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STUDIES ON PCV, GCV, HERITABILITY AND GENETIC ADVANCE IN BOTTLE GOURD GENOTYPES FOR YIELD AND YIELD COMPONENTS

B. Deepthi*, P. Syam Sundar Reddy, A. Satyaraj Kumar and A. Ramanjaneya Reddy

College of Horticulture, Dr. YSR Horticultural University, Anantharajupeta, YSR -516 105 (A.P.) India.

Abstract

The present experiment was carried out in twenty three genotypes and one check variety of bottle gourd to study the genetic variability, heritability and potential for screening suitable genotypes for future improvement programmes. The genotypes exhibited significant differences for all the traits under study. A wide range of variability along with high estimates of PCV and GCV was observed for number of primary branches per vine, node at which first male flower appearance, number of fruits per vine, fruit weight (g), fruit length (cm), fruit diameter (cm), yield per vine (kg), total yield (t/ha), number of seeds per fruit and 100 seed weight (g) indicating high variability available in the germplasm for these characters for further improvement. High heritability coupled with high genetic advance as per cent of mean was observed for tendril length (cm), number of primary branches, days to first male flower appearance, node at first male appeared, number of fruits per vine, fruit weight (g), fruit length (cm), fruit diameter (cm), yield per vine (kg), total yield (t/ha), number of seeds and 100 seed weight (g) indicated these characters had additive gene effect and therefore, these are more reliable for effective selection.

Key words: Bottle gourd, genetic variability, phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV), heritability, genetic advance and selection.

Introduction

Bottle gourd or white flower gourd is one of the most popular cucurbits in India with diploid chromosome number, 2n=22 grown as rainy and summer season vegetable but it can't tolerate cold. It is a rich source of potassium, vitamin C, protein, sulphur, fat and phosphorous. It is good for people suffering from biliousness and indigestion (Thumburaj and Singh, 2003). It is a highly cross pollinated crop due to its monoecious and andromonecious nature (Swiander *et al.*, 1994) and has wide genetic diversity. It is originated in Africa (Singh, 1990) and from there by floating on the seas, it travelled to India. Bottle gourd in India has a tremendous potential for export and has created a huge demand in Gulf markets already. The basic problem in bottle gourd is low marketable yield due to misshapening of the fruits. Any stress factor during the crop growth could result in misshaped fruits. Apart from stress factors, genetic background could also be a factor determining the misshapening of the fruits. Parameters of genotypic and phenotypic coefficient of variation are (GCV and PCV) are useful in detecting the amount of variability present the available genotypes. Heritability and genetic advance helps in determining the influence of environment in expression of characters and the extent to which improvement is possible after selection (Robinson *et al.,* 1949). Crop improvement depends on the magnitude of genetic variability and the extent to which the desirable characters are heritable. High heritability is not enough to make efficient selection in segregating generation, unless the information is accompanied with substantial amount of genetic advance (Johnson *et al*., 1955). Therefore, an attempt was made in the present investigation to estimate the magnitude of genetic variability, heritability, genetic advance in twenty three bottle gourd genotypes.

Materials & Methods

The experimental material consisted of 23 bottle gourd genotypes (IC 249663, PSR 13300, PSR 13156, PSR

***Author for correspondence:** E-mail: bandaru.deepthi16@gmail.com

13290, RJR 27, PSR 13176, RJR 201, IC 446596, IC 249654, IC 249672, IC 249671, IC 249668, IC 446594, RJR 533, IC 249665, IC 249658, IC 249653, IC 446592, IC 249650, RJR 420, IC 249656, IC 256053 and NSJ 298) obtained from NBPGR, Hyderabad and one check variety (Pusa Naveen) which were sown in randomized block design with three replications during spring summer of 2012 at Horticultural College and Research Institute, Dr. Y.S.R. Horticultural University, Venkataramannagudem, Andhra Pradesh. Row to row and plant to plant spacings were maintained at 2m and 1m, respectively in 6m × 4m plot. Six plants were maintained in each plot for recording observations. Recommended cultural practices were adopted for proper growth and stand of crop. Observations on tendril length (cm), no. of primary branches per vine, total vine length (m), no. of nodes per vine, internodal length (cm), days to 1st male flower appearance, days to 1st female flower appearance, node at which 1st male flower appearance, node at which 1st female flower appearance, days to first fruit harvest, no. of fruits per vine, fruit weight (g), fruit length (cm), fruit diameter (cm), fruit yield per vine (kg), total yield (t/ha), no. of seeds per fruit and 100 seed weight (g) for each genotype were recorded from five randomly selected plants per replication. The analysis of variance was carried out as suggested by Panse and Sukhatme (1985). Genotypic and phenotypic coefficients of variations were calculated by the formula given by Burton and Devane (1953) and heritability and genetic advance as per the formula given by Johnson *et al.,* (1955) and Allard (1960) respectively.

Results and Duscussion

Morphological variability observed among fruits of selected bottle gourd genotypes was shown in Fig. 1. The analysis of variance for eighteen characters (table 1) revealed highly significant differences for all the characters indicating the existence of enormous amount of genetic variability for growth and yield attributes.The extent of variability present in the genotypes was measured in terms of range, coefficient of variation, genotypic coefficient of variation (GCV), phenotypic coefficient of variation (PCV), broad sense heritability and genetic advance (GA). The mean sum of square was highly significant for all traits, indicating the presence of wide variability in the genotypes. The mean performance of the different traits under in study in 24 bottle gourd genotypes are shown in table 2. The range of variation was high for the fruit weight followed by number of seeds per fruit, number of nodes per vine, days to 1st fruit harvest, days to 1st female flower appearance, days to first female flower appearance, node at which 1st female flower appearance, tendril length, fruit length, node at which 1st male flower appearance among the genotypes, indicating their suitability for a variability study. This would help in selecting the best genotypes from existing collection. A wide range of variations existing for various quantitative traits has also been reported in bottle gourd by various workers (Narayan *et al*., 1996; Singh *et al*., 2008; Pandit *et al*., 2009; Harika *et al*., 2012 and Emina *et al*., 2012).

Table 1: Analysis of variance for eighteen characters in bottle gourd genotypes.

Character	Mean sum of squares		
	Replications (2)	Genotypes (23)	Error (46)
Tendril length (cm)	7.13	57.98**	6.97
Nodes per vine	228.50	539.42**	170.28
Number of primary branches per vine	7.25	29.53**	4.37
Total vine length (m)	5.43	12.73**	3.71
Internodal length (cm)	0.70	3.84**	1.69
Days to 1st male flower appeared	43.68	565.31**	21.27
Days to 1st female flower appeared	4.12	260.99**	67.43
Node at 1st male flower appeared	17.05	223.39**	21.55
Node at 1st female flower appeared	73.18	305.45**	55.63
Days to first harvest	2.53	239.21**	61.85
Number of fruits per vine	5.03	10.75**	0.52
Fruit weight (g)	22004.58	499284.45**	20196.93
Fruit length (cm)	10.30	622.73**	20.92
Fruit diameter (cm)	0.11	42.25**	0.37
Yield per vine (kg)	6.99	36.40**	1.47
Total yield (t/ha)	43.71	227.50**	9.20
Number of seeds per fruit	454.52	53696.05**	1489.89
100 seed weight (g)	0.35	28.92**	0.31

** Significant at p = 0.01

The components of variance, coefficient of variation, heritability and genetic advance value for eighteen quantitative characters are presented in table 3 & Fig 3. The magnitude of phenotypic coefficient of variation (PCV) was significantly higher than the corresponding genotypic coefficient of variation (GCV) for all the characters under the study (Fig. 2) indicating a considerable influence of environment on their expression. Higher magnitude of PCV and GCV (> 20%),

Table 2: Mean performance of 24 genotypes for the characters under study in Bottle gourd.

S. No.	Geno-type	Tendril Length (cm)	Number of nodes per vine branches	Number of primary (m)	Total vine length (cm)	Inter-nodal length	Days to 1st male flower flower	Days to 1st Female flower	Node at 1st male flower	Node at 1st female harvest	Days to first fruit vine	Number of fruits per	Fruit weight (g)	Fruit length (cm)	Fruit diameter (cm) (kg)	Yield per vine	Total yield (t/ha) fruit	Number of seeds per (g)	100 seed weight
1	IC 249663	33.30	130.90	18.66	13.88	10.61	63.16	84.37	35.78	55.91	99.71	6.74	1821.39	16.18	17.10	12.26	30.66	445.53	16.67
2	PSR 13300	23.46	124.74	9.33	8.15	6.72	52.91	87.06	29.91	55.70	103.63	4.01	1575.37	39.78	7.21	6.33	15.82	164.76	6.73
3	PSR 13156	21.73	120.53	15.16	12.84	10.66	89.44	99.06	56.91	77.27	117.08	4.14	648.61	23.90	5.03	2.72	6.82	98.14	10.06
4	PSR 13290	28.80	122.15	15.00	9.98	7.65	55.75	86.78	31.75	63.03	103.63	4.55	1407.52	32.18	10.54	6.37	15.94	275.51	14.23
5	RJR 27	27.41	113.11	11.83	10.25	9.04	67.92	85.60	31.74	46.35	107.19	3.02	1375.51	42.35	6.83	4.05	10.14	271.65	10.70
6	PSR 13176	22.23	109.74	15.16	10.40	9.48	94.72	82.32	37.84	50.27	112.40	2.75	1410.45	50.63	6.83	3.88	9.70	289.07	11.20
7	RJR 201	28.30	96.43	15.83	8.17	7.92	56.61	82.16	26.39	47.44	100.13	5.84	392.29	17.63	9.11	2.28	5.72	124.55	7.03
8	IC 446596	19.03	79.72	8.16	7.69	9.62	50.18	67.78	24.66	41.84	75.42	10.44	197.55	13.75	6.28	2.09	5.22	155.84	6.53
9	IC 249654	22.26	126.18	9.66	10.40	8.25	70.53	92.54	34.33	50.06	111.25	6.10	1063.06	38.56	7.36	6.54	16.36	192.31	11.49
10	IC 249672	26.66	127.62	17.16	13.42	10.55	69.23	79.78	32.97	45.11	108.16	6.93	1656.50	15.85	16.66	11.56	28.91	306.79	16.02
11	IC 249671	36.44	144.73	20.50	16.36	11.34	66.86	80.91	27.50	40.74	102.49	9.13	1841.49	20.76	18.04	16.76	41.91	729.62	18.21
12	IC 249668	30.16	110.71	13.76	11.32	10.24	76.49	95.97	38.01	47.08	107.06	5.57	1412.85	29.82	8.40	7.89	19.72	182.82	10.63
13	IC 446594	24.56	113.45	11.66	10.91	9.58	73.20	86.58	44.27	54.20	105.76	5.11	1643.97	30.70	15.58	8.39	20.98	290.29	12.50
14	RJR 533	21.08	106.69	9.33	11.03	10.13	52.48	72.37	22.06	43.35	90.46	6.07	1180.81	34.19	7.69	7.21	18.02	227.29	14.25
15	IC 249665	28.73	126.19	12.16	13.05	10.35	57.91	90.22	25.87	53.61	106.94	3.56	1341.98	41.16	7.85	4.74	11.86	244.58	13.97
16	IC 249658	22.75	122.69	11.33	12.98	10.04	69.51	88.75	31.00	52.15	104.86	4.00	1375.49	44.94	6.84	5.49	13.73	278.39	9.78
17	IC 249653	24.50	109.44	10.50	9.12	8.53	93.05	96.90	44.36	44.46	111.33	3.36	1225.56	43.97	7.77	4.17	10.43	209.93	8.95
18	IC 446592	23.43	115.15	13.16	11.68	9.99	71.94	95.37	33.02	50.27	109.57	4.58	1605.92	48.56	7.41	7.30	18.26	207.66	13.95
19	IC 249650	21.50	120.92	13.16	12.54	10.47	59.00	82.93	29.86	42.90	104.72	3.73	1339.11	47.50	7.22	5.03	12.59	107.45	13.68
20	RJR 420	28.49	119.91	13.50	12.71	10.61	80.27	86.98	32.06	52.30	109.96	3.99	1395.95	62.30	6.52	5.55	13.88	233.49	10.94
21	IC 249656	23.40	116.27	13.33	10.71	9.23	58.93	89.17	29.70	63.57	111.46	4.37	1308.54	44.41	6.60	5.65	14.13	294.87	10.92
22	IC 256053	30.53	110.99	10.83	10.44	9.75	87.16	93.59	40.15	49.45	111.27	4.27	1116.76	17.88	10.76	4.78	11.96	105.50	11.71
23	NSJ 298	25.66	95.72	12.00	10.20	10.58	56.11	94.33	29.26	46.68	103.42	3.57	1536.45	62.97	7.05	5.48	13.71	114.48	12.89
24	Pusa Naveen	32.50	129.56	17.50	13.43	10.44	48.05	59.66	12.66	21.80	88.89	6.86	1705.53	47.28	8.50	11.67	29.19	334.16	16.07
	SEm ±	**1.52**	**7.53**	**1.20**	**1.11**	**0.75**	**2.66**	**4.74**	**2.68**	**4.30**	**4.54**	**0.41**	**82.05**	**2.64**	**0.35**	**0.70**	**1.75**	**22.28**	**0.32**
	CV (%)	**10.10**	**11.21**	**15.73**	**17.00**	**13.45**	**6.82**	**9.56**	**14.24**	**14.97**	**7.53**	**14.14**	**10.80**	**12.65**	**6.69**	**18.39**	**18.39**	**15.74**	**4.63**
	CD (P=0.05)	**4.33**	**21.44**	**3.43**	**3.16**	**2.14**	**7.57**	**13.49**	**7.63**	**12.25**	**12.92**	**1.18**	**233.57**	**7.51**	**1.00**	**1.99**	**4.98**	**63.43**	**0.91**

Table3: Components of variance, coefficient of variation, heritability, genetic advance and genetic advance as % of mean for different quantitative traits in bottle gourd.

Characters	Variance		Coefficient of variation (%)		Heritability h^2(%)	Genetic Advance	Genetic Advance as per cent of mean
	Phenotypic	Genotypic	PCV	GCV			
Tendril length (cm)	23.97	17.00	18.74	15.79	70.93	7.15	27.39
Number of nodes per vine	293.33	123.05	14.71	9.53	41.95	14.80	12.72
Number of primary branches per vine	12.76	8.39	26.89	21.80	65.72	4.84	36.42
Total vine length (m)	6.72	3.01	22.89	15.32	44.79	2.39	21.12
Internodal length (cm)	2.49	0.48	16.25	7.11	19.14	0.62	6.41
Days to 1st male flower appearance	202.61	181.35	21.07	19.93	89.50	26.24	38.85
Days to 1st female flower appearance	131.95	64.52	13.37	9.35	48.90	11.57	13.47
Node at which 1st male appearance	88.83	67.28	28.92	25.17	75.74	14.71	45.12
Node at which 1st female appearance	138.90	83.27	23.66	18.32	59.95	14.56	29.22
Days to 1st harvest	120.97	59.12	10.53	7.36	48.87	11.07	10.60
Number of fruits per vine	3.93	3.41	38.76	36.09	86.69	3.54	69.23
Fruit weight (g)	179892.77	159695.84	32.23	30.37	88.77	775.63	58.95
Fruit length (cm)	221.52	200.60	41.18	39.19	90.56	27.76	76.83
Fruit diameter (cm)	14.33	13.96	41.44	40.89	97.39	7.60	83.13
Yield per vine (kg)	13.12	11.64	54.90	51.73	88.77	6.62	100.40
Total yield (t/ha)	81.97	72.77	54.90	51.73	88.77	16.56	100.40
Number of seeds per fruit	18891.94	17402.05	56.06	53.80	92.11	260.81	106.37
100 seed weight (g)	9.85	9.54	26.05	25.63	96.83	6.26	51.95

respectively were recorded for number of primary branches per vine, node at which first male flower appearance, number of fruits per vine, fruit weight (g), fruit length (cm), fruit diameter (cm), yield per vine (kg), total yield (t/ha), number of seeds per fruit and 100 seed weight (g) indicating the existence of wide range of genetic variability in the germplasm for these traits. This also indicated broad genetic base, less environmental influence and these traits are under the control of additive genes and hence there is a good scope for the further improvement of these characters through selection. Husan *et al.,* (2011) and Islam *et al*., (2009) reported similar results in bottle gourd and bitter gourd respectively. Rest of the characters recorded moderate coefficient of variation. However, the differences between phenotypic and genotypic coefficient of variation were quite low. The characters studied were influenced by environment to lesser extent, thus the selection based on phenotypic performance will be reliable.

The genotypic coefficient of variation does not offer full scope to estimate the variation that is heritable or environmental and therefore, estimation of heritability becomes necessary. The magnitude of heritability ranged from 19.14 to 97.39. Heritability estimates were high (>60%) for tendril length (cm), number of primary branches per vine, days to first male flower appearance, node at which first male flower appearance, number of fruits per vine, fruit weight (g), fruit length (cm), fruit diameter (cm), yield per vine (kg), total yield (t/ha), number of seeds and 100 seed weight (g) which showed that selection in these characters would be effective. These findings were in accordance with Husan *et al.,* (2011) and Kumar *et al.,* (2007) in bottle gourd. Moderate heritability (30-60%) for no. of nodes per vine, total vine length, days to 1st female flower appearance and days to 1st fruit harvest suggested that the environmental effects constitute a major portion of the total phenotypic variation and hence, direct selection for these traits will be less effective.

The value of genetic advance as percentage of mean ranged from 6.41 to 106.37. The information on heritability alone may be misleading when used in combination with genetic gain, the utility of heritability estimate increases. In present study, high heritability coupled with high genetic gain as percentage of mean was observed for tendril length (cm), number of primary branches per vine, days to first male flower appearance, node at which first male flower appearance, number of fruits per vine, fruit weight (g), fruit length (cm), fruit diameter (cm), yield per vine (kg), total yield (t/ha), number of seeds and 100 seed weight (g) indicating that most likely the heritability is due to additive gene effects and thus the chances of fixing by selection will be more to improve such traits through pure line selection in the evaluated genotypes. Similar findings were recorded by Pandit *et al.*, (2009) and Yadav *et al*., (2012) in bottle gourd and Hossian *et al.*, (2011) cucumber.

Summary

Depending upon the genotypic and phenotypic coefficient of variation, heritability and genetic advance estimates, it could be predicted that improvement by direct selection was possible in bottle gourd for traits like number of primary branches, node at which 1st male flower appearance, no. of fruits per vine, fruit weight, fruit length, fruit diameter, yield per vine, no. of seeds per fruit and 100 seed weight. Based on the mean performance of genotypes, IC 249671, IC 249663 and IC 249672 can be recommended for cultivation in Coastal districts of A.P through selection.

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