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Studies on heterosis for yield and quality components in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

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Abstract
Seven parental lines of bottle gourd and their 21 F_1 hybrids obtained from half diallel were studied to investigate the extent of heterosis for yield and quality parameters. The experiment laid out in RBD, two replications with spacing 2 m x 1 m during summer season 2020-2021 at experimental Research Farm Department of Horticulture, College of Agriculture Latur. The significant heterosis for F_1's over better parents for the various characters *viz*., Karjat Local x Amravati Local (number of branches per vine, days required for first female flower, node at which first female flower appeared, days required for first harvest of fruit, average weight of fruit, average length of fruit), Buldhana Local x Amravati Local (Length of vine), Chandrapur Local x Kolhapur Local (average diameter of fruit, rind thickness), Karjat Local x Buldhana Local (yield of fruit per ha), Aurangabad Local x Karjat Local (Vitamin-c). Using parents in these crosses can be used in the future breeding programme for hybrid development.

Keywords: Half diallel, heterosis, yield, bottle gourd

Introduction
Bottle gourd [*Lagenaria siceraria* (Mol) Standl.] the name "Lagenaria" and "siceraria" are derived from Latin words '*Lagena*' for bottle and "*sicera*" for drinking utensil. Bottle gourd is one of the very popular vegetable crop belongs to family cucurbitaceae with a diploid chromosome number 2n=2x=22. It is grown in both rainy and summer season and its fruits available in the market throught the year.
Bottle gourd is a modest source of nutrients; it is very popular among a large section of people. Fruits are used as sweets, pickles (especially on hills), kofta, petha, halwa, kopoorkand, paratha, rayata, kheer, pedha and burfi. The per 100 g. of edible portion of fruits contains vitamin C (11mg), thiamine (0.044m.g), riboflavin (0.023m.g), niacin (0.33m.g), mineral matters (0.5%), carbohydrates (2.9%), fats (0.1%) protein (0.2%) and moisture (96.3%) and its different parts possess large number of medicinal properties. As a vegetable it is easily digestible, even by patients. A decotion made from the leaf is a very good medicine for curing jaundice. The fruit has a cooling effect it is a cardiatonic and diuretic.
In Maharashtra the production of bottle gourd is less. Having the wide variability, monoecious and andromonoecious nature, highly cross pollinated and large number of seeds per fruit, variation in size, shape, colour, length and weight observed in bottle gourd. It can be serve as a good source for manifestation of heterosis and its commercial exploitation, due to cross pollination this do not suffer much for inbreeding depression. Thus heterosis breeding can prove as a useful tool in bottle gourd improvement. In spite of differed characters in bottle gourd, the acreage under this cross noticed less in Maharashtra state compared to other cucurbit crops. Due to low yield, susceptibility to disease and pest. The improvement in bottle gourd not much reported in Maharashtra.

Materials and methods
The experiment was conducted at Instructional Cum-Research Farm, Department of Horticulture, College of Agriculture, Latur during summer season 2021. The study was undertaken by using diallel analysis (without reciprocal) involving 21 F_1 hybrids and seven parental lines namely (p_1) Aurangabad Local, (p_2) Ahemdnagar Local, (P_3) Chandrapur Local, (P_4) Karjat Local, (P_5) Buldhana Local, (P_6) Amravati Local, (P_7) Kolhapur Local.
Seven parental lines were sown in randomized block design with three replications. All treatments were grown in 2 meter row to row and 1 meter plant to plant spacing respectively. Five plants were selected and tagged for recording the observations on different characters *viz*, length of vine, number of branches per vine, days required for first female flower, node at which first female flower appeared, days required for first harvest of fruit, average weight of

fruit, average length of fruit, average diameter of fruit, rind thickness, yield of fruit per ha, vitamin-c.
Heterosis was calculated by using formulae.

$$1.\ \overline{BP} = \frac{\overline{F1} - \overline{BP}}{\overline{BP}} \times 100 \quad \text{(over better parent)}$$

$$2.\ MP = \frac{\overline{F1} - \overline{MP}}{\overline{MP}} \times 100 \quad \text{(over mid parent)}$$

Result and discussion
The analysis of variance (Table 1) indicated that the mean square due to genotypes were highly significant for all characters under study.

Table 1: Analysis of variance for different characters in 7 x 7 half diallel of bottle gourd.

Source	d.f.	Length of Vine (cm)	No. of Branches per Vine	Days required for first Female Flower	Days required for 50% female flowers	Node at which first Female Flower appeared	Days required for first Harvest of Fruit
Treatment	27	48599.96**	41.83**	18.79**	16.59 **	10.07 **	29.07 **
Parent	6	39026.63**	40.61**	18.66 **	16.31 **	8.12 **	22.44 **
Crosses	20	53864.86**	42.56**	19.09 **	16.47 **	10.03 **	29.18 **
P x C	1	741.97**	34.74**	13.71 **	20.72 **	22.58 **	66.62**
Error	27	88.76	0.43	1.46	1.09	0.39	0.99

Table 1: Cont…

Source	d.f.	Yield of Fruits per ha (ton)	Average Weight of Fruit (g)	Average length of Fruit (cm)	Average diameter of fruit (cm	Fruit Cavity (cm^3)	Vitamin-C (mg/100g)
Treatment	27	148.05 **	5.51 **	85.82 **	0.93 **	1041.26 **	3.85 **
Parent	6	71.95 **	6.72 **	85.60 **	0.33 **	718.95	3.68 **
Crosses	20	164.05 **	5.31 **	89.93 **	0.99 **	1142.01 **	3.84 **
P x C	1	284.49**	2.10	5.02	3.14 **	960.25	5.08 **
Error	27	14.21	1.10	2.11	0.05	321.38	0.15

In the analysis of mean squares, the differences due to the treatments were significant for all the characters studied. The treatment means were further subdivided into parents, crosses and parent versus crosses. The parents showed significant differences for all the characters except fruit cavity (cm^3). The crosses were found significantly for all the characters. The parent versus crosses showed significant differences for most of the characters except, average weight of fruit (g), average length of fruit (cm), fruit cavity (cm^3).
The analysis of variance showed highly significant difference among the genotypes studied. The mean value of seven parents and 21 F_1 hybrids and their heterosis percentage over better parent are presented in Table 1.
The range of F_1 hybrid was wider than that of parents for all the characters under study, where lower value shows early maturity which is a desirable trait. Similarly, the average heterosis was negative in days to first harvest of fruit and days required for 50% female flowering, which is also a desirable economic trait. The range of heterotic crosses in all the characters over their respective better parents varied from -37.39 to 12.36 in length of vine (cm), -20.00 to 56.00 in number of branches per vine, -15.08 to 3.20 in days required for first female flower, -14.39 to 3.97 in days to 50% female flowering, -51.11 to 2.48 in node at which first female flower appeared, -18.80 to -0.57 in days required for first harvest of fruit, -39.36 to 39.44 in yield of fruits per ha (t/ha), -23.16 to 38.17 in average weight of fruit (g), -36.07 to 10.94 in average length of fruit (cm), -15.39 to 28.18 in average diameter of fruit (cm), -47.05 to 31.75 in fruit cavity (cm^3), -41.45 to 8.73 in vitamin-C (mg/100g).
The result of present investigation revealed that the crosses Buldhana Local x Amravati Local was exhibited positive maximum significant heterosis over better parents (12.36%) for length of vine. While the cross Ahemdnagar Local x Karjat Local also recorded highest significant positive heterosis over better parent (9.81%). Similar results were reported by Ghuge *et al.* (2016) [2], Malviya *et al.* (2017) [5], Jayanth *et al*. (2019) [4] and Mishra *et al.* (2019) [6].
The result of present investigation revealed that the crosses Aurangabad Local x Karjat Local was exhibited positive maximum significant heterosis over better parents (56.00%) for number of branches per vine. While the cross Chandrapur Local x Amravati Local also recorded highest significant positive heterosis over better parent (52.38%). Similar results were reported by Malviya (2017) [5], Jayanth *et al*. (2019) [4] and Mishra *et al.* (2019) [6].
With regards to days for first female flower, the crosses Karjat Local x Amravati Local (-15.08%) exhibited significant negative heterosis followed by Karjat Local x Kolhapur Local (-11.80%) over batter parent. Similar, results were reported by Singh *et al.* (2012) and Mishra *et al*. (2019) [6].
With respect to days required for 50 % female flower, the crosses Karjat Local x Amravati Local (-14.39%) exhibited significant negative heterosis followed by Ahemdnagar Local x Kolhapur Local (-10.95%) and Karjat Local x Kolhapur Local (-9.38%) over batter parent. Similarly, negative heterosis reported by Jayanth *et al*. (2019) [4].
Node at which first female flower appeared, the crosses Karjat Local x Amravati Local (-51.11) while the cross Karjat Local x Kolhapur Local (-42.15%) exhibited significant negative heterosis over better parent. Similar results were reported by Ghuge *et al.* (2016) [2], Jayanth *et al*. (2019) [4] and Mishra *et al.* (2019) [6].
The crosses Karjat Local x Amravati Local (-18.80%), Karjat Local x Kolhapur Local (-13.75%) and Chandrapur Local x Kolhapur Local (-12.45%) exhibited significant minimum negative heterosis over batter parent was recorded significantly minimum negative heterosis for days required for first harvest of fruit. Similar results were recorded for earliness in Bottle gourd by breeding workers like Malviya (2017) [5], Jayanth *et al*. (2019) [4] and Mishra *et al*. (2019) [6].
For yield of fruit per hectare the cross Karjat Local x Amravati Local (39.44 %) was recorded significantly maximum positive heterosis followed by Aurangabad Local x Karjat Local (36.96%) and Ahemdnagar Local x Kolhapur

Local (27.66%) over better parents. This result was similar with Kumar *et al*. (2018) and Varalakshmi *et al.* (2019) [9].

With respect to average weight of fruit, the crosses Karjat Local x Amravati Local (38.17%) exhibited significant positive heterosis followed by Karjat Local x Buldhana Local (34.91%) over batter parent. Similarly, positive heterosis reported by Kumar *et al*. (2018) and Varalakshmi *et al*. (2019) [9].

The result of present investigation revealed that the crosses Aurangabad Local x Karjat Local was exhibited positive maximum significant heterosis over better parents (10.94%) for average length of fruit. While the cross Chandrapur Local x Karjat Local also recorded highest significant positive heterosis over better parent (9.64%). Similar results were reported by Ghuge *et al.* (2016) [2] and Mishra *et al.* (2019) [6].

For average diameter of fruit the cross Chandrapur Local x Kolhapur Local (28.18%) was recorded significantly maximum positive heterosis followed by Chandrapur Local x Amravati Local (18.18%) and Aurangabad Local x Ahemdnagar Local (13.59%) over better parents. This result was similar with Quamruzzaman *et al.* (2009) [7] and Ghuge *et al.* (2016) [2].

With regards to fruit cavity, the crosses Ahemdnagar Local x Buldhana Local (-47.05%) exhibited significant negative heterosis followed by Chandrapur Local x Buldhana Local (-39.58%) over batter parent. Similar, results were reported by Jagtap and Musamade (2014) [3].

The crosses Ahemdnagar Local x Amravati Local was exhibited positive maximum significant heterosis over better parents (8.73%) for Vitamin-C. While the cross Karjat Local x Amravati Local also recorded highest significant positive heterosis over better parent (2.49%). Similar results were reported by Gautam *et al.* (2017) [1].

Out of 21 F_1 hybrids as many as 7 for length of vine, 5 for number of branches per vine, 10 for days required for first female flower, 12 for days to 50% female flowering, 17 for node at which first female flower appeared, 15 for days required for first harvest of fruit, 3 for yield of fruits per ha (t/ha), 7 for average weight of fruit (g), 3 for average length of fruit (cm), 7 for average diameter of fruit (cm), 2 for fruit cavity (cm^3), 2 for vitamin-C (mg/100g). In all characters, the best performing F_1 hybrid was better than top / best parent which had highest value or lower value for the particular characters on desirable direction (Table 1 & 2).

Among the parents, P4 (Karjat Local) highest for Length of vine, Number of branches per vine, days required for 50% female flower, node at which first female flower appeared, days required for first harvest of fruit, yield of fruits per ha, average weight of fruit (g) and fruit diameter (cm), The Parent P3 (Chandrapur Local) performing best for days required for first female flower, Fruit cavity (cm^3), The parent P5 Buldhana Local performing best for average length of fruit (cm) and Parent P1 (Aurangabad Local) Performing best for the vitamin-C (mg/100g).

Table 2: Mean value of parents, F1 hybrids and their heterosis percentage.

Parents and crosses	1. Length of vine (cm)		2. Number of branches per vine		3. Days required for first female flower		4. Days required for 50% female flower	
	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.
P1	537.28		16.40		62.20		66.00	
P2	420.42		12.60		63.70		68.50	
P3	692.89		17.30		55.70		62.00	
P4	853.48		25.10		57.00		60.00	
P5	609.31		21.70		59.30		63.00	
P6	609.96		13.40		63.00		66.00	
P7	510.59		15.40		59.30		64.00	
P1 x P2	495.54	-7.77 **	14.90	0.00	59.30	-6.91 **	63.00	-8.03 **
P1 x P3	498.56	-28.05 **	16.50	-20.00	60.60	-2.57	64.50	-2.27
P1 x P4	737.44	-13.60 **	22.70	56.00**	61.20	-1.61	63.00	-4.55 **
P1 x P5	640.27	5.08 **	23.10	-12.00	56.40	-9.32 **	61.50	-6.82 **
P1 x P6	396.20	-35.05 **	12.70	-16.00	58.00	-7.94 **	62.00	-6.06 **
P1 x P7	548.94	2.17	17.70	36.00**	60.40	-2.89	64.50	-2.27
P2 x P3	721.45	4.12 **	19.80	9.09	60.30	-5.34 **	64.00	-6.57 **
P2 x P4	937.21	9.81 **	25.30	9.09	63.30	-0.63	66.00	-3.65 *
P2 x P5	521.45	-14.42 **	19.70	-18.18	60.70	-4.71 *	63.00	-8.03 **
P2 x P6	398.77	-34.62 **	12.00	-9.09	61.50	-3.45	65.50	-4.38 **
P2 x P7	486.45	-4.73 *	13.40	4.00	57.10	-10.36 **	61.00	-10.95 **
P3 x P4	876.94	2.75 *	26.50	-9.09	55.30	-2.98	60.00	-3.23
P3 x P5	647.28	-6.58 **	21.10	-13.64	57.40	-3.20	61.00	-3.17
P3 x P6	471.69	-31.92 **	15.50	52.38**	59.40	-5.71 **	63.50	-3.79 *
P3 x P7	543.55	-21.55 **	16.50	8.00	54.40	-8.26 **	58.50	-8.59 **
P4 x P5	712.58	-16.51 **	23.50	0.00	61.20	3.20	65.50	3.97 *
P4 x P6	914.51	7.15 **	25.10	40.90**	53.50	-15.08 **	56.50	-14.39 **
P4 x P7	607.03	-28.88 **	19.00	4.00	52.30	-11.80 **	58.00	-9.38 **
P5 x P6	685.38	12.36 **	22.50	0.00	61.00	-3.17	65.50	-0.76
P5 x P7	655.81	7.63 **	23.70	8.00	60.00	1.18	65.00	1.56
P6 x P7	381.29	-37.49 **	12.70	28.00*	63.30	0.48	67.50	2.27
SE±	6.64	9.42	0.50	0.65	0.83	1.20	0.74	1.04
C.D at 5%	19.24	19.33	1.46	1.34	2.43	2.47	2.16	2.14

Table 2: Cont...

Parents and crosses	5. Node at which first Female Flower appeared		6. Days required for first Harvest of Fruit		7. Yield of Fruits per ha (ton)		8. Average Weight of Fruit (g)	
	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.
P1	14.00		71.00		21.52		607.55	
P2	14.10		73.40		16.75		609.80	
P3	10.30		66.70		25.45		628.45	
P4	8.70		63.50		32.00		633.80	
P5	12.00		70.30		23.00		631.45	
P6	13.50		71.80		13.55		617.75	
P7	12.10		69.10		19.94		614.40	
P1 x P2	11.40	-19.15 **	69.00	-5.99 **	21.75	1.07	680.15	11.54
P1 x P3	14.20	1.43	70.30	-0.99	25.45	0.00	705.60	12.28
P1 x P4	10.50	-25.00 **	69.70	-1.83	39.30	22.81	810.75	27.92 **
P1 x P5	9.20	-34.29 **	64.30	-9.44 **	31.50	36.96 *	715.95	13.38
P1 x P6	11.30	-19.29 **	68.30	-4.87 **	13.05	-39.36 *	474.70	-23.16 *
P1 x P7	12.70	-9.29 *	66.30	-6.62 **	19.20	-10.78	620.85	1.05
P2 x P3	12.70	-9.93 *	70.30	-4.22 **	27.15	6.68	671.25	6.81
P2 x P4	13.10	-7.09	69.60	-5.18 **	39.20	22.50	843.40	33.07 **
P2 x P5	9.40	-33.33 **	68.50	-6.68 **	19.82	-13.83	611.05	-3.23
P2 x P6	12.50	-11.35 *	68.40	-6.81 **	12.50	-25.37	555.75	-10.04
P2 x P7	9.70	-31.21 **	66.30	-9.67 **	16.10	-19.28	619.60	0.85
P3 x P4	8.00	-22.33 **	61.10	-8.40 **	40.85	27.66 *	801.85	26.51 *
P3 x P5	10.20	-15.00 **	67.50	-3.98 **	31.35	23.18	755.65	19.67
P3 x P6	11.80	-12.59 *	67.70	-5.71 **	26.70	4.91	644.45	2.55
P3 x P7	7.30	-39.67 **	60.50	-12.45 **	32.00	22.40	820.65	30.58 **
P4 x P5	8.40	-30.00 **	69.00	-1.85	31.20	-2.50	855.05	34.91 **
P4 x P6	6.60	-51.11 **	58.30	-18.80 **	44.62	39.44 **	875.75	38.17 **
P4 x P7	7.00	-42.15 **	59.60	-13.75 **	29.20	-8.75	835.65	31.85 **
P5 x P6	12.80	-5.19	70.10	-2.37	23.92	4.00	647.95	2.61
P5 x P7	12.40	2.48	69.90	-0.57	23.32	1.41	640.35	1.41
P6 x P7	12.10	-10.37 *	69.80	-2.79	18.62	-6.64	690.75	11.82
SE±	0.43	0.62	0.70	0.99	2.65	3.77	42.91	61.08
C.D at 5%	1.26	1.28	2.05	2.04	7.68	7.73	124.31	125.33

Table 2: Cont...

Parents and crosses	9. Average length of Fruit (cm)		10. Average diameter of fruit (cm		11. Fruit Cavity (cm3)		12. Vitamin-C (mg/100g)	
	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.	Mean	Heterosis % over B.P.
P1	32.92		5.15		79.98		10.47	
P2	34.66		4.90		84.04		8.62	
P3	33.30		5.50		71.07		7.74	
P4	45.16		6.15		112.35		9.82	
P5	47.58		5.65		124.24		9.40	
P6	38.63		5.35		102.90		8.71	
P7	30.53		5.20		90.56		6.40	
P1 x P2	37.27	7.53	5.85	13.59 **	105.65	25.71	9.87	-5.73
P1 x P3	31.86	-4.32	5.75	4.55	84.64	5.83	6.13	-41.45 **
P1 x P4	39.61	-12.29 **	6.25	1.63	120.97	7.67	10.12	-3.34
P1 x P5	49.06	3.11	6.05	7.08	151.54	21.97	8.68	-17.10 **
P1 x P6	40.65	5.23	4.85	-9.35 *	95.44	-7.25	7.12	-32.00 **
P1 x P7	33.11	0.58	5.40	3.85	89.53	-1.13	8.10	-22.64 **
P2 x P3	32.81	-5.34	5.90	7.27	84.71	0.80	6.80	-21.06 **
P2 x P4	48.49	7.37 *	6.75	9.76 *	132.99	18.38	8.19	-16.60 **
P2 x P5	34.62	-27.24 **	4.75	-15.93 **	65.78	-47.05 **	7.21	-23.24 **
P2 x P6	37.06	-4.06	5.05	-5.61	74.12	-27.97	9.47	8.73*
P2 x P7	35.08	1.21	5.40	3.85	94.07	3.88	6.30	-26.91 **
P3 x P4	49.51	9.64 **	6.35	3.25	100.74	-10.33	9.90	0.87
P3 x P5	30.42	-36.07 **	5.95	5.31	75.06	-39.58 *	8.42	-10.43 *
P3 x P6	31.87	-17.50 **	6.50	18.18 **	93.89	-8.76	7.80	-10.45 *
P3 x P7	32.85	-1.34	7.05	28.18 **	95.30	5.23	6.12	-20.98 **
P4 x P5	46.71	-1.83	6.85	11.38 **	137.07	10.33	9.12	-7.13
P4 x P6	50.10	10.94 **	6.95	13.01 **	148.02	31.75	10.06	2.49*
P4 x P7	32.32	-28.42 **	6.95	13.01 **	121.76	8.38	6.91	-29.63 **
P5 x P6	32.47	-31.76 **	5.75	1.77	99.16	-20.19	8.90	-5.32
P5 x P7	40.60	-14.67 **	5.60	-0.88	113.29	-8.82	6.15	-34.57 **
P6 x P7	36.37	-5.84	5.25	-1.87	112.49	9.31	7.50	-13.89 **
SE±	1.01	1.45	0.16	0.23	12.53	17.92	0.27	0.3
C.D at 5%	2.92	2.98	0.48	0.48	36.31	36.78	0.78	0.8

References

1. Gautam DK, Yadav GC, Kumar P, Kumar V, Singh M. Estimation of heterosis for growth, yield and quality traits in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. International Journal of Current Microbiology and Applied Science 2017;6(8):789-802.
2. Ghuge MB, Syamal MM, Karcho S. Heterosis in bottle [*Lagenaria siceraria* (mol.) Standl.]. Indian. Journal of Agriculture Research 2016;50(5):466-470.
3. Jagtap VS, Musamade AM. Heterosis and quality components in Muskmelon (*Cucumis melo* L.). Trends in Biosciences. 2014;7(24):4130-4135.
4. Jayanth S, Dr. Lal Makhan, Dr. Duhan DS, Vidya R. Estimation of heterosis and combining ability for earliness and vegetative traits in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. International Journal of Chemical Studies 2019;7(1):20-25.
5. Malviya AV, Bhanderi DR, Patel AI, Jadav NK, Patel UV. Heterosis for fruit yield and its components in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Trends in Biosciences 2017;10(2):783-787.
6. Mishra S, Pandey S, Kumar N, Pandey VP, Singh T. Studies on the extent of heterosis for the quantitative characters in kharif season bottle gourd gourd [*Lagenaria siceraria* (Molina) Standl.]. Journal of Pharmacognosy and Phytochemistry 2019;8(1):29-38.
7. Quamruzzaman AKM, Rashid MA, Masud, Uddin MN. Heterosis in bottle gourd. Bangladesh Journal of Agriculture Research 2009;34(3):465-472.
8. Singh PR, Chandan Karak, Mohapatra PP, Kumar BA, Hazra P. Manifestation of heterosis in bittergourd. International Journal Current Microbiology Applied Science 2018;7(10):1376-1385.
9. Varalakshmi B, Pitchaimuthu M, Rao ES. Heterosis and combining ability for yield and its related traits in ridge gourd [*Luffa acutangula* (L.) Roxb]. Journal of Horticulture Science 2019;14(1):48-57.