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HORTICULTURE

Seasonal Variation and Genotypic Variability Studies on Bottle Gourd for Yield and it's Attributing Traits

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ABSTRACT

A field study on seasonal variability bottle gourd was conducted at Vegetable Research Farm, BAU, Sabour, Bhagalpur, Bihar, India during early winter season and early summer season, 2013 and summer season, 2014 to know the genetic variability, heritability and genetic advance for eleven yield and its contributing traits in nine bottle gourd genotypes. Highly significant treatment differences for all traits in the three environments *viz.*, E_1, E_2 and E_3 except for fruit circumference in E_2 and vine length in E_3, represent inherent genetic difference among the genotypes. The field condition revealed that PCV was higher than the GCV in all environments and pooled for most of traits. The moderate to high heritability in broad sense (51% – 80%) in the different environments and pooled coupled with high genetic advance in per cent of mean (23.11% – 30.72%) in all environments and pooled for number of fruits per vine, that indicates the preponderance of additive gene action and better scope for improvement of these characters would be effective through selection of genotype. The promising genotypes identified in order to merit of fruit yield per plant were Pusa Naveen and HZP-RC-1 for early maturity and high yielding in all environments and polled.

Highlights

- The genotypes, Pusa Naveen, HZP-RC-1, Rajendra Chamtakar and Pusa Shantusti can be used effectively as donor parent for hybridization programme in environment.
- Average fruit weight, fruit length, and number of fruits per vine in all environments and pooled, indicates High heritability in broad sense (moderate to high on the basis of different season) with genetic advance.

Keywords: Environment, GCV, PCV, genetic variability, heritability, genetic advance, gene action

Bottle gourd [*Lagenaria siceraria* (Molina) Standl.; 2n = 22] (Synonyms *L. vulgaris* Scr. *L. leucantha* (Duch) Rusby.) is a cultivated annual monoecious species, with high yield potential and adaptability to diverse climatic conditions. The centre of origin of bottle gourd is Africa and America according to Cutler and Whitaker (1961). This plant is probably indigenous to tropical Africa. Archeological evidence showed that the presence of bottle gourd in Peru was 12000 years old. India is considered as secondary centre of diversity of bottle gourd and exhibits a great range of variability with respect to its morphological traits, maturity period and fruit yield etc. It is also commonly grown in Ethiopia, Africa, Central America and other warmer regions of the world.

The freshly extracted juice of bottle gourd has a tremendous medicinal property that is used for excessive thirst due to severe diarrhea, diabetes and is used in the treatment of epilepsy, stomach acidity, indigestion, ulcers as well as other nervous diseases (Warrier *et al.*, 1995). In addition to this, the fiber portion helps in preventing constipation and other digestive disorders like flatulence and piles.

To improve the yield and other characters and information of their genetic variability of different traits is necessary for improvement. Genetic variability is a prerequisite for the meaningful selection of the genotypes for the trait of interest, and heritability in conjunction with expected genetic advance determines its success. To know the extent of variability present in a population, evaluation of large number of germplasm lines is the first line of work. High value of genotypic (GCV) and phenotypic (PCV) coefficients of variance indicates wider diversity. Similarly, narrow difference between GCV and PCV reveals low sensitivity to the seasonal effects. This is broad sense heritability and gives an idea about that portion of observed variability i.e. attributable to genetic differences. Heritability is a component in the computation of expected progress which is most meaningful when accompanied by genetic advance. Genetic advance would be more in cases where the additive genetic variance is more than non additive genetic variance (Lush, 1949).The objective of obtaining information regarding genetic variability, heritability and genetic advance for fruit yields with other morphologically important characters. Some basic and preliminary experiments indicates that there is a seasonal variation among the genotypes with respect to *per se* performance of yield and yield attributes (Muaurya, 1994 and Singh, 1998), which suggest season specific genotypes/varieties of bottle gourd should be identified to get better yield and remunerative net return throughout the year.

MATERIALS AND METHODS

The experiment was conducted at Vegetable Research Farm of the Department of Horticulture (Vegetable and Floriculture), Bihar Agricultural University, Sabour, Bhagalpur, Bihar, India. The nine diverse genotypes (Table 1) were sown in complete randomized block design with three replications. The crop was grown in channel and bed system (0.5m × 2.5m). The plant to plant spacing was given 50cm. Sowing of pre-soaked seeds was done on three consecutive environmental conditions, *viz*; early winter (E_1) – sown on 20th August, 2013 (Autumn winter); early summer (E_2) – sown on 09th November, 2013 (Spring summer) and summer season (E_3) – sown on 06th February, 2014 (*Zaid*). All the recommended agronomical practices and plant protection measures were adopted to raise a good crop. Observations were recorded for eleven diverse characters *viz.,* node number to anthesis of first staminate flower, node number to anthesis of first pistillate flower, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to first fruit harvest, vine length (m), fruit length (cm), fruit circumference (cm), number of fruit per vine, average fruit weight (kg) and fruit yield per vine (kg). The data were analyzed to estimate genotypic and phenotypic co-efficient of variations, heritability in broad sense (Burton and De Vane, 1953) and genetic advance in per cent of mean (Johnson *et al*., 1955). The data were analyzed using the software Statistical Package for Agricultural Research (SPAR)

RESULTS AND DISCUSION

Analysis of variance in different season

The mean sum of square were highly significant among the genotypes for all the characters in the three environments *viz.,*E_1, E_2 and E_3 except for fruit circumference (cm) in E_2 and vine length (m) in E_3 (Table 2).This indicated the presence of considerable amount of variation among the genotypes to carry

Table 1: Distinctive characteristic features of the nine genotypes of bottle gourd

Sl. No	Parental Line	Source	Specific traits
1	Rajendra Chamatkar	BAU, Sabour	Long fruit, prolific bearing and resistant to powdery mildew and insect
2	Pusa Santushti	IARI, Pusa (N. Delhi)	Pear shape, early fruiting
3	Pusa Naveen	IARI, Pusa (N. Delhi)	Perfectly cylindrical, blossom end scar pointed.
4	Narendra Dharidar	NDUAT, Faizabad	Perfectly cylindrical, white or green stripes on fruit.
5	SBBG-23	BAU, Sabour	Medium long, symmetrical straight light green, very slim
6	SBBG-31-1	BAU, Sabour	Cylindrical, pointed blossom end scar
7	SBBG-32	BAU, Sabour	Small ellipsoid shape, Late fruiting
8	SBBG-11	BAU, Sabour	Cylindrical and medium BES
9	HZP-RC-1	BAU, Sabour	Long, light green

Table 2: Analysis of variance (mean sum of square) for nine parents with eleven characters of bottle gourd in early winter (E_1), early summer (E_2) and summer (E_3) season

Sl. No.	Characters	Source of variation								
		Early winter (E_1)			Early summer (E_2)			Summer (E_3)		
		R	T	E	R	T	E	R	T	E
	d. f.	2	08	16	2	08	16	2	08	16
1	Node no. to anthesis of first staminate flower	0.13	4.21**	0.52	1.02	2.06**	0.49	0.37	1.93**	0.68
2	Node no. to anthesis of first pistillate flower	0.05	11.72**	0.57	1.93	9.58**	1.09	2.20	9.01**	0.63
3	Days to anthesis of first staminate flower	4.64	14.32*	2.51	8.86	120.87**	10.74	1.02	11.28**	1.22
4	Days to anthesis of first pistillate flower	8.64	22.02**	3.05	1.49	114.65**	12.09	0.89	7.012*	2.76
5	Days of first fruit harvest	1.12	14.51*	3.88	19.23	88.75**	12.24	0.25	16.94*	5.77
6	Vine length (m)	0.15	1.246**	0.12	0.02	0.55*	0.179	0.01	0.22	0.34
7	Fruit length (cm)	0.49	136.07**	1.51	1.17	188.60**	3.97	5.34	175.78**	4.68
8	Fruit circumference (cm)	0.91	5.44**	1.93	0.33	1.27	1.84	0.47	3.37*	1.44
9	Number of fruits per vine	0.23	2.06*	0.50	1.00	2.22**	0.39	0.18	3.65**	0.27
10	Average fruit weight (kg)	0.01	0.09**	0.01	0.01	0.06**	0.01	0.00	0.08**	0.00
11	Fruit yield per vine (kg)	0.46	1.62*	0.27	0.37	1.22**	0.28	0.54	1.74*	0.41

** &** Significant at 5% and 1 % level, respectively and Replication (R), Treatment (T) and Error (E)*

out further genetic analysis. Similar results were also reported by Pandit *et al*. (2009) and Mandal *et al*. (2015). The highest coefficient of variation (15.24 %) in E_1, (11.99 %) in E_2 and (11.26 %) in pooled was recorded for number of fruits/vine and other character like fruit yield per vine recorded high value (11.32 %) in E_1. Similar results were reported in case number of fruit per vine by Mandal *et al.* (2015).

Effect of season on growth and yield attributing traits

The overall mean for the node numbers to anthesis of first staminate flowers were 12.62, 7.96, 10.31 and 10.30 in E_1, E_2, E_3 and for pooled (P), respectively. The grand mean for this character was lowest in E_2 (7.96) and highest E_1 (12.62). Minimum node number to first pistillate flower among the genotypes was recorded in the entire environments in Pusa Naveen 7.97 and 11.07 in $E_2$and pooled, respectively followed by HZP-RC-1 10.40 in $E_3$and Narendra Dharidar 12.07 in E_1 (Table 3). The minimum days taken to anthesis of staminate flower were by genotypes Pusa Naveen (39.13, 43.87, 60.31 and 97.93 in E_1, P, E_3 and E_2 respectively). Minimum days to anthesis of first pistillate flower among the genotypes were recorded in Pusa Naveenin all the environments (41.30 days in E_2, 48.40 days in E_1 65.04 days in P and 105.43 days in E_2). Earliest genotype for days to first fruit harvest were Pusa Naveen in all seasons as well as pooled, *viz*., 55.67 days in E_1, 62.90 days in E_3, and 75.92 days in P and 109.20 days in E_2. Maximum vine length among the genotypes was recorded for HZP-RC-1 in E_2, SBBG-32 in E_1 and P; and SBBG-31-1 in E_3, while minimum for Pusa Naveen (4.94 m, 5.88 m and 6.84 m in E_1, E_2 and P, respectively) and also SBBG-23 (6.84 m) in E_3. Maximum fruit circumference among the genotypes was recorded for Narendra Dharidar (23.83 cm) in E_3, HZP-RC-1 (21.87 cm and 21.27 cm in E_1 and P, respectively), and Rajendra Chamatkar (20.53 cm) in E_2. The genotype HZP-RC-1 (3.70, 4.10, 4.30 and 5.10 in E_1, E_2, P and E_3, respectively) yielded the minimum number of fruits, whereas, the genotype Pusa Naveen (9.03, 7.45, 6.93 and 6.37 in E_3, P, E_2 and E_1, respectively) produced maximum number of fruits per plants. The average fruit weight ranged between 0.76 kg to 1.35 kg in E_1, 0.94 kg to 1.41 kg in E_2 and 0.99 kg to 1.55 kg in E_3 and 0.90 kg to 1.44 kg in P, with minimum average fruit weight produced genotype Pusa Naveen and maximum average fruit produced genotype HZP-RC-1.

The highest fruit yield was recorded in genotype Pusa Naveen in the entire environments as well as pooled. Very wide ranges of variation in mean performance of genotypes were observed for all the characters under study. The comparison of mean performance of nine genotypes in three seasons and pooled performance revealed existence of very high level of variability in the germplasm. The genotypes showing very high mean performance in desirable direction for various characters are listed in Table 2, which may also be used for donors for improving the characters for which they had high mean performance to similar statement of observation (Jain and Singh, 2016).

Variability for yield attributing traits in different seasons

The phenotypic coefficient of variance (PCV) was significantly higher than genotypic coefficient of variance (GCV) for node numbers to anthesis of first staminate flower, ranging from 10.16% to 12.65% for PCV and 6.24% to 9.09% for GCV, with moderate PCV and low GCV in all the environments and pooled. The phenotypic and genotypic coefficients of variance were quite close to each other for this character which reveals that the influence of the environment on this character is negligible and the role of the genotypic performance for the full expression of the phenotype. Quite nearer to each other for node number to anthesis of first pistillate flower ranged from 13.81% to 18.25% and 12.00% to 15.50% with moderate PCV and GCV respectively, in all over the environment and pooled in Table 3.

Similar results are previously reported by Kumar *et al*. (2011). The PCV and GCV were low for days to anthesis of first staminate flowers and ranged from 4.55% to 6.76% and 3.90% to 5.79% respectively, and were quite closer to each other, respectively in all the environments and pooled. Similar findings were observed by Singh and Kumar (2002) and Yadav *et al*. (2008) in bottle gourd. The PCV was higher than GCV in the entire environments studied and pooled the trait days to anthesis of first pistillate flower and ranged from 4.11% to 6.51% for PCV and, 2.40% to 5.35% for GCV, which were low for this attribute and was in conformity with conclusions of Narayan *et al*. (1996) and Yadav *et al*. (2008) in bottle gourd. PCV and GCV for days to first fruit harvest ranged from 4.51% to 5.34% and 2.94% to 4.39%, respectively which were quite close to each other in all the environments and pooled and low for this trait. Estimated PCV and GCV for vine length ranged from 7.58% to 12.53% and 2.17% to 10.86%, respectively in all the environments and pooled under grouped low to moderate.

Similar result was obtained by Singh *et al*. (2008) and Kumar *et al*. (2011) who reported that PCV was somewhat higher than GCV for this trait studied in bottle gourd. The variation among the genotypes in fruit length estimated in terms of PCV and GCV ranged from 15.86% to 17.47% and 15.25% to 16.93%, respectively and could be categorized as moderate in the all environments and pooled. For fruit circumference estimated low PCV and GCV in per cent ranged from 6.53 to 8.98 and 2.14 to 5.50, respectively. GCV and PCV for fruit length and fruit circumference were also observed by Emina *et al*. (2012), Sharma and Sengupta (2013), Murlidharan *et al*. (2014) and Mandal *et al*. (2015) in bottle gourd. The PCV and GCV for number of fruit per vine ranged from 18.54 percent to 21.85% (moderate to high) and 14.95% to 16.63% (moderate), respectively in all the environments and pooled as shown in Table 3. The estimated result for this trait indicates presence of high degree of genetic variability and direct selection was assumed to be effective. The present results were in accordance with the findings of Pandit *et al*. (2009) and Mandal *et al*. (2015) in bottle gourd. The results of PCV higher than GCV was obtained for average fruit weight and ranged from 13.64% to 19.69% and 12.45 to 17.80% respectively, were quite close to each other in all the environments and categorized as moderate. This trait indicated that variation among the genotypes was high and there was better scope for the improvement of these characters through selection. These findings are in agreement with Husna *et al*. (2011) and Emina *et al*. (2012) in bottle gourd. Moderate PCV and low to moderate GCV was estimated ranging from 12.44% to 18.45% and 9% to 14.56% respectively, for fruit yield per vine in all the environments and pooled as depicted in Table 3. The estimates of both GCV and PCV were high, respectively for this trait. Similar results were also reported by Kumar *et al* (2011), Husna *et al*. (2011) and Bhardwaj *et al*. (2013) in bottle gourd

Effects of season on heritability for yield attributing traits

Heritability in broad sense (h^2_{bs}) for node number to anthesis of node number to anthesis of first staminate flower ranged from 38% to 70%, grouped as moderate to high in the different environments, whereas highest estimates of heritability (>70 %)

Table 3: Estimates of range, grand mean, phenotypic, genotypic, environmental, coefficients of variation, heritability in broad (h^2_{bs}) sense and genetic advance in per cent of mean (GA) eleven characters in bottle gourd genotypes

Sl. No.	Component	Node no. to anthesis of first staminate flower 1				Node no. to anthesis of first pistillate flower 2				Days to anthesis of first staminate flower 3				Days to anthesis of first pistillate flower 4			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1	R. Chamatkar	12.60	7.40	9.90	9.97	16.53	10.40	13.47	13.47	43.87	98.93	46.05	62.95	45.53	107.03	49.00	67.19
2	P. Santushti	12.73	7.70	9.67	10.03	14.93	8.87	11.90	11.90	44.47	101.50	46.88	64.28	47.53	110.33	49.10	68.99
3	P. Naveen	11.80	7.07	11.27	10.04	13.60	7.97	11.63	11.07	39.13	97.93	43.87	60.31	41.30	105.43	48.40	65.04
4	N. Dharidar	11.13	7.73	9.33	9.40	12.07	12.33	11.60	12.00	45.07	101.77	47.05	64.63	49.13	121.70	51.57	74.13
5	SBBG-23	14.33	9.80	11.47	11.87	16.33	11.50	14.03	13.96	46.47	113.37	51.07	70.30	47.00	110.13	49.23	68.79
6	SBBG-32	14.53	8.57	11.23	11.44	16.77	13.37	15.27	15.13	46.27	111.87	48.28	68.80	48.37	111.53	49.53	69.81
7	SBBG-31-1	12.93	7.53	10.33	10.27	17.80	12.67	15.27	15.24	44.33	113.37	46.44	68.05	50.53	123.53	52.97	75.68
8	SBBG -11	12.07	8.30	9.73	10.03	14.13	9.97	12.07	12.06	45.73	103.40	47.17	65.44	48.33	111.00	49.30	69.54
9	HZP-RC-1	11.47	7.50	9.90	9.62	12.80	10.60	10.40	11.27	43.97	100.10	46.12	63.40	45.23	109.97	48.43	67.88
10	P.C.V. (%)	10.48	12.65	10.16	11.02	13.81	18.25	14.40	15.27	5.75	6.58	4.55	6.76	6.51	6.06	4.11	6.41
11	G.C.V. (%)	8.79	9.09	6.24	7.47	12.85	15.50	13.00	12.00	4.46	5.79	3.90	4.56	5.35	5.21	2.40	4.51
12	E.C.V. (%)	5.71	8.80	8.02	8.10	5.04	9.62	6.20	9.44	3.63	3.13	2.35	4.99	3.71	3.10	3.34	4.55
13	(h^2_{bs}) (%)	70.00	52.00	38.00	46.00	87.00	72.00	81.00	62.00	60.00	77.00	73.00	45.00	67.00	74.00	34.00	50.00
14	GA	15.18	13.46	7.90	10.44	24.65	27.14	24.18	19.42	7.11	10.49	6.88	6.32	9.06	9.22	2.88	6.55
15	GM	12.62	7.96	10.31	10.30	15.00	10.85	12.85	12.90	44.37	104.69	46.99	65.35	47.00	112.30	49.73	69.67
16	Lower range	11.13	7.07	9.33	9.40	12.07	7.97	10.40	11.07	39.13	97.93	43.87	60.31	41.30	105.43	48.40	65.04
17	Highest range	14.53	9.80	11.47	11.87	17.80	13.37	15.27	15.24	46.47	113.37	51.07	70.30	50.53	123.53	52.97	75.68
18	CV	5.71	8.80	8.02	8.10	5.04	9.62	6.20	9.44	3.63	3.13	2.35	4.99	3.71	3.10	3.34	4.55
19	S.Em±	0.42	0.40	0.48	0.28	0.44	0.60	0.46	0.41	0.93	1.89	0.64	1.09	1.01	2.01	0.96	1.06

(Cont...)

Sl. No.	Component	Days of first fruit harvest				Vine length(m)				Fruit length (cm)				Fruit circumference (cm)			
		5				6				7				8			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Polled	E_1	E_2	E_3	Polled	E_1	E_2	E_3	Polled
1	R. Chamatkar	59.80	112.27	62.93	78.33	5.25	6.02	7.17	6.15	40.10	40.87	46.33	42.43	21.00	20.53	20.93	20.82
2	P. Santushti	61.07	114.60	64.67	80.11	5.10	5.73	6.94	5.92	37.30	39.47	45.70	40.82	19.80	20.10	22.90	20.93
3	P. Naveen	55.67	109.20	62.90	75.92	4.94	5.84	6.84	5.88	36.87	38.07	39.07	38.00	17.67	18.53	20.97	19.06
4	N. Dharidar	62.40	119.00	65.37	82.26	5.18	6.33	7.15	6.22	37.80	40.50	42.60	40.30	18.80	19.00	23.83	20.54
5	SBBG-23	60.87	113.40	70.27	81.51	5.81	5.37	7.20	6.13	48.77	50.60	52.27	50.54	20.33	20.20	21.20	20.58
6	SBBG-32	62.10	115.20	67.17	81.49	7.05	5.61	7.60	6.75	50.80	53.30	56.73	53.61	20.07	19.60	22.27	20.64
7	SBBG-31-1	62.40	127.17	63.63	84.40	5.89	6.31	7.66	6.62	38.60	40.93	45.03	41.52	18.80	20.17	20.90	19.96
8	SBBG -11	61.43	115.07	65.57	80.69	5.51	6.12	7.36	6.33	40.30	53.70	55.30	49.77	18.33	19.63	22.43	20.13
9	HZP-RC-1	58.57	109.63	63.67	77.29	5.95	6.77	7.20	6.64	54.70	59.50	62.70	58.97	21.87	19.23	22.70	21.27
10	P.C.V. (%)	4.51	5.34	4.73	5.32	12.53	9.12	7.58	9.62	15.92	17.47	15.86	16.46	8.98	6.53	6.56	7.39
11	G.C.V. (%)	3.11	4.39	2.96	2.94	10.86	5.82	2.77	4.13	15.64	16.93	15.25	15.50	5.50	2.21	3.64	2.14
12	E.C.V. (%)	3.26	3.04	3.69	4.43	6.26	7.03	8.08	8.69	2.95	4.30	4.37	5.53	7.10	6.90	5.46	7.07
13	(h^2_{bs}) (%)	48.00	68.00	39.00	31.00	75.00	41.00	13.00	18.00	97.00	94.00	92.00	89.00	38.00	11.00	31.00	8.00
14	GA	4.43	7.43	3.82	3.50	19.38	7.64	2.09	3.66	31.66	33.81	30.20	30.08	6.95	1.54	4.15	1.28
15	GM	60.48	115.06	65.13	80.22	5.63	6.01	7.24	6.29	42.80	46.33	49.53	46.22	19.63	19.67	22.01	20.44
16	Lower range	55.67	109.20	62.90	75.92	4.94	5.37	6.84	5.88	36.87	38.07	39.07	38.00	17.67	18.53	20.90	19.06
17	Highest range	62.40	127.17	70.27	84.40	7.05	6.77	7.66	6.75	54.70	59.50	62.70	58.97	21.87	20.53	23.83	21.27
18	CV	3.26	3.04	3.69	4.43	6.26	7.03	8.08	8.69	2.95	4.30	4.37	5.53	7.10	6.90	5.46	7.07
19	S.Em±	1.14	2.02	1.39	1.19	0.20	0.24	0.34	0.18	0.72	1.15	1.25	0.85	0.80	0.78	0.69	0.48

(Cont...)

S. No.	Component	No. of fruit per vine				Average fruit weight (kg)				Fruit yield per vine (kg)			
		9				10				11			
		E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled	E_1	E_2	E_3	Pooled
1.	R. Chamatkar	5.27	5.73	5.90	5.63	0.90	1.09	1.31	1.10	5.11	5.85	7.75	6.24
2.	P. Santushti	4.79	5.77	6.73	5.76	0.89	0.99	1.15	1.01	4.68	5.76	7.76	6.07
3.	P. Naveen	6.37	6.93	9.06	7.45	0.76	0.94	0.99	0.90	5.58	6.51	8.95	7.01
4.	N. Dharidar	4.37	5.07	6.43	5.29	0.99	1.01	1.12	1.04	4.33	5.15	7.18	5.55
5.	SBBG-23	4.53	5.17	6.20	5.30	0.82	1.04	1.15	1.00	4.52	5.43	7.09	5.68
6.	SBBG-32	3.77	4.23	5.87	4.62	1.01	1.06	1.14	1.07	4.01	4.56	6.68	5.08
7.	SBBG-31-1	4.73	5.23	6.27	5.41	1.06	1.08	1.10	1.08	4.59	5.71	6.94	5.74
8.	SBBG -11	4.03	4.80	5.86	4.90	0.83	1.00	1.10	0.98	3.18	4.81	6.48	4.82
9.	HZP-RC-1	3.70	4.10	5.10	4.30	1.35	1.41	1.55	1.44	5.40	6.23	7.90	6.51
10.	P.C.V. (%)	21.85	19.16	18.54	19.75	19.69	13.64	14.17	15.72	18.45	13.84	12.44	14.49
11.	G.C.V. (%)	15.65	14.95	16.63	16.22	17.80	12.45	13.39	13.90	14.56	10.09	9.00	11.32
12.	E.C.V. (%)	15.24	11.99	8.21	11.26	8.40	5.58	4.63	7.34	11.32	9.48	8.59	9.06
13.	(h^2_{bs}) (%)	51.00	61.00	80.00	68.00	82.00	83.00	89.00	78.00	62.00	53.00	52.00	61.00
14.	GA	23.11	24.02	30.72	27.46	33.17	23.40	26.08	25.33	23.68	15.15	13.40	18.20
15.	GM	4.62	5.23	6.38	5.41	0.96	1.07	1.18	1.07	4.60	5.56	7.41	5.86
16.	Lower range	3.70	4.10	5.10	4.30	0.76	0.94	0.99	0.90	3.18	4.56	6.48	4.82
17.	Highest range	6.37	6.93	9.06	7.45	1.35	1.41	1.55	1.44	5.58	6.51	8.95	7.01
18.	CV	15.24	11.99	8.21	11.26	8.40	5.58	4.63	7.34	11.32	9.48	8.59	9.06
19.	S.Em±	0.41	0.36	0.30	0.20	0.05	0.03	0.03	0.03	0.30	0.30	0.37	0.18

Here, PCV = Phenotypic coefficient of variation, GCV = Genotypic coefficient of variation, ECV = Environmental coefficient of variation, h^2_{bs} = Heritability in broad sense, (GA) = Genetic Advance in percent of mean, GM= General mean and CV = Co-efficient of Variation, S.Em± = Standard Error.

were observed in season E_1 with moderate genetic advance per cent of mean (15.18) as represented in Table 3.

These results are in harmony with the findings of Kumar *et al.* (2007) in bottle gourd. The heritability in broad sense ranged from 62% to 87% high in over the environments; highest estimates of heritability (> 87 %) were observed in season E_1 with high genetic advance per cent of mean (24.65) in node number to anthesis of first pistillate flower. Also estimated of heritability of 82% and 72% respectively with genetic advance per cent of mean of 24.18 and 27.14 respectively in E_3 and E_2, respectively. High heritability in conjunction with genetic advance per cent of mean was observed for this trait which indicates the preponderance of additive gene action governing the inheritance of this character and offers the best possibility of improvement through simple selection procedures. These results are in accordance with the findings of Narayan *et al.* (1996), Emina *et al.* (2012) and Bhardwaj *et al.* (2013) in bottle gourd. Days to anthesis of first staminate and pistillate flower recorded moderate to high heritability in broad sense with low moderate genetic advance per cent of mean over the environment and pooled as depicted in Table 3.

The indicates the role of both additive and non additive gene action governing the inheritance of this trait and offers the best possibility of improvement through progeny selection or any modified selection procedures aiming to exploit the additive gene effects. These results are in accordance with the findings of Husna *et al.* (2014). Low to high heritability in broad sense ranging from 13% to 75% with low to moderate genetic advance in per cent of mean ranging from 2.09% to 19.38% was recorded for vine length in all the environments and pooled. Moderate genetic advance per cent of mean of the vine length was in accordance with the previous findings of Kumar *et al.* (2011) in bottle gourd and Fayeun *et al.* (2012) in pumpkin. Fruit length exhibited high heritability in broad sense ranging from 89% to 97% coupled with high genetic advance per cent of mean ranging from 30.08% to 33.81% in the all environments and pooled.

High heritability coupled with high genetic advance per cent of mean was observed for this trait which indicates the preponderance of additive gene action governing the inheritance of this character and offers the best possibility of improvement through simple selection procedures. These results are similar with the findings of Pandit *et al.* (2009) and Emina *et al.* (2012) in bottle gourd. High heritability coupled with high genetic advance as per cent of mean was observed for fruit circumference.

These results are in agreement with the findings of Kumar *et al.* (2011) in bottle gourd. The moderate to high heritability in broad sense ranging from 51% to 80% in the different environments and pooled coupled with high genetic advance per cent of mean ranging from 23.11% to 30.72% all the environments and pooled for number of fruit per vine as shown in Table 3.

This indicates the preponderance of additive gene action and better scope for improvement of these characters would be effective through selection of genotypes. These results are in accordance with the conclusions of Kumar *et al.* (2007) and Damor *et al.* (2016) in bottle gourd. The estimated heritability in broad sense was high (ranged from 78% to 89%) with high genetic advance per cent of mean (ranged from 23.40% to 33.17%) for the different environments and pooled for average fruit weight and offers the best possibility of improvement through simple selection. These results are in corroboration with the findings of Pandit *et al.* (2009), Emina *et al.* (2012) in bottle gourd and Dey *et al.* (2009) in bitter gourd. Heritability in broad sense ranged from 52% to 62%, that could be categorized as moderate to high and genetic advance in per cent of mean ranged from 13.40% to 23.68% (i.e., moderate to high) for fruit yield per vine in all the environments and pooled as represented in Table 3. These results are in accordance with the findings of Kumar *et al.* (2011) and Husna *et al.* (2011) in bottle gourd.

CONCLUSION

The highest average fruit weight, number of fruits per plant and fruit per vine were obtained in the E_3. In present study, the bottle gourd genotypes that showed desirable mean values in all the seasons as well as good pooled performance should be selected as base materials in breeding programme. High genotypic coefficients of variation, high heritability and high genetic gain was observed in traits like node number of pistillate flower in early winter season, average fruit weight, fruit length, and number of fruits per vine in all the environments and pooled performance direct selection was assumed to be effective for these traits. High heritability in broad sense (moderate to high on the basis of different season) were observed for days to anthesis of first staminate and pistillate flower, days to first fruit harvest, vine length and these traits should be selected on the basis of mean performance for desirable traits and coupled with heritability and genetic advance criteria. Traits like node number to anthesis of first staminate flower, fruit circumference and fruit yield per vine should be given due consideration in different season for bottle gourd improvement work as revealed from variability studies.

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