Vegetable Science (2017) 44 (2) : 132-134

Short Communication

Genetic architectural study for yield and yield contributing traits in diverse genotypes of bitter gourd (*Momordica charantia* L.)

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Received: July 2017 / Accepted: November 2017

Bitter gourd (*Momordica charantia* L., 2n=2x=22) is one of the major crop belonging to the cucurbitaceae family. It is well known for its high medicinal values, possessing antiviral, antioxidant, antihepatotoxic, antiulcerogenic and antimicrobial properties. Bitter gourd extracts traditionally used as vegetable insulin possess hypoglycemic, antioxidative and antidiabetic agents that are useful in the treatment of diabetes (Behera et al. 2010). The fruits contain two alkaloids viz., momordicin and cucurbitacin. Indian bitter gourd is classified into two botanical varieties based on fruit size, shape, colour, and surface texture: (1) *Momordica charantia* var. *charantia* has large fusiform fruits, which do not taper at both ends and possess numerous triangular tubercles giving the appearance of a "crocodile's back"; (2) *Momordica charantia* var. *muricata* (Wild), which develops small and round fruits with tubercles, more or less tapering at each end (Chakravarthy 1990). Genetic variability facilitates to establish the foundation for crop improvement. Genotypic and phenotypic coefficients of variation are useful in detecting the amount of variability present in the available genotypes whereas the study of variability, heritability and genetic advance in the germplasms will help to ascertain the real potential of the genotypes.

The present experiment was conducted at Vegetable Research Farm, Department of Horticulture, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (U.P.) during *Kharif* 2014. The experiment was laid out with 20 genotypes in Randomized Complete Block Design (RCBD) in three replications. The unit plot size was 5 m^2 (2.5 m × 2 m). The plants were planted on the ridges of the row with a spacing of 2 m between the rows and 0.5 m between the plants. The promising experimental materials (seeds) were collected from ICAR-Indian Institute of Vegetable Research, Varanasi and Bidhan Chandra Krishi Viswavidyalaya, Mohanpur. The observations for fifteen important characters viz., node number of first staminate flower appearance, node number of first pistillate flower appearance, days to anthesis of first staminate flower, days to anthesis of first pistillate flower, days to 50% flowering, days to first harvest, number of primary branches per plant, vine length (m), internodal length (cm), fruit length (cm), fruit circumference (cm), fruit diameter (cm), average fruit weight (g), number of fruits per plant and yield per plant (kg) were recorded on selected five plants excluding the border plants at both the extreme end in each row. The analysis of variance for different quantitative characters in bitter gourd was estimated as procedure for suggested by Panse and Sukhatme (1985). Genotypic and phenotypic coefficients of variation were estimated using the procedure suggested by Burton and De Vane (1953) and heritability in broad sense and genetic advance expressed in per cent of mean were calculated (Burton, 1952).

The analysis of variance for all the characters was found to be highly significant thus indicating significant differences among the genotypes for all fifteen traits under investigation. The mean performance of these genotypes was illustrated in Table 1. The range of variation was found to be highest for average fruit weight (23.67 - 63.39 g) followed by days to first harvest (61.17 - 81.53), days to 50% flowering (52.23 - 70.74), days to anthesis of first staminate flower (37.33 - 54.00), fruits per plant (10.44 - 25.31), days to anthesis of first pistillate flower (47.33 - 60.67), node number of first pistillate flower appearance (12.50 - 23.15), node number of first staminate flower appearance (7.58 - 16.31), fruit length (7.41), fruit circumference (7.98 - 13.56), number of primary branches per plant (6.63 - 10.49), internodal length (4.60 - 6.83), fruit diameter (2.98 - 4.76), vine length (1.76 - 3.09) and yield per plant (0.34 - 1.23). This is in accordance with the research by Akter et al.

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Table 1: Mean performance of 15 characters in 20 genotypes of bitter gourd

Character	Node number of first staminate flower appearance	Node number of first pistillate flower appearance	Days to anthesis of first staminate flower	Days to anthesis of first pistillate flower	Days to 50% flowering	Days to first harvest	Number of primary branches per plant	Vine length (m)	Internodal length (cm)	Fruit length (cm)	Fruit circumference (cm)	Fruit diameter (cm)	Average fruit weight (g)	Fruits per plant	Yield per plant (kg)
Jharli	10.50	17.35	41.00	50.33	59.42	66.42	7.67	2.45	5.65	12.50	12.06	3.75	52.11	18.46	1.00
Special Bolder Ucha	7.58	18.50	37.33	47.33	52.23	61.17	6.69	2.75	5.10	7.42	12.20	3.98	23.67	25.31	0.60
Meghna No. 2	13.45	19.83	40.67	49.33	60.04	66.51	9.64	2.92	6.09	10.76	12.92	4.76	46.63	18.28	1.23
Vikas	15.67	21.97	45.67	51.00	62.93	67.63	9.96	3.02	5.28	13.23	12.73	3.72	44.00	21.40	1.04
Improved Kathai	14.75	22.83	43.67	50.33	62.91	69.43	7.05	2.60	5.88	11.94	13.24	3.95	59.32	19.39	1.06
Arola - D	12.24	21.92	48.00	56.67	61.83	72.18	6.63	2.82	5.27	12.54	13.56	4.39	55.91	16.29	0.85
Dhanraj	15.01	23.15	50.67	57.33	67.04	79.34	7.25	1.97	4.94	11.88	12.24	4.26	35.15	19.89	0.73
NBR-Noble Katahi	13.58	22.93	50.33	58.33	69.38	71.86	7.86	2.75	5.78	11.91	13.01	3.73	53.21	21.88	1.03
Jaunpuri (Special)	14.79	20.84	52.00	59.00	69.40	75.87	10.00	2.64	6.18	16.04	12.97	3.95	63.39	14.70	0.85
Preethi	16.32	20.82	44.33	53.33	67.83	72.54	9.00	2.91	6.83	11.89	8.10	3.82	27.54	14.57	0.45
PF Uchia	9.08	17.44	53.67	60.33	70.67	76.19	10.49	2.84	5.36	12.90	9.51	2.98	28.79	16.37	0.47
Karola Gor	13.59	21.92	52.67	59.33	68.61	79.30	7.78	2.40	5.11	12.32	9.42	3.03	36.35	18.76	0.66
G.Uchia	9.83	19.71	50.33	60.67	69.90	80.50	10.45	2.94	6.20	13.61	11.85	3.59	42.51	18.86	0.96
IC-085608	11.40	19.72	52.00	58.33	68.47	73.70	7.83	2.35	5.15	10.85	8.97	3.35	33.80	12.89	0.47
IC-085609	12.14	20.39	53.67	60.67	70.74	81.53	10.30	2.57	4.85	10.30	9.72	3.34	34.95	15.29	0.63
IC-085610	8.33	14.12	52.67	58.00	67.70	75.65	9.40	1.96	4.97	10.11	9.54	3.69	24.49	12.39	0.65
IC-085611	11.50	17.00	54.00	57.67	65.52	79.18	9.33	2.25	5.90	9.96	7.98	3.72	36.20	13.42	0.45
IC-085612	8.63	12.50	45.33	51.33	58.58	73.85	7.33	1.76	4.61	9.88	12.27	3.57	30.50	10.44	0.34
IC-085613	11.37	15.42	48.33	54.67	62.74	72.97	9.15	2.60	5.61	15.85	10.13	3.20	43.98	13.32	0.64
IC-085615	13.33	18.83	45.33	51.33	62.28	69.84	10.17	3.09	6.08	11.59	8.25	3.33	37.09	12.17	0.54
Mean	12.15	19.36	48.08	55.27	64.91	73.28	8.70	2.58	5.54	11.88	11.03	3.71	40.48	16.70	0.73
C.V.	7.98	7.80	4.12	3.64	4.15	3.86	10.45	7.43	4.31	11.83	9.31	6.36	9.99	14.37	13.87
S.E.	21.12	11.73	18.55	13.77	10.08	10.86	6.63	11.39	17.07	6.05	10.64	10.67	24.87	7.70	18.73
C.D. 1%	0.56	0.87	1.15	1.16	1.56	1.64	0.52	0.11	0.14	0.81	0.59	0.14	2.33	1.39	0.06
Range Lowest	1.60	2.50	3.28	3.32	4.45	4.68	1.50	0.32	0.39	2.32	1.70	0.39	6.68	3.97	0.17
Range Highest	2.15	3.34	4.39	4.45	5.97	6.27	2.01	0.42	0.53	3.11	2.27	0.52	8.95	5.31	0.23

(2013) in pumpkin. Yield is the character of utmost importance which decides the commercial acceptability of the variety; hence, the trait deserves highest consideration in any crop improvement programme. The extent of variability present in bitter gourd genotypes was measured in terms of mean, range, phenotypic variance, phenotypic coefficient of variation (PCV), genotypic variance, genotypic coefficient of variation (GCV), heritability (broad sense), genetic advance (GA) and genetic advance as per cent of mean in Table 2. The PCV was higher than the GCV but the differences between phenotypic and genotypic coefficient of variation was less suggesting that influence of environment for the traits like days to anthesis of first staminate flower (0.82), anthesis of first pistillate flower (0.83), internodal length (0.89) was less. The disparity between phenotypic and genotypic coefficient of variation recorded for all characters were very less in the investigation, indicating that the characters were not much susceptible to environmental fluctuations. Similar results were reported in bitter gourd by Raja et al. (2007) and Singh et al. (2012). The highest phenotypic coefficient of variation was observed for yield per plant *i.e.,* 36.47 followed by average fruit weight (g), number of fruits per plant and number of first staminate flower appearance. The highest genotypic coefficient of variation was observed for yield per plant *i.e.*, 33.73 followed by average fruit weight (g), number of fruits per plant and number of first staminate flower appearance. The heritability measures of the fraction of the phenotypic variation caused by the action of the genes. In the present investigation, the magnitude of heritability ranged from 62.74% (fruit length) to average fruit weight (88.83%). High heritability is found in all the characters under study (> 60%). The estimate of genetic advance as per cent of mean showed a wide range from 12.64% (days to first harvest) to 64.26% (yield per plant). The other traits expressing high genetic advance as per cent of mean of are average fruit weight (g), node number of first staminate flower appearance, node number of first pistillate flower appearance, number of primary branches per plant, vine length (m), fruit length (cm), fruit circumference (cm), fruit diameter (cm) and number of fruits per plant. High heritability was accompanied with high genetic advance as per cent of mean for average fruit weight (88.83, 54.69), yield per plant (85.52, 64.26), node number of first staminate flower appearance (87.02, 39.70), node number of first pistillate flower appearance (78.14, 26.85), vine length (77.59, 25.09), number of fruits per plant (69.06, 36.75), number of primary branches per plant (65.25, 23.83) and fruit length (62.74, 25.04). High heritability

Table 2: Estimates of Mean, Range, Variability, Heritability and Genetic Advance as per cent of mean for 15 characters in 20 genotypes of bitter gourd

S. No.	Character	Range	General Mean	Phenotypic variance	Genotypic variance	Phenotypic coefficient of variation	Genotypic coefficient of variation	Heritability in broad sense (h^2b)	Genetic Advance as % of mean
1.	Node number of first staminate flower appearance	7.58 - 16.32	12.15	7.24	6.30	22.14	20.66	0.87	39.70
2.	Node number of first pistillate flower appearance	12.50 – 23.15	19.36	10.43	8.15	16.68	14.75	0.78	26.85
3.	Days to anthesis of first staminate flower	37.33 – 54.00	48.08	26.95	23.01	10.80	9.98	0.85	18.99
4.	Days to anthesis of first pistillate flower	47.33 – 60.67	55.27	21.96	17.22	8.34	7.51	0.81	13.92
5.	Days to 50% flowering	52.23 – 70.74	64.91	29.25	21.99	8.33	7.22	0.75	12.90
6.	Days to first harvest	61.17 – 81.53	73.28	34.37	26.35	8.00	7.01	0.77	12.64
7.	Number of primary branches per plant	6.63 – 10.49	8.70	2.38	1.55	17.73	14.32	0.65	23.83
8.	Vine length (m)	1.76 – 3.09	2.58	0.16	0.13	15.70	13.83	0.78	25.09
9.	Internodal length (cm)	4.61 – 6.83	5.54	0.36	0.31	10.86	9.97	0.84	18.86
10.	Fruit length (cm)	7.42-16.04	11.88	5.29	3.32	19.37	15.35	0.63	25.04
11.	Fruit circumference (cm)	7.98-13.56	11.03	4.44	3.39	19.10	16.68	0.76	30.00
12.	Fruit diameter (cm)	2.98-4.76	3.71	0.23	0.18	13.08	11.43	0.76	20.57
13.	Average fruit weight (g)	23.67-63.39	40.48	146.36	130.02	29.89	28.17	0.89	54.69
14.	Number of fruits per plant	10.44-25.31	16.70	18.62	12.86	25.83	21.47	0.69	36.75
15.	Yield per plant (kg)	0.34-1.23	0.73	0.07	0.06	36.47	33.73	0.86	64.26

coupled with good level of genetic advance for these characters indicate the effectiveness of selection for the improvement of these traits.

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