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Genetic Studies in F_4 Progenies of Bottle Gourd (*Lagenaria siceraria* (Molina) Standl.)

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A B S T R A C T

Genetic variability, genotypic and phenotypic coefficient of variation, Heritability, genetic advance and Correlation analysis were undertaken for thirteen characters of bottle gourd obtained from the cross Pusa Samridhi x DBG-5 in F_4 generation. High genotypic and phenotypic coefficient of variation and high heritability estimates associated with high values of genetic advance as a percent mean were observed for number of primary branches per vine, number of fruits per vine, yield per vine, average weight of fruit which indicated additive gene action for these characters, which could be improved by simple selection method. Yield per vine showed significant and high positive correlation both at phenotypic and the genotypic level in sex ratio, node at which first female flower appered, average length of fruit, fruit diameter at pedicel, fruit diameter at center, fruit diameter at stylar end and number of fruits per vine. It is suggested that characters viz., node at which first female flower appeared, average length of fruit, fruit diameter at pedicel, fruit diameter at center, fruit diameter at stylar end and number of fruits per vine should be given priority for selecting high yielding genotypes.

Introduction

Bottle gourd [*Lagenaria siceraria* (Molina) Standl.] is one of the most popular vegetables of the family cucurbitaceae, with a chromosome number 2n=22. It is a highly cross pollinated crop due to its monoecious and andromonecious nature (Swiander and Maccollum, 1994). Bottle gourd was originated in Africa (Singh, 1990) and from there by floating on the seas, it travelled to India, where it has evolved into numerous local varieties, and has spread to China, Indonesia and far to New Zealand.

As the area and production of bottle gourd is increasing fast, but the crop is still remained less explored on aspects of crop improvement by breeding methods. Thus, there is much need of cultivars with early fruiting, high yield, high female to male sex ratio, medium length cylindrical fruits, green color fruits,

presence of pubeascence, resistance to fruit fly, downy and powdery mildew, gummosis and fusarium wilt. Therefore, to introgress these horticultural traits, the F_4 progenies were assessed for variability, heritability, genetic advance and correlation for the utilization in crop improvement.

Materials and Methods

The experiment was laid out in a Randomized Block Design with three replication during summer 2014 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 F_4 progenies from cross Pusa samridhi x DBG-5 each having 20 plants along with their parents. Plants of each F_4 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 F_4 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), coefficient of variations following Burton and De Vane (1953) and heritability following (Lush, 1949). The correlation coefficient was estimated as suggested by Snedecor and Cochran, 1967).

Results and Discussion

Wide range were observed in the characters viz., length of vine was ranged from 7.45 to 10.48 m, number of primary branches per vine from 7.33 to 9.00, days required for appearance of first female flower from 52.33 to 57.33, sex ratio from 14.23 to 15.46, node at which first female flower appeared from 8.66 to 10.33, days required for first harvest of fruit from 60.69 to 71.33, number of fruits per vine from 16 to 25, yield per vine from 12.38 to 18.12 kg, average weight of fruit from 634.66 to 809.66 g, average length of fruit from 26.03 to 31.50 cm, fruit diameter at pedicel from 4.70 to 5.63 cm, Fruit diameter at center from 4.73 to 6.21 cm and fruit diameter at stylar end from 4.83 to 6.58 cm. Pandit *et al.,* (2009), Arvindkumar *et al.,* (2011), Yadav *et al.,* (2008) in bottle gourd also reported higher estimates for yield contributing traits.

Wide range of the genotypic co-efficient of variation (GCV), phenotypic coefficient of variation (PCV) and environmental co-efficient of variation (ECV) was observed for all characters in F_4 progenies. The characters Length of vine at last harvest (10.87 %, 14.42 % and 9.47 %), number of primary branches per vine (7.80 %, 11.20 % and 08.04 %), days required for appearance of first female flower (3.78%, 4.24% and 1.92%), Sex ratio (M:F) (11.00 %, 11.79 % and 4.26 %), node at which first female flower appeared (5.68 %, 9.01% and 7.00%), Days required for first harvest of fruit (3.12%, 4.02% and 2.54%), Average weight of fruit (11.20 %, 12.31 % and 5.11 %), average length of fruit (15.58%, 16.67% and 5.94%), Fruit diameter at pedicel (13.26%, 17.34% and 11.17%),Fruit diameter at center (14.95%, 17.58% and 9.24%), Fruit diameter at stylar end (12.44%, 15.97% and 10.02%), number of fruits per vine (23.25, 26.95 & 13.63), Yield per vine (16.81%, 20.92% and 12.45%) (Table 1) respectively were recorded.

The traits, Length of vine, Sex ratio (M:F), Average weight of fruit, Average length of fruit, Fruit diameter at pedicel, Fruit diameter

at center, Fruit diameter at stylar, Number of fruits per vine, Yield per vine recorded high values of genotypic and phenotypic coefficients of variations. Whereas, Number of primary branches per vine exhibited moderate values of genotypic and phenotypic coefficients of variation. Rest of traits such as days required for appearance of first female flower, Node at which first female flower appeared & days required for first harvest of fruit exhibited lower values of genotypic and phenotypic coefficients of variations. Characters which showed higher estimates of GCV and PCV will be fully exploited for improvement in further selection programme. These findings were in conformity with those of Reddy (1989), Munshi *et al.,* (2005), Yadav *et al.,* (2008), Singh *et al.,* (2008), Pandit *et al.,* (2009) and Patil (2010) in bottle gourd.

Table.1 Mean, range, GCV, PCV, ECV, heritability, genetic advance and percent mean of genetic advance of two parents and F_4 population of cross Pusa Samridhi x DBG-5

Sr. No.	Character	Mean	Range	GCV (%)	PCV (%)	ECV (%)	h^2 bs (%)	GA	GAM (%)
1.	Length of vine (m)	8.85	7.45-10.48	10.87	14.42	9.47	57	1.93	**21.80**
2.	Number of primary branches per vine	8.01	7.33-9.00	7.80	11.20	8.04	49	1.14	**14.23**
3.	Days required for appearance of first female flower	54.81	52.33-57.33	3.78	4.24	1.92	79	4.79	**8.74**
4.	Sex ratio (M:F)	15.04	14.23-15.46	11.00	11.79	4.26	87	1.52	**10.10**
5.	Node at which first female flower appeared	9.23	8.66-10.33	5.68	9.01	7.00	40	0.89	**9.64**
6.	Days required for first harvest of fruit	66.15	60.69-71.33	3.12	4.02	2.54	60	4.33	**6.46**
7.	Average weight of fruit (g)	721.91	634.66-809.66	11.20	12.31	5.11	83	200.56	**27.78**
8.	Average length of fruit (cm)	28.53	26.03-31.50	15.58	16.67	5.94	87	11.55	**40.48**
9.	Fruit diameter at pedicel (cm)	5.08	4.70-5.63	13.26	17.34	11.17	59	1.43	**28.14**
10.	Fruit diameter at center (cm)	5.55	4.73-6.21	14.95	17.58	9.24	72	1.89	**34.05**
11.	Fruit diameter at stylar end (cm)	5.77	4.83-6.58	12.44	15.97	10.02	61	1.48	**25.64**
12.	Number of fruits per vine	18.85	16.00-25.00	23.25	26.95	13.63	74	9.40	**49.86**
13.	**Yield per vine (kg)**	**14.34**	**12.38-18.12**	**16.81**	**20.92**	**12.45**	**65**	**4.93**	**34.37**

Table.2 Genotypic and Phenotypic Correlation co-efficient for yield and yield contributing characters in F_4 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**	0.683**	0.397	-0.499*	-0.378	0.651**	0.891**	**0.858****	-0.472*	-0.655*	-0.878**	-0.374	**-0.849****
		p	**1.000**	0.376	-0.328	-0.314	-0.104	0.155	0.625**	**0.670****	-0.311	-0.31	-0.503*	-0.447*	**-0.648****
2.	Number of primary branches per vine	**G**	-	**1.000**	-0.115	-0.512*	-0.3	0.671**	0.691**	**0.805****	-0.152	-0.36	-0.580**	-0.138	**-0.188**
		P		**1.000**	0.246	-0.597**	-0.143	0.346	0.576**	**0.467***	-0.285	-0.29	-0.484*	-0.487*	**-0.36**
3.	Days required for appearance of first female flower	**G**	-	-	**1.000**	0.141	0.211	0.545**	0.145	0.025	-0.086	-0.215	-0.224	-0.168	**-0.558****
		P			**1.000**	0.03	0.293	0.495*	-0.291	-0.345	0.322	0.426*	0.27	0.266	**0.498***
4.	Sex ratio (M:F)	**G**	-	-	-	**1.000**	0.878**	-0.553**	-0.817**	-0.706**	0.746**	0.886**	0.982**	0.935**	**0.498***
		P				**1.000**	0.542**	-0.486*	-0.658**	-0.554**	0.693**	0.649**	0.769**	0.783**	**0.527****
5.	Node at which first female flower appeared	**G**	-	-	-	-	**1.000**	-0.254	-0.47	-0.441	0.237	0.401*	0.670**	0.576**	**0.154**
		P					**1.000**	-0.194	-3080	-0.14	0.635**	0.602**	0.623**	0.579**	**0.540****
6.	Days required for first harvest of fruit	**G**	-	-	-	-	-	**1.000**	0.453*	0.379	-0.309	-0.547**	-0.594**	-0.492*	**-0.105**
		P						**1.000**	0.32	0.197	-0.218	-0.075	-0.285	-0.217	**-0.065**
7.	Average weight of fruit (g)	**G**	-	-	-	-	-	-	**1.000**	**0.964****	-0.630**	-0.865**	-0.910**	-0.935**	**-0.854****
		P							**1.000**	**0.907****	-0.673**	-0.584**	-0.808**	-0.738**	**-0.751****
8.	Average length of fruit (cm)	**G**	-	-	-	-	-	-	-	**1.000**	**0.416***	**0.694****	**0.910****	**0.686****	**0.734****
		P								**1.000**	0.399	0.335	**0.586****	**0.557****	**0.567****
9.	Fruit diameter at pedicel (cm)	**G**	-	-	-	-	-	-	-	-	**1.000**	0.924**	0.790**	0.944**	**0.678****
		P	-								**1.000**	0.940**	0.936**	0.854**	**0.835****
10.	Fruit diameter at center (cm)	**G**	-	-	-	-	-	-	-	-	-	**1.000**	0.968**	0.933**	**0.746****
		P	-									**1.000**	0.874**	0.828**	**0.786****
11.	Fruit diameter at stylar end (cm)	**G**	-	-		-	-	-	-	-	-	-	**1.000**	0.905**	**0.920****
		P	-										**1.000**	0.728**	**0.901****
12.	Number of fruits per vine	**G**	-	-	-	-	-	-	-	-	-	-	-	**1.000**	**1.110****
		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.

Significant differences among the F_4 progenies were observed for all traits. In general the phenotypic coefficient of variation (PCV) was slightly higher than the genotypic coefficient of variation (GCV) for all the characters in all the traits (Table 1), which indicates the presence of minor role of environment in the expression of these traits. Similar results were in agreement with the findings of Arvindkumar *et al.,* (2011), Yadav and Kumar (2012), in bottle gourd and Rakhi and Rajamony (2005), Torkadi and Musmade (2007), Mali (2015) in muskmelon.

In all plant growth characters, yield contributing and qualitative traits, wide range of variations was observed. Singh *et al.,* (2008), Pandit *et al.,* (2009) and Patil (2010) reported wide range of variation for all traits in F_4 generation of bottle gourd. Similarly, Rakhi and Rajamony (2005), Torkadi and Musmade (2007), Ibrahim (2012), Mishra *et al.,* (2012) and Reddy *et al.,* (2013) also reported wide range of variability for various characters in muskmelon.

Heritability (broad sense) was found high for most of the traits in F_4 progenies of cross Pusa Samridhi x DBG-5 from 40 to 87 percent, which indicates, that simple selection can improve these characters. Similar results were reported by Prasad and Prasad (1979), Arunkumar *et al.,* (2000), Kumar *et al.,* (2007) and Patil (2010) in bottle gourd.

The genetic advance ranged from 0.89 to 200.56. High estimates of heritability with high estimates of genetic advance as per cent of mean were recorded in characters like Average length of fruit (87 and 40.48 %), number of fruits per vine (74 and 49.86) it indicated that these characters were under the control of additive gene action and can be easily improved by simple selection method.

Whereas the high estimates of heritability with moderate estimates of genetic advance as per cent of mean was observed for average weight of fruit (83 and 27.78 %), fruit diameter at centre (72 and 34.05 %), fruit diameter at stylar end (61 and 25.64 %), yield per vine (65 and 34.37%) These finding are in agreement with Arvindkumar *et al.,* (2011) and Yadav and Kumar (2012) in bottle gourd and Ibrahim (2012), Reddy *et al.,* (2013), Mali (2015) in muskmelon.

The genotypic correlation was with higher magnitude than the phenotypic one for all traits thereby indicating predominant role of heritable factor (Table 2). The yield per vine exhibited significant and high positive correlation both at phenotypic and the genotypic level with the yield contributing characters such as sex ratio, average length of fruit, fruit diameter at pedicel, fruit diameter at center, fruit diameter at stylar end and number of fruits per vine. While, the characters like length of vine, and average weight of fruit were significantly and negatively correlated with yield per vine, which were helpful relationships. Most of these characters were also found to be positively associated among them in F_4 generation of cross Pusa Samridhi x DBG-5. These findings are in agreement with those reported by Sharma and Dhankar (1993), Badade *et al.,* (2001), Singh *et al.,* (2002), Kumar *et al.,* (2007) and Pandit *et al.,* (2009) in bottle gourd. Gupta *et al.,* (2015) reported that fruit yield per vine in bitter gourd had direct and indirect influence on total marketable fruit yield. Correlation of various characters with yield is useful and provides criteria for direct selection of component characters.

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