

Estimates of gene action in bitter gourd (*Momordica charantia*)

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Bitter gourd (*Momordica charantia* L.) is a member of the family cucurbitaceae. India is endowed with a wide range of diversity in this crop, so there is a vast opportunity for genetic improvement.

Development of high yielding varieties mainly depends upon genetically superior parents, coupled with suitable breeding methodology. To formulate any breeding method, it is imperative to have knowledge of gene action involved in inheritance of various traits. The success of selection mainly depends upon the extent of genetic variability present in it. In spite of wide range of diversity very little work has been undertaken to exploit this naturally endowed diversity. Hence, an attempt was made to investigate the gene action (inheritance pattern) of yield and attributing traits.

The present investigation was carried out at the Research Farm of Division of Vegetable Science, Indian Agricultural Research Institute, New Delhi, during spring-summer seasons of 2005-07. Nine previously established to be genetically diverse inbreds of bitter gourd namely, DBGy-201 (gynoecious line P_1), “Pusa Do Mausami”(P_2) and

“Pusa Vishesh”(P_3) (two cultivars of north India), “Priya”(P_6) and “Arka Harit”(P_9) (two cultivars of south India), PBIG-44-3(P_4), NDBT-12(P_5), DVBGTG-5-5(P_7) (three promising selections of north India) and Nakhara (P_8) (one popular land race of east India. Flowers were hand emasculated and pollinated to produce all possible combinations of F_1 hybrids without the reciprocals. The seeds of 36 F_1 hybrids and the nine parents (total of 45 genotypes) were sown in polythene bags (15 × 10 cm) under the polyhouse and transplanted in a randomized complete-block design in three replication at spacing of 2 m between channel and 45 cm between plants. All the recommended package of practice followed to raise a successful crop. Out of 10 plants 8 were marked for observation. Observation on individual plant basis was recorded on 11 quantitative characters. Gene action was studied by diallel method of numerical approach given by Hayman (1954).

The estimates of genetic components of variation and various statistical parameters for different characters have been presented in table 1. The genetic component of variation for node number to first female flower, the estimates of D , H_1 and H_2 were significant while F and h^2 were non-significant. The higher value of H_1 as compared to D indicated preponderance of non-additive gene action. The value of F was found to be positive and the value of E was non-significant. Mean degree of dominance (H_1/D)^{1/2} was more than unity (1.30) suggesting over-dominance. The proportion of genes with positive and negative effect ($H_2/4H_1$) in the parents was 0.22 (less than 0.25) denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was 1.49 and the number of group of gene which controlled character and exhibiting dominance (h^2/H_2) was 0.04. The narrow sense heritability was found to be low (0.42) confirming non-additive gene action for this character.

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Table 1: Estimates of genetic components of variation and various statistical parameters for different characters

Components	Node to first female flower appearance	Days to first harvest	Number of fruits per plant	Fruit length	Fruit diameter	Individual fruit weight	Vine length	Yield per plant
[D] Additive effect	12.40** ±1.45	115.07** ±16.31	16.52** ±5.82	9.19** ±0.52	0.62** ±0.06	301.35** ±45.45	3220.37** ±231.65	89216.96 ±12475.69
[H] Dominance effect								
H ₁	20.93** ±3.21	177.75** ±35.99	134.31** ±12.84	4.66** ±1.14	0.46** ±0.12	405.29** ±100.32	1702.63** ±511.30	1413988.36** ±275359.85
H ₂	18.64** ±2.76	154.04** ±30.94	72.43** ±11.04	3.87** ±0.98	0.33** ±0.11	276.18** ±86.24	1069.33* ±439.63	789957.04** ±236709.58
F	6.43 ±3.39	-15.76 ±38.04	-49.40** ±13.58	-0.58 ±1.21	0.16 ±0.13	271.18* ±106.03	571.00 ±540.40	-314482.88 ±291033.42
h ²	0.77 ±1.85	43.47* ±20.73	131.67** ±7.40	2.33** ±0.66	0.00 ±0.07	4.05 ±57.77	140.96 ±294.44	1124859.37** ±158574.19
E	0.52 ±0.46	8.97 ±5.16	0.99 ±1.84	0.17 ±0.16	0.02 ±0.02	3.29 ±14.37	39.93 ±75.25	9345.17 ±39451.60
(H ₁ /D) ^{1/2}	1.30	1.24	2.85	0.71	0.86	1.16	0.73	3.98
H ₂ /4H ₁	0.22	0.22	0.13	0.21	0.18	0.17	0.16	0.14
(4DH ₁) ^{1/2} +F/ (4DH ₁) ^{1/2} -F or KD/KR	1.49	0.89	0.13	0.91	1.35	2.27	1.27	-5.99
h ² /H ₂	0.04	0.28	1.81	0.60	0.02	0.01	0.13	1.42
Heritability (narrow sense)	42.82	33.40	8.08	60.90	61.82	67.17	71.37	4.80

*, **-Significant at 5% and 1% level of probability.

The result pertaining to days to first harvest the estimates of D, H₁, H₂ and h² were significant while F was non-significant. The higher value of H₁ as compared to D indicated preponderance of non-additive gene action. The value of F was found to be negative and the value of E was non-significant. Mean degree of dominance (H₁/D)^{1/2} was more than unity (1.24) suggesting over-dominance. The proportion of genes with positive and negative effect (H₂/4H₁) in the parents was 0.22 denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was 0.89 and the number of group of gene which controlled a characters and exhibiting dominance (h²/H₂) was 0.28. Non-additive gene action for this character was confirmed as the narrow sense heritability was found to be low (0.33).

The genetic component of variation for number of fruits per plant viz. D, H₁, H₂, h² and F were significant except environmental component (E). The higher value of H₁ as compared to D indicated preponderance of non-additive gene action. The value of F was found to be negative. Mean degree of dominance (H₁/D)^{1/2} was more than unity (2.58) suggesting over-dominance. The proportion of genes with positive and negative effect (H₂/4H₁) in the parents was 0.13 denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was 0.13 and the number of group of gene which controlled a characters and

exhibiting dominance (h²/H₂) was 1.81. Narrow sense heritability being very low (0.08) confirming non-additive gene action for this character.

The estimates of D, H₁, H₂ and h² were significant while F was non-significant for fruit length. The higher value of D as compared to H₁ indicated preponderance of additive gene action. The value of F was found to be negative and the value of E was non-significant. Mean degree of dominance (H₁/D)^{1/2} was less than unity (0.71) suggesting partial-dominance. The proportion of genes with positive and negative effect (H₂/4H₁) in the parents was 0.21 denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was 0.91 and the number of group of gene which controlled a characters and exhibiting dominance (h²/H₂) was 0.60. The narrow sense heritability was found to be high (0.60) confirming additive gene action for this character.

The genetic parameters like D, H₁ and H₂ were significant while F and h² were non-significant for fruit diameter. The higher value of D as compared to H₁ indicated preponderance of additive gene action. The value of F was found to be positive and the value of E was non-significant. Mean degree of dominance (H₁/D)^{1/2} was less than unity (0.86) suggesting partial-dominance. The proportion of genes with positive and negative effect (H₂/4H₁) in the parents was 0.18 denoting asymmetry at loci showing dominance. The proportion

of dominant and recessive alleles (KD/KR) was 1.35 and the number of group of gene which controlled a characters and exhibiting dominance (h^2/H_2) was 0.02. High value of narrow sense heritability (0.61) indicates that additive gene action play predominant role for inheritance of this character.

Result pertaining to individual fruit weight the estimates of D, H_1 , H_2 and F were significant while h^2 was non-significant. The higher value of H_1 as compared to D indicated preponderance of non-additive gene action. The value of F was found to be positive and the value of E was non-significant. Mean degree of dominance (H_1/D)^{1/2} was more than unity (1.16) suggesting over-dominance. The proportion of genes with positive and negative effect ($H_2/4H_1$) in the parents was 0.17 denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was 2.27 and the number of group of gene which controlled a characters and exhibiting dominance (h^2/H_2) was 0.01. The narrow sense heritability being high (0.67) indicates predominant role of additive genetic variance in controlling this trait.

For vine length, the estimates of D, H_1 and H_2 were significant while F and h^2 were non-significant. The higher value of D as compared to H_1 indicated preponderance of additive gene action. The value of F was found to be positive and the value of E was non significant. Mean degree of dominance (H_1/D)^{1/2} was less than unity (0.73) suggesting partial dominance. The proportion of genes with positive and negative effect ($H_2/4H_1$) in the parents was 0.13 (less than 0.25) denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was 1.27 and the number of group of gene which controlled a characters and exhibiting dominance (h^2/H_2) was 0.16. Additive gene action for this character was confirmed through high (0.71) narrow sense

heritability.

The genetical parameters like H_1 , H_2 and h^2 were significant while D and F were non-significant for total yield per plant. The higher value of H_1 as compared to D indicated preponderance of non-additive gene action. The value of F was found to be positive and the value of E was non-significant. Mean degree of dominance (H_1/D)^{1/2} was more than unity (3.98) suggesting over-dominance. The proportion of genes with positive and negative effect ($H_2/4H_1$) in the parents was 0.14 denoting asymmetry at loci showing dominance. The proportion of dominant and recessive alleles (KD/KR) was -5.59 and the number of group of gene which controlled a characters and exhibiting dominance (h^2/H_2) was 1.42. The narrow sense heritability was 0.04 which indicates non additive genetic control of this trait. These results on yield related characters were in consonance with the report of Sirohi and Choudahry (1977), Lawande and patil (1990) and Matoria and Khandelwal (1999).

The results of present study revealed overdominance and dominance gene action for all the yield related traits under study. The predominance of non-additive gene action and low to moderate narrow sense heritability for the characters studied suggest that heterosis breeding would be advantageous to get higher gain in bitter gourd.

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