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Variability and correlation studies in f$_4$ progenies of bottle gourd (*Lagenaria siceraria* (Molina) Standl.)

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Abstract
An investigation was conducted on F$_4$ progenies derived from the cross *DBG-5* x *Bhagirati* in bottle gourd to assess genetic variability, genotypic and phenotypic coefficients of variation, heritability, genetic advance, and correlation among thirteen agronomic traits. Substantial genotypic and phenotypic variability, coupled with high heritability and considerable genetic advance as a percentage of mean, were noted for traits such as the number of primary branches per vine, number of fruits per vine, yield per vine, and average fruit weight. These observations suggest that additive gene effects predominantly govern these traits, indicating the effectiveness of simple selection methods for improvement. Furthermore, yield per vine demonstrated a strong and significant positive association, at both phenotypic and genotypic levels, with traits like sex ratio, node of first female flower appearance, average fruit length, fruit diameters at pedicel, center, and stylar end, as well as number of fruits per vine. Thus, these traits-particularly those influencing floral development and fruit morphology-should be prioritized in breeding programs aimed at enhancing yield potential.

Keywords: Genetic variability, correlation, bottle gourd, F$_4$ generation

Introduction

Bottle gourd (*Lagenaria siceraria* [Molina] Standl.), a member of the Cucurbitaceae family with a chromosome number of 2n=22, is widely cultivated and valued as a vegetable crop. Its monoecious and andromonoecious flowering behavior contributes to a high degree of cross-pollination (Swiander and Maccollum, 1994) [24]. Originally domesticated in Africa (Singh, 1990), the species is believed to have dispersed to the Indian subcontinent via oceanic drift. Over time, it has diversified into numerous indigenous landraces and has further spread to countries like China, Indonesia, and even as far as New Zealand.

Despite its increasing cultivation and production, bottle gourd remains relatively underexploited in terms of systematic genetic improvement. There is a pressing need for the development of improved cultivars exhibiting traits such as early fruit maturity, enhanced yield, favorable female-to-male flower ratio, medium-sized cylindrical fruits with green coloration and pubescence, and resistance to common pests and diseases such as fruit fly, downy mildew, powdery mildew, gummosis, and fusarium wilt. In pursuit of these goals, the present study aimed to evaluate F$_3$ progenies for genetic variability, heritability, expected genetic advance, and trait correlations to identify promising genotypes for future breeding endeavors.

Material and Methods

The experiment was laid out in a Randomized Block Design with three replication at the All India Coordinated Research Project on Vegetable Crops, Department of Horticulture, Mahatma Phule Krishi Vidyapeeth, Rahuri, Dist. Ahmednagar (Maharashtra). The experimental material consisted of five F4 progenies from cross *DBG-5* x *Bhagirati* each having 20 plants along with their parents. Plants of each F4 progeny were maintained with a plant spacing of 3 x 1 m. The Observations were recorded on various growth and yield parameters from randomly selected plants of F4 generation such as length of vine (m), Number of primary branches per vine, days required for appearance of first female flower, sex ratio, node at which first female flower appeared, days required for first fruit harvest, number of fruits per vine, yield per vine(kg), average weight of fruit (g), average length of fruit (cm), fruit diameter at center, pedicel and stylar end. Estimation of components of variations and genetic advance was done following Johnson *et al.*, (1955) [7], coefficient of variations following Burton and De Vane (1953) [4] and heritability following (Lush, 1949). The correlation coefficient was estimated as suggested by Snedecor and Cochran, 1967) [23].

Table 1: Mean, range, GCV, PCV, ECV, heritability, genetic advance and percent mean of genetic advance of two parents and F4 population of cross DBG-5 x Bhagirathi.

Sr. No.	Character	Mean	Range	GCV (%)	PCV (%)	ECV (%)	h^2 bs (%)	GA	GAM (%)
1.	Length of vine (m)	8.73	7.31-10.05	9.56	15.06	11.63	40	1.41	16.15
2.	Number of primary branches per vine	8.28	7.33-9.00	6.67	9.07	6.14	54	1.06	12.80
3.	Days required for appearance of first female flower	54.66	52.00-57.00	3.50	3.88	1.68	81	4.47	8.17
4.	Sex ratio (M: F)	14.33	13.58-15.10	13.36	14.79	6.35	82	1.71	11.93
5.	Node at which first female flower appeared	9.33	8.33-10.66	5.95	9.96	7.98	36	0.86	9.21
6.	Days required for first harvest of fruit	62.72	57.24-67.45	2.99	4.22	2.98	50	3.75	5.97
7.	Average weight of fruit (g)	706.9	651.33-760.00	9.94	12.71	7.93	61	149.96	21.21
8.	Average length of fruit (cm)	31.47	29.26-34.20	10.11	13.28	8.61	58	6.64	21.09
9.	Fruit diameter at pedicel (cm)	4.88	4.20-5.20	16.15	17.61	7.03	84	1.99	40.77
10.	Fruit diameter at center (cm)	5.26	4.36-5.86	16.89	18.18	6.73	86	2.31	43.91
11.	Fruit diameter at stylar end (cm)	5.39	4.46-6.03	11.31	14.24	8.64	63	1.31	24.30
12.	Number of fruits per vine	19.66	17.00-27.33	25.70	28.94	13.30	79	11.05	56.20
13.	Yield per vine (kg)	14.38	12.32-17.92	14.66	21.20	15.31	48	3.68	25.59

Table 2: Genotypic and Phenotypic Correlation co-efficient for yield and yield contributing characters in F4 generation of cross Pusa Samridhi x DBG-5.

Sr. No.	Character		1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Length of vine (m)	G	1.000	0.374	-0.388	-0.465*	-0.909**	0.664**	0.853**	0.963**	-0.797**	-0.619**	-0.837**	-0.804**	-9.935**
		p	1.000	0.376	-0.328	-0.314	-0.104	0.155	0.625**	0.670**	-0.311	-0.31	-0.505*	-0.447*	-0.648**
2.	Number of primary branches per vine	G	-	1.000	0.372	-0.773	-0.076	0.842**	0.940**	0.972**	-0.702**	-0.473*	-0.733**	-0.670**	-0.606**
		P		1.000	0.246	-0.597**	-0.143	0.346	0.576**	0.467*	-0.285	-0.29	-0.483*	-0.486*	-0.36
3.	Days required for appearance of first female flower	G	-	-	1.000	0.024	0.494*	0.617**	-0.226	-0.363	0.331	0.508**	0.275	0.375	0.539**
		P			1.000	0.03	0.293	0.493*	-0.291	-0.345	0.322	0.426*	0.269	0.266	0.498*
4.	Sex ratio (M:F)	G	-	-	-	1.000	0.768**	-0.530**	-0.854**	-0.794**	0.970**	0.786**	0.968**	0.987**	0.826**
		P				1.000	0.541**	-0.486*	-0.659**	-0.554**	0.693**	0.649**	0.769**	0.783**	0.526**
5.	Node at which first female flower appeared	G	-	-	-	-	1.000	-0.401*	-0.793**	-0.844**	0.936**	0.928**	0.929**	0.945**	0.934**
		P					1.000	-0.194	-0.308	-0.14	0.634**	0.602**	0.622**	0.579**	0.540**
6.	Days required for first harvest of fruit	G	-	-	-	-	-	1.000	0.571**	0.462*	-0.435*	-0.138	-0.533**	-0.385	-0.413*
		P						1.000	0.32	0.197	-0.218	-0.075	-0.284	-0.216	-0.065
7.	Average weight of fruit (g)	G	-	-	-	-	-	-	1.000	0.940**	-0.946**	-0.878**	-0.983**	-0.948**	0.926**
		P							1.000	0.907**	-0.673**	-0.584**	-0.808**	-0.738**	-0.751**
8.	Average length of fruit (cm)	G	-	-	-	-	-	-	-	1.000	0.902**	0.962**	0.998**	0.972**	0.259
		P								1.000	0.398	0.334	0.586**	0.557**	0.567**
9.	Fruit diameter at pedicel (cm)	G	-	-	-	-	-	-	-	-	1.000	0.997**	0.912**	0.960**	0.910**
		P	-								1.000	0.940**	0.935**	0.853**	0.835**
10.	Fruit diameter at center (cm)	G	-	-	-	-	-	-	-	-	-	1.000	0.961**	0.942**	0.900**
		P	-									1.000	0.873**	0.828**	0.786**
11.	Fruit diameter at stylar end (cm)	G	-	-		-	-	-	-	-	-	-	1.000	0.902**	0.949**
		P	-										1.000	0.928**	0.901**
12.	Number of fruits per vine	G	-	-	-	-	-	-	-	-	-	-	-	1.000	0.981**
		P	-											1.000	0.820**
13.	Yield per vine (kg)	G	-	-	-	-	-	-	-	-	-	-	-	-	1.000
		P	-												1.000

S: Symbol, G: Genotypic, P: Phenotypic *, ** Significance at 5% and 1%, respectively.

Result and Discussion

A wide range of variability was observed among the F_4 progenies for all the traits studied. Vine length varied from 7.31 to 10.05 m, number of primary branches per vine ranged from 7.33 to 9.00, and days to the appearance of the first female flower ranged between 52.00 to 57.00 days. The sex ratio (male: female) ranged from 13.58 to 15.10, while the node at which the first female flower appeared varied between 8.33 and 10.66. Days to the first fruit harvest ranged from 57.24 to 67.45. Number of fruits per vine ranged from 17 to 27.33, yield per vine from 12.52 to 17.92 kg, and average fruit weight from 651.33 to 760.00 g. The average fruit length ranged from 29.26 to 34.20 cm, with fruit diameters at the pedicel, center, and stylar end ranging from 4.20 to 5.20 cm, 4.36 to 5.86 cm, and 4.46 to 6.03 cm, respectively. Similar high levels of variability for yield and yield-contributing traits in bottle gourd were reported by Pandit *et al.* (2009) [13], Arvindkumar *et al.* (2011) [2], and Yadav *et al.* (2008) [26].

Significant genotypic, phenotypic, and environmental coefficients of variation (GCV, PCV, and ECV, respectively) were observed across all characters. The traits showing high GCV and PCV included number of fruits per vine (25.70% and 28.94%), and yield per vine (14.66% and 21.20%). These traits are considered highly variable and governed largely by additive gene effects, making them amenable to improvement through simple selection.

Moderate GCV and PCV values were observed for traits such as sex ratio (13.36% and 14.79%), length of vine (9.56% and 15.06), average length of fruit (10.11% and 13.28%) average fruit weight (09.94% and 12.71%), and fruit diameters at the pedicel (16.15% and 17.61%) center (16.89% and 18.18%) and stylar end (11.31% and 14.24%). Traits like days to first female flower appearance (3.50% and 3.88%) and days to first fruit harvest (2.99% and 4.22%) showed relatively low GCV and PCV values. These findings are consistent with previous studies by Reddy (1989) [18], Munshi *et al.* (2005) [11], and Singh *et al.* (2008) [21], who reported similar trends in bottle gourd.

For all traits studied, the phenotypic coefficient of variation was slightly higher than the genotypic coefficient, indicating a limited influence of the environment. This trend has also been reported by Rakhi and Rajamony (2005) [16], Torkadi and Musmade (2007) [25], and Mali (2015) [10] in muskmelon.

Heritability estimates in the broad sense ranged from 36% to 86%, with high heritability observed for most traits. High heritability combined with high genetic advance as percent of mean was recorded for number of fruits per vine (79% and 56.20%), and fruit diameter at pedicel (84% and 40.77%), fruit diameter at center (86.00% and 43.91%). These values indicate the predominance of additive gene action and suggest that these traits can be effectively improved through simple selection strategies.

Moderate genetic advance along with high heritability was recorded for sex ratio (82% and 11.93%), average fruit length (58% and 21.09%), days required for first female flower (81% and 08.17%), and fruit diameter at stylar end (63% and 24.30%), indicating moderate response to selection. Similar observations were made by Arvindkumar *et al.* (2011) [2], Yadav and Kumar (2012) [27] in bottle gourd, and by Ibrahim (2012) [6], Reddy *et al.* (2013) [17], and Mali (2015) [10] in muskmelon.

Correlation analysis revealed that genotypic correlations were generally of higher magnitude than phenotypic correlations, emphasizing the predominant role of genetic factors. Yield per vine exhibited significant and strong positive correlations both at genotypic and phenotypic levels with traits such as sex ratio, node at which the first female flower appeared, average fruit length, and fruit diameter at the pedicel, center, and stylar end, as well as with the number of fruits per vine. These traits are important contributors to yield and should be prioritized in selection programs.

Conversely, traits such as vine length, number of primary branches, days to first fruit harvest, and average fruit weight showed significant negative correlations with yield per vine. These associations suggest that reduced vine length and early fruiting may favor yield improvement. Similar findings have been reported by Sharma and Dhankar (1993) [19], Badade *et al.* (2001) [3], Singh *et al.* (2002) [22], and Kumar *et al.* (2007) [8]. Gupta *et al.* (2015) [5] further highlighted the significance of component traits in influencing marketable fruit yield in bitter gourd.

References

1. Arunkumar KH, Ramanjinappa V, Hugar A. Association of yield and yield components in F2 population of bottle gourd (*Lagenaria siceraria*). Plant Archives. 2011;11(1):457-459.
2. Arvindkumar N, Singh B, Kumar M, Naresh RK. Genetic variability, heritability and genetic advance for yield and its components in bottle gourd (*Lagenaria siceraria*). Ann Hortic. 2011;4(1):101-103.
3. Badade DS, Warade SD, Gaikwad SK. Correlation studies in bottle gourd. J Maharashtra Agric Univ. 2001;6(1):20-22.
4. Burton GW, De Vane EH. Estimating heritability in tall fescue (*Festuca arundinacea* L.) from replicated clonal material. Agron J. 1953;45:478-481.
5. Gupta N, Bhardwaj ML, Singh SP, Sood S. Correlation and path analysis of yield and yield components in some genetic stocks of bitter gourd (*Momordica charantia* L.). SABRAO J Breed Genet. 2015;47(4):475-481.
6. Ibrahim EA. Variability, heritability and genetic advance in Egyptian sweet melon (*Cucumis melo* var. *aegyptiacus* L.) under water stress conditions. Int J Plant Breed Genet. 2012;6(4):238-244.
7. Johnson HW, Robinson HF, Fatokun CA. Genetic advance in pea (*Pisum sativum* L.). Madras Agric. 1955;67:387-390.
8. Kumar S, Yadav JP, Srivastava JP, Yadav JR, Shukla IN, Mishra G, *et al*. Correlation and path coefficient analysis in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Prog Res. 2007;2(1/2):165-166.
9. Lush RL. Heritability of quantitative characters in farm animals. Hereditas (Suppl). 1949;35:365-387.
10. Mali MD. Genetic studies in F4 and F4 generations of muskmelon (*Cucumis melo* L.) [PhD thesis]. Rahuri (India): Mahatma Phule Krishi Vidyapeeth; 2015.
11. Munshi AD, Sirohi PS. Combining ability estimates in bottle gourd (*Lagenaria siceraria*). Veg Sci. 2005;21:132-136.
12. Narayan R, Singh SP, Sharma DK, Rastogi KB. Genetic variability and selection parameters in bottle gourd. Indian J Hortic. 1996;53(1):53-58.
13. Pandit MK, Mahato B, Sakar A. Genetic variability heritability and genetic advance for some fruit characters and yield in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Acta Hortic. 2009;809:221-223.
14. Patil PD. Genetic variability studies in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.) [MSc thesis]. Rahuri (India): Mahatma Phule Krishi Vidyapeeth; 2010.

15. Prasad R, Prasad A. A note on the heritability and genetic advance in bottle gourd (*Lagenaria siceraria* (Mol.) Standl.). Indian J Hortic. 1979;36(4):446-448.
16. Rakhi R, Rajamony L. Variability, heritability and genetic advance in landraces of melon (*Cucumis melo* L.). J Trop Agric. 2005;43(1-2):79-82.
17. Reddy BP, Begum H, Reddy MT. Variance component analysis of quantitative traits in muskmelon (*Cucumis melo* L.). Trakia J Sci. 2013;2:118-124.
18. Reddy LM. Variability, heritability and genetic advance in tomato (*Lycopersicon esculentum* Mill.). Andhra Agric J. 1989;36(2-3):123-124.
19. Sharma NK, Dhankhar BS, Tewatia AS. Correlation and path analysis in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]. Haryana J Hortic Sci. 1993;22(1):62-66.
20. Singh AK. Cytogenetics and evolution in the Cucurbitaceae. London: Cornell University; 1990. p. 10-28.
21. Singh KP, Choudhury DN, Mandal G, Saha BC. Genetic variability in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. J Interacademicia. 2008;12(2):159-163.
22. Singh KP, Panda PK, Singh AK. Variability, heritability and genetic advance in ash gourd (*Benincasa hispida*). Haryana J Hortic Sci. 2002;31(1-2):139-140.
23. Snedecor GW, Cochran WG. Statistical methods. 6th ed. Bombay: Oxford and IBH Publishing Co.; 1967.
24. Swiander JM, Ware GW, Maccollum JP. Vegetable crops. Danville (IL): Interstate Publishers; 1994. p. 323-340.
25. Torkadi SS, Musmade AM. Genetic variability studies in muskmelon (*Cucumis melo* L.). J Soils Crops. 2007;17(2):308-311.
26. Yadav JR, Yadav A, Srivastava JP, Mishra G, Parihar NS, Singh PB. Study on variability heritability and genetic advance in bottle gourd [*Lagenaria siceraria* (Molina) Standl.]. Prog Res. 2008;3(1):70-72.
27. Yadav YC, Kumar DS. Studies on genetic variability, correlation coefficient and path analysis in bottle gourd (*Lagenaria siceraria* (Molina) Standl.). Ann Hortic. 2012;5(1):80-89.