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Short Communication

Heterosis for fruit yield and its component traits in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

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Bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] is an important cucurbitaceous vegetable grown in subtropical and tropical regions of India for its tender fruits. It is considered as a good source of minerals. Being monoecious in nature, the amount of cross pollination ranges from 60-80% (Choudhary 1987). Hence, there is an ample scope for exploitation of hybrid vigour. Therefore, the present investigation on the extent of heterosis for fruit yield and its component traits was carried out through half diallel mating design in bottle gourd. The present investigation was conducted at the Main Vegetable Research Station, Anand Agricultural University, Anand, during *kharif* 2016. The experimental material comprised of 56 genotypes representing 45 F_1 hybrids developed in diallel fashion excluding reciprocals, their ten parents *viz.,* ABG 1, ABGS 11-17, ABGS 11-22, ABGS 11-23, DBG 6, Pusa Naveen, PSPL, Arka Bahar, DBG 5and Punjab Komaland one standard check NDBGH 4 were evaluated in randomized complete block design with two replications. The seeds of experimental material were dibbled in the field on 8th July, 2016. Each experimental unit was represented by a single row accommodating seven plants with inter and intra row spacing of 2 and 1 m, respectively. The recommended cultural practices and plant protection measures obligatory to raise healthy crop were followed. Observations were recorded on fruit yield and its component characters *viz.,* fruit length (cm), fruit girth (cm), fruit weight (g), number of primary branches per plant, number of fruits per plant and fruit yield per plant (kg) on net five plants for each experimental unit in each replication. The analysis of variance technique reviewed by Panse and Sukhatme (1978) were followed to test the significant difference between the genotypes for all the characters. Heterosis was estimated as heterobeltiosis over better parentand as standard heterosis over standard check NDBGH 4.

The analysis of variance revealed that the mean square due to genotypes were highly significant for all characters indicating existence of a considerable amount of variability among the genotypes of experimental material. The mean square differences among parents were found highly significant for all the traits except for fruit weight, indicating presence of variability among parents. The results further indicated that hybrids differed statistically among themselves for all the characters.The mean square due to parents vs.hybrids were significant for fruit girth and fruit weight suggesting that parents and hybrids differed statistically for the above stated characters and consequently the evidence for the existence of heterotic effects. The mean square due to check vs. hybrids were significant for fruit weight, number of fruits per plant and fruit yield per plant which revealed significant difference between standard check and hybrids.

The range of heterosis by hybrids over their better parent and standard check NDBGH 4, number of hybrids showing significant desirable heterosis over better parent and standard check NDBGH 4 and superior crosses based on estimates of heterobeltiosis and standard heterosisare presented in Table 1.The extent of heterosis for fruit length varied from-39.39% (Pusa Naveen x Punjab Komal) to 25.47% (Arka Bahar x DBG 5) and -40.55% (Pusa Naveen x Punjab Komal) to 36.16% (Pusa Naveen x PSPL) over better parent and standard check, respectively. Out of 45 crosses, 9crossesshowed significant positive heterobeltiosis and10 crosses manifested significant positive standard heterosis. Similar findings were reported (Sharma et al. 2009, Kumar et al. 2011, and Yadav and Kumar 2012). The estimates of heterosis for fruit girth ranged from -44.14% (PSPL x

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Punjab Komal) to 11.11% (ABGS 11-17 x ABGS 11-22) and -24.26% (ABGS 11-23 x PSPL) to 39.05% (ABGS 11-17 x Punjab Komal)over better parent and standard check, respectively. Four crosses registered significant positive heterobeltiosis and 7 crosses depicted significant positive standard heterosis for the trait. These findings were in accordance with the reports of Pal et al. (2005), Dubey and Ram (2008), and Adarsh et al. (2017).

Fruit weight is one of the most important yield contributing traits which influences the total fruit yield. For fruit weight, the extent of heterosis varied from -25.16% (ABGS 11-23 x Punjab Komal) to 15.68% (ABGS 11-17 x DBG 6) and -32.87% (ABG 1 x ABGS 11-17) to 7.20% (ABGS 11-17 x DBG 6)over better parent and standard check, respectively. Total 28 hybrids exhibited significant heterobeltiosis, of these, only one hybrid showed positive estimates. While, total 13 hybrids registered significant heterosis over standard check, of which, none recorded positive effect. These results were in agreement with reports of Dubey and Ram (2008), Sharma et al. (2009), and Adarsh et al. (2017). The heterotic effect in respect to better parent varied from-52.94% (ABGS 11-23 x PSPL,PSPL x DBG 5) to 44.44% (ABG 1 x Punjab Komal) for number of primary branches per plant, with 7 hybrids showing significant positive heterobeltiosis. The extent of heterosis over standard check ranged from -27.27% (ABGS 11-23 x PSPL, PSPL x DBG 5) to 54.55% (ABGS 11-17 x PSPL) with 12 hybrids showing significant standard heterosis. These results confirmed the observations of Pal et al. (2005), and Yadav and Kumar (2012).

Number of fruits per plant is an important trait, which contributes to the yield enhancement, hence, positive and significant heterosis effects would be desirable. Out of 45 crosses, 15 crosses over better parent and 28 crosses over standard check showed significant positive heterobeltiosis and standard heterosis, respectively, for number of fruits per plant,in which heterosis ranged from -63.89% (ABGS 11-23 x PSPL) to 70.37% (ABGS 11-23 x DBG 5) over better parent and -36.59% (ABGS

Table 1. Identification of superior crosses in bottle gourd based on heterosis

Trait	Range of heterosis (%)		No. of superior crosses over		Superior crosses based on	
	BP (Better parent)	SC (Standard check)	BP	SC	Heterobeltiosis	Standard heterosis
FL	-39.39 (Pusa Naveen x Punjab Komal) to 25.47(Arka Bahar x DBG 5)	-40.55 (Pusa Naveen x Punjab Komal) to 36.16(Pusa Naveen x PSPL)	9	10	Arka Bahar x DBG 5 (25.47**) Pusa Naveen x PSPL (20.92**) Pusa Naveen x Arka Bahar (19.27**)	Pusa Naveen x PSPL (36.16**) ABG 1 x PSPL (33.15**) DBG 6 x PSPL (29.04**)
FG	-44.14 (PSPL x Punjab Komal) to 11.11(ABGS 11-17 x ABGS 11-22)	-24.26 (ABGS 11-23 x PSPL) to 39.05(ABGS 11-17 x Punjab Komal)	4	7	ABGS 11-17 x ABGS 11-22 (11.11**) ABG 1 x ABGS 11-23 (10.63*) ABGS 11-23 x Arka Bahar (9.68*)	ABGS 11-17 x Punjab Komal (39.05**) DBG 5 x Punjab Komal (33.73**) ABGS 11-23 x Punjab Komal (29.59**)
FW	-25.16 (ABGS 11-23 x Punjab Komal) to 15.68 (ABGS 11-17 x DBG 6)	-32.87 (ABG 1 x ABGS 11-17) to 7.20 (ABGS 11-17 x DBG 6)	1	-	ABGS 11-17 x DBG 6(15.68**)	-
NPBP	-52.94 (ABGS 11-23 x PSPL, PSPL x DBG 5) to 44.44 (ABG 1 x Punjab Komal)	-27.27 (ABGS 11-23 x PSPL, PSPL x DBG 5) to 54.55 (ABGS 11-17 x PSPL)	7	12	ABG 1 x Punjab Komal (44.44**) ABG 1 x ABGS 11-23 (30.00**) ABGS 11-23 x Punjab Komal (30.00**)	ABGS 11-17 x PSPL (54.55**) ABGS 11-22 x DBG 6 (45.45**)
NFP	-63.89 (ABGS 11-23 x PSPL) to 70.37 (ABGS 11-23 x DBG 5)	-36.59 (ABGS 11-23 x PSPL) to 124.39 (ABGS 11-23 x DBG 5)	15	28	ABGS 11-23 x DBG 5 (70.37**) ABG 1 x DBG 6 (59.09**) ABGS 11-22 x ABGS 11-23 (56.00**)	ABGS 11-23 x DBG 5 (124.39**) DBG 6 x DBG 5 (104.88**) DBG 6 x Punjab Komal (100.00**) Pusa Naveen x Arka Bahar (100.00**)
FYP	-68.12 (ABGS 11-23 x PSPL) to 79.55 (ABG 1 x Arka Bahar)	-48.31 (ABGS 11-23 x PSPL) to 125.23 (ABGS 11-23 x DBG 5)	10	28	ABG 1 x Arka Bahar (79.55**) ABGS 11-23 x DBG 5 (60.53**) ABG 1 x DBG 6 (47.52**)	ABGS 11-23 x DBG 5 (125.23**) ABG 1 x Arka Bahar (94.46**) DBG 6 x DBG 5 (92.00**)

*, ** significance at 5% and 1%, respectively.Traits: Fruit length (FL), Fruit girth (FG), Fruit weight (FW), Number of primary branches per plant (NPBP), Number of fruits per plant (NFP), Fruit yield per plant (FYP)

11-23 x PSPL) to 124.39% (ABGS 11-23 x DBG 5) over standard check, respectively. For fruit yield per plant, the estimates of heterosis ranged from -68.12% (ABGS 11-23 x PSPL) to79.55% (ABG 1 x Arka Bahar) and-48.31% (ABGS 11-23 x PSPL) to 125.23% (ABGS 11-23 x DBG 5) over better parent and standard check, respectively, with 10 and 28 hybrids showing significant positive heterobeltiosis and standard heterosis, respectively.The hybrid ABG 1 x Arka Bahar (79.55%) registered the highest heterosis over better parent followed by ABGS 11-23 x DBG 5 (60.53%) and ABG 1 x DBG 6 (47.52%). Whereas, the hybrid ABGS 11-23 x DBG 5 (125.23%) exhibited the maximum heterosis over standard check NDBGH 4 followed by ABG 1 x Arka Bahar (94.46%) and DBG 6 x DBG 5 (92.00%).

The identification and utilization of most heterotic and useful crosses are very important in hybrid approach in order to make the commercial cultivation of hybrid beneficial.The hybrid ABGS 11-23 x DBG 5 recordedthe maximum *per se* performance and the highest estimates of standard heterosisand it also had higher estimate of heterobeltiosis for fruit yield.This hybrid also registered the highest estimates of heterobeltiosis as well as standard heterosis for number of fruits per plant. The other promising hybrids, which showed higher *per se* performance, higher and significant estimates of standard heterosis for fruit yield were ABG 1 x Arka Bahar and DBG 6 x DBG 5, these hybrids also registered significant heterotic effect with respect to standard check NDBGH 4 for another yield contributing attribute*i.e.,* number of fruits per plants. Heterosis breeding approach could be advantageous to develop superior hybrids with improved fruit yield in bottle gourd. The above findings indicated that some cross combinations had strong heterotic capability compared to other ones during hybridization process. The mostpromising heterotic cross combinations with respect to standard check NDBGH 4 for fruit yield per plant were ABGS 11-23 x DBG 5, ABG 1 x Arka Bahar and DBG 6 x DBG 5. These cross combinations also recorded high *per se* performance and significant desirable SCA effect. Therefore, these cross combinations could be recommended in future breeding programmes after critical evaluation in varied environments or over locationsfor commercial exploitation of heterosis.

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