shinde *et al*. (2016) in bottle gourd.

IC-92420 was identified as the best general combiner for five characters, namely the number of primary branches at final harvesting, length of fruit (cm), average fruit weight (g), fruit yield per vine (kg), and fruit yield per hectare (q/ha). Genotype IC-92404 and IC-92371 recorded high positive *gca* values for the diameter of fruit and number of fruits per vine, respectively. Hence, the parent IC-92420, IC-92371, and IC-92404 were reported to be the best general combiner for yield and yield contributing traits.

The results obtained from the present finding are in support of Singh and Singh (2009), who observed and detected the line NDBG-27 noted highest *gca* effects for fruit weight in bottle gourd. The parents with larger fruits were actively involved in producing hybrids with long fruits as reported by Rani and Reddy (2017) in bottle gourd crops. Similarly, in bitter gourd Radharani *et al*. (2013) also reported the highest significant *gca* effects for the length of fruit, number of primary branches, days to first male and female flowers, node number to first male and female flower, number of fruits per vine, and yield per vine.

In parent IC-92420, which was the best general combiner for most of the characters on the basis of mean performance and *gca* effects. By this investigation, we conclude that the parents noted for high mean performance were also revealed the best general combination, indicating a positive association between the two parameters.

Table 2: Estimates of general combining ability for 18 characters in line x tester set of bottle gourd

S. No.	Parents	Days to 50% germination	Days to first male flower opening	Days to first female flower opening	Nodes to appearance of first male flower	Nodes to appearance of first female flower	Number of primary branches at final harvesting	Leaf length (cm)	Leaf width (cm)	Length of fruit (cm)
1.	IC-42345	1.11**	1.01	-0.97*	-0.06	-0.43	-0.81**	-1.4**	-0.56	-0.28
2.	IC-92363	0.00	0.83	-0.61	0.31	-0.38	-0.96**	-0.18	0.63	-0.50
3.	IC-92371	-0.44	-1.34*	-1.5**	-0.35	0.37	0.02	-1.18*	-1.8*	0.44
4.	IC-92420	0.44	1.29*	0.03	0.24	-0.21	0.93**	-1.2*	-1.21	3.17**
5.	IC-92404	-1.00**	1.25*	1.45**	0.19	-0.03	-0.13	1.01	-0.10	-0.34
6.	IC-92414	-0.22	-0.02	-0.63	0.31	-0.56	-0.81**	1.23*	1.44	0.30
7.	GH- 40	0.23	1.15	0.62	-0.24	0.72	-0.24	1.26*	1.73*	0.75
8.	GH-41	-0.22	-1.62**	0.35	-0.24	-0.79	0.44	-0.77	-2.30**	-4.60**
9.	GH-42	0.45	-0.64	0.10	0.09	0.50	0.78*	-0.75	-0.65	1.27**
10.	GH -43	-0.33	-1.90**	1.18*	-0.24	0.81	0.78*	2.05**	2.87**	-0.20
11.	NDBG-133	0.11	-0.42	0.03	-0.38*	-0.28	0.62**	0.22	0.20	0.35
12.	Arka Bahar	0.22	0.09	-0.47	-0.04	0.11	-0.40	0.35	0.77	0.18
13.	N. Rashmi	-0.11	0.33	0.44	0.43**	0.16	-0.22	-0.57	-0.97*	-0.54*
	S.E. (m) ±	0.28	0.59	0.45	0.19	0.41	0.30	0.54	0.76	0.44
	CD at 5%	0.56	1.18	0.91	0.39	0.39	0.60	1.08	1.51	0.88

* and ** significant at 5% and 1% level

Table 2: (Cont...) Estimates of general combining ability for 18 characters in line x tester set of bottle gourd

S. No.	Parents	Diameter of fruit (cm)	Days to first fruit harvest	Crop duration (days)	Number of fruits per vine	Average fruit weight (g)	Fruit yield per vine (kg)	Yield per hectare (q/ha)	Total soluble solids (%)	Vine length at the time of final harvest (m)
1.	IC-42345	-0.06	-0.66	1.36	0.32**	4.02	0.42	28.76	-0.92**	0.00
2.	IC-92363	0.29	1.01	2.47	0.24*	49.36	0.61	41.27	0.06*	0.19
3.	IC-92371	-0.62*	1.68**	-0.20	0.47**	22.36	0.66*	45.02*	0.13**	-0.31
4.	IC-92420	-0.41	-0.87	3.24	0.19	97.35**	0.84**	57.23**	-0.30**	-0.12
5.	IC-92404	1.18**	-0.32	-0.31	-0.40**	76.68**	0.07	4.49	0.55**	-0.23
6.	IC-92414	-0.21	0.56	-0.08	-0.16	-58.86*	-0.61	-41.27	0.19**	0.34
7.	GH- 40	0.31	1.23*	0.02	0.14	-74.53**	-0.38	-25.68	0.10**	-0.06
8.	GH-41	0.52	-0.10	-0.98	-0.01	-79.64**	-0.59	-39.71	0.45**	0.06
9.	GH-42	-0.45	-0.21	1.36	-0.09	29.02	0.14	9.04	-0.37**	0.03
10.	GH -43	-0.55*	-2.32**	-6.86**	-0.71**	-65.76*	-1.17**	-79.13**	0.11**	0.10
11.	NDBG-133	-0.06	-0.09	0.30	-0.09	12.06	-0.02	-1.28	-0.11**	-0.01
12	Arka Bahar	0.19	0.08	-0.63	-0.11	15.40	0.03	0.26	0.16	-0.08
13	N. Rashmi	-0.13	0.01	0.33	0.21	13.56	0.01	1.02	-0.04	0.08
	S.E.(m)	0.26	0.57	1.79	0.12	-28.00	0.31	20.77	0.03	0.19
	CD at 5%	0.53	1.15	3.59	0.24	53.78	0.62	41.56	0.05	0.39

* and ** significant at 5% and 1%level

Specific combining ability

The crosses, Pusa IC-92420 × NDBG-133 and IC-92414 × Narendra Rashmi showed significant *sca* effects for days to 50% germination, while the crosses IC-92404 × NDBG-133 for days to first male flower opening and for days to first female flower opening recorded the same result. The best *sca* value for nodes to appearance of first male flower was testified by the cross IC-92371 × Arka Bahar and for nodes to appearance of first female flower was noted in cross IC-92371 × NDBG-133. The cross IC-92420 × Narendra Rashmi found the best specific combiner for days to first fruit harvest. Islam *et al*. (2012) and Iqbal *et al.* (2019) also reported that the parental lines involved in the best cross were either one or both good general combiners having high and desirable *gca*effects for earliness traits. The significant *sca* effects for days to first male and female flower opening and days to first harvesting was also reported by Malav *et al*. (2018), Singh *et al*. (2018), Jayanth *et al*. (2019) and Mishra *et al*. (2019) in bottle gourd. For node to first male and female flower significant *sca* effects were also reported in bitter gourd by Radharani *et al*. (2013).

For leaf length and leaf width the notable *sca* effects were reported the cross IC-92404 × Narendra Rashmi and IC-92371 × NDBG-133, respectively. With respects to number of primary branches at final harvesting the cross IC-92363 × Narendra Rashmi was reported to have maximum significant *sca* effects. The highest *sca* effects for number of primary branches and vine length were also reported by Muthaiah *et al*. (2017) and Mishra *et al*. (2019) in bottle gourd.

The best *sca* effects for fruit yield attributing characters like length and diameter of fruit were noted in the crosses, IC-92404 × Narendra Rashmi and IC-42345 × Narendra Rashmi, respectively. The results obtained from the study, were in harmony with those obtained by Rani and Reddy (2017) and Malav *et al*. (2018) in bottle gourd, they also reported the highest significant *sca* effects for fruit length and girth. For trait number of fruits per vine the best crosses in the current study were IC-92420 × Narendra Rashmi followed by IC-92371 × NDBG-133 and IC-92363 × Narendra Rashmi. The highest significant *sca* effects for average fruit weight, fruit yield per vine and fruit yield per hectare were recorded by the cross IC-92363 × Arka Bahar. Likewise, Muthaiah *et al*. (2017) and Singh *et al*. (2018) reported the highest significant *sca* effects for yield and yield contributing character in bottle gourd crop. Similar findings were earlier reported by Jayanth *et al*. (2019), Iqbal*et al*. (2019) and Mishra *et al*. (2019) in bottle gourd.

Table 3: Estimates of specific combining ability for 18 characters in line x tester set of bottle gourd crop

S. No.	Crosses	Days to 50% germi-nation	Days to first male flower opening	Days to first female flower opening	Nodes to appearance of first male flower	Nodes to appearance of first female flower	Number of primary branches at final harvesting	Leaf length (cm)	Leaf width (cm)	Length of fruit (cm)
1.	IC-42345 × NDBG-133	0.22	0.95	0.32	0.27	0.02	-0.58	-0.10	-2.58	-0.02
2.	IC-42345 × Arka Bahar	0.22	-1.47	0.48	0.05	-0.12	0.32	-0.16	0.75	-4.02**
3.	IC-42345 × N. Rashmi	-0.44	0.52	-0.80	-0.32	0.10	0.26	0.26	1.83	4.04**
4.	IC-92363 × NDBG-133	0.45	-0.65	-0.55	0.91*	0.24	-1.45**	0.07	1.08	-1.25
5.	IC-92363 × Arka Bahar	-0.67	0.87	0.34	-0.66	0.11	0.36	0.45	0.06	4.77**
6.	IC-92363 × N. Rashmi	0.67	-0.22	0.21	-0.24	-0.35	1.09*	-0.52	-1.14	-3.52**
7.	IC-92371 × NDBG-133	0.44	2.64*	0.11	0.01	-1.72*	0.07	0.79	3.00*	4.88**
8.	IC-92371 × Arka Bahar	-0.22	-2.00	0.20	-1.32**	1.08	0.51	-1.05	-1.57	0.20
9.	IC-92371 × N. Rashmi	-0.22	-0.64	-0.31	1.31**	0.63	-0.58	0.26	-1.43	-5.08**
10.	IC-92420 × NDBG-133	-1.11*	0.48	-0.46	-0.80*	0.86	0.53	0.13	0.91	-1.28
11.	IC-92420 × Arka Bahar	0.22	-1.27	-0.52	0.75*	0.06	-1.42**	-0.27	-2.05	3.34**
12.	IC-92420 × N. Rashmi	0.89	0.79	0.98	0.05	-0.92	0.90	0.15	1.14	-2.06**
13.	IC-92404 × NDBG-133	0.33	-4.25**	-2.00*	0.01	-0.52	-0.23	-2.45*	-1.98	-0.34
14.	IC-92404 × Arka Bahar	0.00	0.09	-0.61	0.01	-0.38	1.35*	-1.24	1.51	-5.59**
15.	IC-92404 × N. Rashmi	-0.33	4.17**	2.60**	-0.02	0.90	-1.11*	3.68**	0.47	5.94**
16.	IC-92414 × NDBG-133	0.56	0.30	-0.13	-0.55	0.68	0.56	-0.72	-0.69	-4.79**
17.	IC-92414 × Arka Bahar	0.56	1.56	1.04	0.24	0.15	-0.36	1.21	1.19	3.21**
18.	IC-92414 × N. Rashmi	-1.11*	-1.87	-0.91	0.31	-0.84	-0.20	-0.48	-0.51	1.58*
19.	GH-40 × NDBG-133	-0.89	-1.97	0.36	0.23	0.06	-0.35	-0.60	-1.09	-4.28**
20.	GH-40 × Arka Bahar	0.11	2.18*	0.11	-0.43	-0.20	0.21	1.50	0.56	1.18
21.	GH-40 × N. Rashmi	0.78	-0.21	-0.47	0.20	0.14	0.14	-0.91	0.53	3.11**
22.	GH-41 × NDBG-133	1.22*	1.57	1.11	-0.54	0.37	0.22	2.72**	1.06	-0.50
23.	GH-41 × Arka Bahar	-0.78	1.28	-0.95	1.01**	-0.56	0.09	-0.96	0.38	-0.49
24.	GH-41 × N. Rashmi	-0.44	-2.85**	-0.16	-0.47	0.19	-0.32	-1.76	-1.44	0.99
25.	GH-42 × NDBG-133	-0.44	0.93	0.65	0.35	-0.38	0.90	0.59	0.18	4.97**
26.	GH-42 × Arka Bahar	0.22	0.19	0.18	0.46	-0.38	0.10	-0.31	0.40	0.95
27.	GH-42 × N. Rashmi	0.22	-1.12	-0.83	-0.80*	0.76	-1.00	-0.28	-0.58	-5.92**
28.	GH-43 × NDBG-133	-0.33	0.01	0.58	0.12	0.37	0.33	-0.44	0.11	2.61**
29.	GH-43 × Arka Bahar	0.33	-1.44	-0.26	-0.10	0.24	-1.16*	0.83	-1.23	-3.53**
30.	GH-43 × N. Rashmi	0.00	1.44	-0.33	-0.02	-0.61	0.83	-0.39	1.12	0.92
	S.E.(m)	0.48	1.02	0.78	0.34	0.72	0.52	0.93	1.31	0.76
	CD at 5%	0.96	2.04	1.58	0.68	1.44	1.05	1.87	2.63	1.53

*and ** significant at 5% and 1%level

Table 3: (Cont…) Estimates of specific combining ability for 18 characters in line x tester set of bottle gourd crop

S. No.	Crosses	Diameter of fruit (cm)	Days to first fruit harvest	Crop duration (days)	Number of fruits per vine	Average fruit weight (g)	Fruit yield per vine (kg)	Yield per hectare (q/ha)	Total soluble solids (%)	Vine length at the time of final harvest (m)
1.	IC-42345 × NDBG-133	-0.58	-0.91	0.48	0.08	-65.82	-0.39	-26.21	0.21**	-0.07
2.	IC-42345 × Arka Bahar	-0.19	1.59	1.74	0.21	44.71	0.54	36.63	-0.08	0.24
3.	IC-42345 × N. Rashmi	0.77	-0.68	-2.22	-0.29	21.11	-0.16	-10.41	-0.13**	-0.17
4.	IC-92363 × NDBG-133	0.76	0.09	-5.30	-0.95**	-48.82	-1.33*	-89.97*	-0.78**	-0.28
5.	IC-92363 × Arka Bahar	-0.25	-0.74	6.63*	0.13	141.04**	1.22*	82.33*	0.34**	-0.05
6.	IC-92363 × N. Rashmi	-0.52	0.66	-1.33	0.82**	-92.22	0.11	7.65	0.44**	0.33
7.	IC-92371 × NDBG-133	-0.37	-1.58	3.03	0.88**	-29.49	0.73	49.46	-0.81**	0.39
8.	IC-92371 × Arka Bahar	-0.35	0.92	0.30	0.14	16.38	0.28	18.68	0.52**	-0.23
9.	IC-92371 × N. Rashmi	0.71	0.66	-3.33	-1.02**	13.11	-1.01	-68.13	0.29**	-0.16
10.	IC-92420 × NDBG-133	0.36	2.31*	-2.74	-0.760**	92.51	-0.29	-19.71	0.69**	0.27
11.	IC-92420 × Arka Bahar	-0.26	-0.52	-1.81	-0.51*	-45.62	-0.87	-58.80	-0.01	-0.11
12.	IC-92420 × N. Rashmi	-0.10	-1.79	4.56	1.27**	-46.89	1.16*	78.51*	-0.69**	-0.16
13.	IC-92404 × NDBG-133	0.25	0.76	-2.52	0.31	-129.49**	-0.55	-36.74	-0.19**	-0.14
14.	IC-92404 × Arka Bahar	0.27	-1.41	-2.26	-0.33	-3.29	-0.45	-30.20	0.17**	0.23

15.	IC-92404 × N. Rashmi	-0.51	0.66	4.78	0.02	132.78**	0.99	66.93	0.02	-0.09
16.	IC-92414 × NDBG-133	0.12	1.20	-0.08	-0.38	62.07	0.04	2.57	0.60**	0.08
17.	IC-92414 × Arka Bahar	0.18	-0.30	-0.81	0.12	-28.07	-0.06	-4.16	0.33**	0.06
18.	IC-92414 × N. Rashmi	-0.30	-0.90	0.89	0.26	-34.00	0.02	1.59	-0.93**	-0.14
19.	GH-40 × NDBG-133	-0.36	0.20	1.48	0.33	71.40	0.88	59.72	-0.37**	-0.18
20.	GH-40 × Arka Bahar	0.49	0.37	0.74	0.46*	-59.40	-0.02	-1.35	0.22**	-0.14
21.	GH-40 × N. Rashmi	-0.14	-0.57	-2.22	-0.78**	-12.00	-0.87	-58.38	0.14**	0.31
22.	GH-41 × NDBG-133	0.68	-0.80	-1.86	-0.24	-12.16	-0.28	-19.07	0.32**	-0.36
23.	GH-41 × Arka Bahar	-0.58	-0.63	-3.92	-0.64**	8.04	-0.59	-39.60	-0.43**	0.12
24.	GH-41 × N. Rashmi	-0.10	1.43	5.78	0.87**	4.11	0.87	58.67	0.11*	0.24
25.	GH-42 × NDBG-133	-0.56	-1.36	4.81	0.43*	30.18	0.69	46.26	-0.34**	0.12
26.	GH-42 × Arka Bahar	0.38	1.14	2.41	0.24	29.71	0.43	29.05	-0.95**	0.00
27.	GH-42 × N. Rashmi	0.18	0.21	-7.22*	-0.66**	-59.89	-1.12*	-75.32*	1.30**	-0.12
28.	GH-43 × NDBG-133	-0.30	0.09	2.70	0.31	29.62	0.50	33.69	0.68**	0.16
29.	GH-43 × Arka Bahar	0.30	-0.41	-3.03	0.18	-103.51 *	-0.49	-32.58	-0.12**	-0.12
30.	GH-43 × N. Rashmi	0.00	0.32	0.33	-0.49*	73.89	-0.01	-1.11	-0.56**	-0.04
	SE	0.45	1.00	3.10	0.20	46.53	0.53	35.96	0.04	0.33
	CD at 5%	0.92	2.00	6.21	0.41	93.14	1.06	71.99	0.09	0.67

*and ** significant at 5% and 1%level

Conclusion

The predominance of SCA variance over GCA variance for most of the traits under study indicated the predominance of non-additive gene action. This could be attributed to dominance and/or the epistatic components such as additive x dominance and dominance × dominance type of gene interaction. Among the parents, IC-92420 and GH-42 were observed to be good general combiners for fruit yield and its attributing traits. Among the cross combinations, C-92420 × Narendra Rashmi, GH-42 × NDBG-133, and IC-92363 × Arka Bahar expressed high heterosis and *sca* effects for the maximum number of fruit yield-related characters. So, these parents and hybrids could be used for future breeding programmes in bottle gourd crop.

References

Anonymous (2019). 3rd Advance estimates of area and production of horticultural crops in India. www.agricoop.nic.in/statistics/horticulture, Ministry of Agriculture and Farmers Welfare, Government of India. pp. 8

Anonymous (2023). Horticulture Department, Govt. of Haryana, Final area, and production of vegetable crops 2021-22 in the report of final data and production report. www.hortharyana.com. In, Excel sheet part 2.

Bisognin, A.D. (2002). Origin and evolution of cultivated cucurbits. *Ciencia Rural,* **32**(4), 715-723.

Decker-Walters, D.S., Wilkins-Ellert, M., Chung, S.M., Staub, J.E. (2004). Discovery and genetic assessment of wild bottle gourd [*Lagenaria siceraria* (Mol.) Standley; Cucurbitaceae] from Zimbabwe. *Econ. Bot*; **58**, 501–508.

Doloi, N., Patel, J.N., and Acharya, R.R. (2018). Heterosis studies in bottle gourd [*Lagenaria siceraria* (Mol) Standl]. *Vegetos*, **31**,150-158.

Iqbal, M., Usman, K., Arif, M., Jatoi, S.A., Munir, M., and Khan, I. (2019). Evaluation of bottle gourd genotypes for yield and quality traits. *Sarhad Journal of Agriculture*, ***35***(1), 68-70.

Islam, S., Munshi, A.D. and Kumar, R. (2012). Studies on heterosis and combining ability for earliness and yield in sponge gourd (*Luffa cylindrical* (Roem.) L.). *Indian Journal of Horticulture*, **69**(3),348-352.

Jayanth, S., Lal, M., Duhan, D.S. and Vidya, R., 2019. Estimation of heterosis and combining ability for earliness and vegetative traits in bottle gourd [*Lagenaria siceraria* (Molina.) Standl.]. *International journal of chemical studies*, **7**(1), 20-25.

Malav, N., Yadav, M.L. and Maurya, I.B. (2018). Heterosis and combining ability in cucumber (C*ucumis sativus.* L.). *International Journal of Chemical Studies*, **6**(3), 457-460

Mishra S., S. Pandey, N., Kumar, V.P., Pandey and Singh, T. (2019). Studies on the extent of heterosis for the quantitative characters in *kharif* season bottle gourd (*Lagenaria siceraria* (Molina) Standl.). *Journal Pharmacognosy and Phytochemistry*, **8**(1), 29-38.

Muthaiah, K., Gasti, V.D., Mallesh, S., Arindam, D.A.S. and Mangi, V. (2017). Combining ability studies for early and yield traits in ridge gourd [*Luffa acutangula* L. Roxb.]. *International Journal of Agriculture Sciences*, **5**(8), 56-76.

Podder, R., Rasul, M.G., Islam, A.K.M.A., Mian, M.A.K. and Ahmed, J.U. (2010). Combining ability and heterosis in snake gourd (*Tricosanthes cucurminata* L). *Bangladesh Journal of Plant Breeding and Genetics*, **23**(2), 1-6.

Radharani, K., Reddy, K. and Raju, C. (2013). Heterosis and combining ability for quantitative traits in bitter gourd (*Momordica charantia* L.). *Current Advances in Agricultural Sciences*, **5**(2), 184-188.

Rani, K.U. and Reddy, E.N. (2017). Combining ability analysis for yield and its components in bottle gourd. *International Journal of Pure and Applied Biosciences*, **5**(4), 809-817.

Ray, P., Yadav, G., Baramwal, D. and Singh, H. (2015). Genetic estimates and gene action for obtaining promising heterotic hybrids in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. *The Bioscan,* **10**(2), 801-806.

Shinde, S., Supe, V.S. and Gaikwad, S.S., 2016. Combining ability studies for earliness and yield in bottle gourd (*Lagenaria siceraria* L. (Molina) Standl.) in *kharif*

season. *Asian Journal of Science and Technology*, **7**(5), 2846-2849.

Singh, P.P. and Singh, S.P. (2009). Combining ability analysis in relation to heterosis for yield and its components in bottle gourd. *Vegetable Science*, **36**(1), 98-99.

Singh, Y. P., Singh, Y. B., Kumar, A. and Pramila (2018). Studies on general and specific combining ability for yield and its contributing traits in sponge gourd [*Luffa cylindrical* (Roem) L.]. *International Journal of Current Microbiology and Applied Science,* **7**, 5066-5078.

Yadav, Y.C., and Kumar, S. (2012). Specific combining ability analysis for yield improvement in bottle gourd *Lagenaria siceraria* (Molina) Standl. *Environment and Ecology*, **30**(1), 18-23.