Genetic Variability and Correlation Studies in Hybrids of Bottle gourd (*Lagenariasiceraria*)

ABSTRACT

The present investigation was carried out with ten bottle gourd hybrid varietiesincluding one check arranged in a randomized block design with three replications and observations were recorded on five randomly selected plants for eleven quantitative traits at Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj, U.P. A detailed analysis of the results on ten bottle gourd hybrid varieties revealed that from analysis of variance it is revealed that all the traits have high significant variability and thus can be used in further analysis. Shreeman 152 showed higher days to first male and first female appearance, number of branches per vine, vine length. F115 hybrid variety found the highest fruit diameter and SW906 were found high in fruit yield per and fruit yield per ha GCV were recorded higher for Fruit yield per ha, Fruit length, Vitamin C and Fruit diameter, indicating a good amount of variability present in the material under investigation. High heritability coupled with high genetic advance as percentmean is observed in Fruit yield per ha, Fruit length, Vitamin C, TSS and days to first female appearances suggesting that selection of these traits would be effective for the desired improvement in bottle gourd. A significant positive correlation was reported between fruit yield per plant with Vitamin C, TSS, fruit yield per ha. A significant negative correlation was reported between vine length and days to first harvest, days to first male and female appearances.

Keywords: Bottle gourd, Analysis of variance, Mean performance of hybrid variety, Variability Correlation Analysis.

INTRODUCTION

"Bottle gourd [*Lagenariasiceraria*(Mol.) Standl] is one of the most versatile cucurbitaceous crops belongs to the family Cucurbitaceae and subfamily Cucurbitoidae having the somatic chromosome 2n = 2x = 22. It is a fastgrowing climbing plant which bears hard shelled and bottle shaped fruits and widely cultivated in tropics and subtropics. It is grown in both rainy and summer seasons and its fruits are available in the market throughout the year. Under North-Indian conditions, its cultivation is done in spring-summer and rainy seasons. India is endowed with the wealth of bottle gourd germplasm, comprising of both wild and cultivated species. In final estimate of NHB database 2020-21, India produced 3171.07 thousand metric tonnes of bottle gourd and Bihar is a leading producer (655.55 thousand metric tonnes) with maximum share (20.67%) of total share (APEDA Agri Exchange, 2021). Due to suitability of growing under limited irrigation and high yield potential, it is widely cultivated in North Konkan region and semi-arid area of Maharashtra" (Harika*et al.*, 2012).

"In spite of being in cultivation since ancient times and wide germplasm availability, conscious evaluation and exploitation of germplasm in heterosis breeding has not been attended to until recently"(Harika*et al.*, 2012)."It is a highly cross-pollinated crop with wide genetic variability present within the cultivated varieties throughout the country. In India, no comprehensive systematic research has been done in this crop. The yield potentiality of this crop needs to be improved through an effective breeding program. Studies on the variations of yield and yield contributing characters are of great importance before planning a breeding program. As the yield and its components are quantitative characters, careful assessments of the amount of variation and their association must be analyzed to gain insight into the complexity of the mechanism. Therefore, the present study was planned to estimate the amount of genetic variability, heritability and path-coefficient analysis in the thirty-eight genotypes of bottle gourd for

yield and its attributing traits" (Harika*et al.*, 2012).

Bottle gourd seed is a good source of protein, lipid, micro and macro nutrients and if properly utilized, could contribute in solving the problem of malnutrition and also serve as raw material for agro-based industries (Hassan et al., 2008). The dehulled seed has been reported to contain high amount of crude protein (35.0 ± 0.48 %) and crude lipid (39.22 ±1.48 %), while the seed coat contains high amounts of crude fibre (59.05 ± 0.98 %). The plant leaf decoction along with sugar is used for treatment of jaundice, while external application of the pulp is adopted as a poultice and reduces the shaved head delirium. It is also rubbed on the feet and hands to diminish the effect of heat, while the fruit ash mixed with honey is applied to the eyes as a remedy for night blindness.

MATERIALANDMETHODS

The experiment was conducted at Vegetable Research Farm, Department of Horticulture, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology &Sciences, Prayagraj (UP) during 2021-2022. All the facilities necessary for cultivation, including labor were made available in the department.

The soil of experimental site was loamy mixed with pH ranging from 7.3 to 7.6. The land was prepared by two harrowing followed by planking. The experiment was conducted in Randomized Block Design (RBD) with three replications. The genotypes were sowing on 5 Aug 2021 and harvested on 30th Nov, 2022 at the SHUATS College Research Station, Prayagraj. The seedlings were sowing at 20 × 10cm^2 spacing. The crop was fertilized with 40 Kg N_2 and 20 Kg P_2O_5 per hectare. The nitrogen was applied in two splits, one at the time of transplanting and other at 25 days after transplanting. Entire Phosphorus was applied as basal dose. All recommended practices were followed and timely plant protection measures were taken to avoid damage through insect-pests and diseases.

3.3 Experimental materials

Table.1. List of genotypes and its source

S.No	Notation	Characters Genotype	Sources
1	H1	VARDAN	NATH SEEDS
2	H2	BHARAT	NOBLE SEEDS
3	H3	JK 9113	JK SEEDS
4	H4	SHARDA	SEMINIS
5	H5	F115	FAMOUS
6	H6	SHREEMAN 152	PANCHA GANGA SEEDS
7	H7	PRATIK	KALASH
8	H8	SW 906	US AGRISEEDS
9	H9	KIRTI	SAKATA
10	H10	MUSKAN	PAHUJA SEEDS

RESULTSANDDISCUSSION

Mean, range and estimates of various geneticparametersof12differentcharactersofthe10 genotypeofbottlegourdarepresentedin**Table 2**. The analysis of variance revealed significantdifferencesamongthegenotype

ofbottlegourdforallthe12 traitsstudied.Widerangeofvariationwereobserved for most of the characters likefruit yield/plant (4.23 -6.37 Kg), fruitnumber/vine (7.33-10.22),fruit yield/ha (24.01- 43.47 t)anddays tofirstfemaleflowerappearance(57.33-80.67).Presence ofsuch high variability fortheseparameters will form the basis for effective selection ofsuperiorlinesinbottlegourd.Suchwidevariabilityin this crop has also been reported by Kumar *et al*(2011),Husna*etal*(2011). The degree ofvariabilityshownbydifferentparameterscanbejudged bythemagnitudeofGCVandGCV,whichgivesthe picture of extent of genetic variability present inthe population ranged from 8.90 (days taken for firstfemale flower appearance) to 5.09 (fruit yield/vine).Similarfindingswerereportedby Yadav*etal* (2008),Husna*etal*(2011)and Ara*etal*(2014)inbottlegourd.A perusal of data in Table 2 showedthat there isconsiderable difference of GCVvaluesforallthecharactersstudied(Singh*etal*,2008).

Table2.Means,coefficientsofvariation,heritabilityandgeneticadvanceforelevendifferentcharactersinbottlegourd

S. No.	Characters	General mean	Range	GCV %	Heritability %	GA	GA as %
1	Days to first male appearance	59.14	55.00-70.33	6.67	87	7.68	12.99
2	Days to first female appearance	67.13	57.33- 80.67	8.9	82.3	11.82	17.61
3	No of branches per vine	11.96	11.00 - 13.11	2.08	14.2	0.19	1.62
4	Vine length	410.54	158.64-510.10	13.93	65.4	95.28	23.21
5	Fruit length	39.6	17.96 - 43.95	25.83	95.7	12.63	31.9
6	Fruit diameter	6.57	5.67- 12.29	28.81	91	2.43	36.95
7	No of fruits per vine	8.36	7.33 - 10.22	5.09	41.5	0.57	6.75
8	Days to first harvest	57.45	52.11 - 60.11	2.89	66.1	2.78	4.85
9	Fruit yield per plant	5.02	4.23 - 6.37	10.92	39.9	0.45	9
10	Fruit yield per hectare	337.49	249.01-434.79	17.06	96	116.13	34.42
11	Vitamin -C	8.01	7.34-8.56	23.21	92.4	1.6	45.96
12	T.S.S.	3.75	3.17 -4.58	13.97	96.2	1.28	28.23

and selection as such may not be effective for theimprovementofbottlegourd.

WiththehelpofGCValone,itisnotpossibleto determinetheextentofvariationthatisheritable.Thustheestimatesofheritabilityindicatetheeffectiveness with which selection can be expected to exploit theexistinggeneticvariability.

High magnitude of Heritability was observed in T.S.S. (96.20) followed by Fruit yield per plant (96.00), fruit length (95.70cm), Vitamin C (92.40), fruit diameter (91.00cm), Number of days first male appearance (87.00), Number of days first female appearance (82.30), Days to first harvest (66.10) and Vine length (65.40cm). While moderate Heritability was observed in traits, Number of fruit per vine (41.50) and Fruit yield per plant (39.90) and Lowest Heritability was observed in traits number of branches per vine (14.20).Similar findingswere reported by Kumar *et al* (2011), *Husnaet al*(2011) inbottlegourd.

The highest GA (%) was observed in character fruit yield per ha(116.13) followed by vine length (95.28). Fruit length (12.63cm), Number of day's first female appearance (11.82), showed moderate genetic advance as percent of mean. While Number of days first female appearance (7.68), days to first harvest (2.78), fruit diameter (2.43cm), Vitamin C (1.60), T.S.S. (1.28), number of fruit per vine (0.57), fruit yield per plant (0.45) and Number of branches per vine(0.19) showed low genetic advance as percent.These results are in conformity with the findings ofYadav *et al* (2007), Wani*et al* (2008),Husna *et al*(2011)andAra*etal* (2014)inbottlegourd.

Genetic advance of 5% mean of variation was observing Highest genetic value was observed in the traits Vitamin C (45.96) followed by fruit diameter (36.95), Fruit yield per ha (34.42), fruit length (31.90), T.S.S. (28.23) and Vine length (23.21). While moderate genetic advance mean value was observed in traits Number of days first female appearance (17.61), (25.52) and Number of days first male appearance (12.99), fruit yield per ha (9.00) and Lowest GCV was observed in traits number of fruit per vine (6.75), days to first harvest (4.85) and number of branches per vine (1.62).These results are in conformity with the findings ofYadav *et al* (2007), Wani*et al* (2008),Husna *et al*(2011)andAra*etal* (2014)inbottlegourd.

Positive and significant correlation was observed for Fruit diameter, Number of fruits per vine, fruit yield per hectare and Vitamin C at genotypic level. Therefore, these characters emerged as most important attributing associates of fruit yield per plant in bottle gourd. Thus, selection practiced for the improvement in one character will automatically result in the improvement of the other character even if direct selection for improvement has not been made for the yield character. Similarly,Wani*etal*(2008)andHusna*etal*(2011)alsoreportedthatfruittraitshadmaximumdirecteffectonfruityield

Table3.Genotypic correlations of grain yield per plant with other characters in 20 genotypes of Bottle gourd.

Genotype	DFM	DFF	BV	VL	FL	FD	FV	FH	FYP	FYH	VC	T.S.S.
DFM	1	0.303*	-0.686**	-0.509**	-0.041	-0.02	-0.045	-0.116	-0.317*	0.146	-0.291*	0.12
DFF		1	-0.204	-0.228	-0.331**	-0.627**	-0.448**	-0.576**	-0.449**	-0.175	-0.767**	0.16
BV			1	0.137	-0.015	-0.721**	0.002	0.017	0.06	-0.196	0.049	-0.079
VL				1	-0.673**	-0.536**	-0.07	-0.077	0.136	-0.351**	-0.08	0.133
FL					1	0.305*	0.226	0.194	-0.313*	0.039	0.039	0.062
FD						1	0.355**	0.380**	-0.097	0.528**	0.312*	-0.003
FV							1	0.972**	-0.418**	-0.09	0.618**	0.235
FH								1	-0.212	-0.024	0.785**	0.112
FYP									1	0.378**	0.393**	0.039
FYH										1	0.153	0.637**
VC											1	0.671**
T.S.S.												1

DFM- Days tofirst male appearance**, DFF**- Days to first female appearance, **BV**-No of branches per vine, **VL**-Vine length, **FL**-Fruit length, **FD**-Fruit diameter**, FV**- No of fruits per vine, **FH**- Days to first harvest**, FYP**- Fruit yield per plant, **FYH**- Fruit yield per hectare, **VC**- Vitamin –C, **T.S.S**

**Significantat*P=0.01*,*Significantat*P=0.05*

Table.No.4. Analysis of variance for twelve traits in 10 genotypes of Bottlegourd" (*Lagersnariasicernaria*)]

S. No	Characters Genotype	Days to first male appearance	Days to first female appearance	No of branches per vine	Vine length (cm)	Fruit length	fruit diameter	no of fruits per vine	days to first harvest	fruit yield per plant	fruit yield per hectare	Vitamin - C	T.S. S.
1.	VARDAN	51.00	54.33	10.67	588.33	28.95	7.00	7.83	62.50	9.17	23.82	8.10	4.42
2.	BHARAT	50.33	51.50	8.50	616.67	45.75	6.95	8.83	61.50	12.62	30.96	8.56	3.78
3.	JK 9113	48.17	46.67	6.33	655.00	26.97	6.15	6.50	55.50	8.64	21.23	7.78	3.85
4.	SHARDA	53.00	55.83	11.83	568.33	35.45	7.02	13.50	66.50	13.16	33.46	7.90	3.17
5.	F115	52.50	54.50	6.83	393.33	38.43	7.31	9.17	64.17	10.17	25.79	7.34	3.23
6.	SHREEMAN 152	53.17	55.83	11.83	748.33	58.92	6.90	4.83	65.17	6.17	18.10	8.58	4.58
7.	PRATIK	45.17	47.33	8.00	586.67	18.53	7.17	6.00	55.50	7.33	20.13	8.17	3.42
8.	SW 906	47.33	50.50	10.17	658.33	43.32	7.21	14.50	60.33	15.81	41.68	8.45	3.60
9.	KIRTI	43.83	45.83	5.83	498.33	28.88	6.94	11.50	52.83	12.64	32.96	7.95	4.58
10.	MUSKAN	53.00	53.33	4.50	391.67	32.92	6.88	10.00	63.50	7.48	19.94	7.67	4.12
	Mean	49.75	51.57	8.45	570.50	35.81	6.95	9.27	60.75	10.32	26.81	8.05	3.88
	SE	0.72	0.52	1.19	0.29	0.36	0.43	0.56	0.47	0.96	0.52	0.28	1.21
	CD5%	1.46	1.05	2.41	0.59	0.74	0.86	1.13	0.95	1.94	1.05	0.56	2.02
	CV	1.19	0.72	1.56	2.78	9.72	9.37	3.41	2.13	3.29	3.89	4.86	3.76

The variation in days to first male appearance ranged between 43.83 to 53.17 days. The earliest genotype (KIRTI) flowered at 43.83 days whereas; the late genotype (SHREEMAN 152) flowered at 53.17 days. The average days to first male appearance was 49.75 days. The genotypic co-efficient of variation was 6.67 per cent.The variation in days to first female appearance ranged between 45.83 to 55.83 days. The earliest genotype (KIRTI) flowered at 45.83 days whereas; the late genotype (SARDA) flowered at 55.83 days. The average days to first male appearance was 51.57 days. The genotypic co-efficient of variation was 8.90 per cent.

As far as plant height is concerned, the tallest genotype SREEMAN 152 and SARDA had max number of branches per vine of 11.83 whereas, the followed by genotype VARDAN was measured 10.67. The average value for number of branches per vine was 8.45. The genotypic co-efficient of variation was 2.08 per cent. The maximum vine length was observed in SHREEMAN 152 (748.33cm) and followed by SW 906 (658.33cm) were found and lowest for MUSKAN (391.67cm) respectively. The general mean for this trait was 410.54. The genotypic co-efficient of variation was 13.93 per cent indicating existence of variation in this character.

The range of variation observed for fingers per ear was from 18.53cm in PRATIK to 58.92cm in SHREEMAN 152 with mean of 35.81cm. The genotypic co-efficient of variation were 25.83 per cent.Highest value for this trait was observed in F 115 (7.31cm) while, lowest value was observed in JK 9113 (6.15cm) with a general mean of 6.95cm. The genotypic co-efficient of variation were also high 28.81per cent. The number of fruit per vine ranged from 4.83 (SREEMAN 152) to 14.50 (SW 906). The general mean for this trait was 9.27. The genotypic co-efficient of variation were 5.09 per cent.

The spectrum of variation for this days to first harvest character has been found between the lower and upper limit of 52.83 and 66.50, respectively. The SARDA (66.60) was found to be the highest days to first harvest while KIRTI (52.83) was found to be the lowest value days to first harvest and with a mean value of 60.75. The genotypic (2.89 per cent) co-efficient ofvariation indicated high genetic variability.

The highest fruit yield per plant was observed for SW906 (15.81) and the lowest for SREEMAN 152 (6.17). The average Fruit yield per plant was 10.32. The estimates of genotypic coefficients of variation were (GCV = 10.92 per cent). The highest fruit yield per hawas observed for SW906 (41.68) and the lowest for SREEMAN 152 (18.10). The average Fruit yield per plant was 26.81. The estimates of genotypic coefficients of variation were (GCV = 17.06 per cent). The highest Vitamin C in fruit was observed in SREEMAN152 (8.58) and BHARAT (8.56).The lowest vitamin C plant MUSKAN (7.67cm) and JK 9113 (7.78cm) respectively. The general mean for this trait were 8.05. The genotypic co-efficient of variation for vitamin C were 23.21 percent of variation for indicating existence of variation in this character.

The highest TSS of fruit pulp was observed in SREEMAN 152 (4.58) and lowest for SARDA (3.17) respectively. The general mean for this trait was 3.88. The genotypic co-efficient of variation was 13.97 per cent indicating existence of variation in this character.Similarly, Wani*et al* (2008) and Husna *et al* (2011) also reported that fruit traits had maximum direct effect on fruit yield in bottlegaurd.

Conclusion

In light of the aforementioned findings, it can be said that the traits first harvest and fruit production per hectare have positive and very significant association values, along with high positive direct effects, high heritability, genetic advancement, and high GCV values. Consequently, for the advancement of the (Lagersnariasicernaria) intra-specific and inter-specific populations.These traits are most important for selection of elite hybrid as well as used in breeding programme. In spite of that, fruit yield per plant and fruit length exhibited high positive significant correlation whereas, no. of fruities per vine and no. of branches per vine showed high direct effect on yield. .Fromthe above results, it is concluded thatin all the hybrid varietiesShreeman152 variety of bottle gourd showed the best performance and was also economically best hybrid of bottle gourd(cost of cultivation Rs.41080, Gross return Rs. 21575, Net return Rs.160495, Benefit cost ratio 3.91).

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