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Genetic analysis in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.]

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ABSTRACT

The nature of gene action involved in the inheritance of fruit yield per plant and its components was studied in bottle gourd [*Lagenaria siceraria* (Mol.) Standl.] in a diallel set of 8 lines excluding reciprocals. The estimates of the components of variance indicated predominance of additive genetic effects for days to first male and female flower, node at which first male flower appeared, days to first fruit picking, number of fruits per plant, fruit length, days to last fruit picking and fruit yield per plant, indicating possibility of selection in later generations of the hybrid progenies. The dominant genetic variance was more important for node at which first female flower appeared, vine length and average fruit weight and could be exploited by developing the F_1 hybrids. Very high narrow sense heritability was observed in vine length, number of fruits per plant, fruit length and fruit yield per plant indicated that simple selection would be effective for these traits, while narrow sense heritability for days to first male and female flower indicated that recurrent selection would be fruitful for effective utilization of both type of gene actions.

Key words : Additive, dominance components, gene action, bottle gourd

Bottle gourd or white flowered gourd [*Lagenaria siceraria* (Mol.) Standl.] is an important tropical vegetable crop and found in all the households as a vegetable in India. Besides this, different people also use it in different ways. Being a cross-pollinated crop, a wide range of genetic variability is present in this crop for fruit characters and fruit yield. Very little work has been done on gene action of fruit yield and yield attributing characters. However, appropriate knowledge of gene action of yield and its characters are helpful to formulate an appropriate breeding procedure for achieving the objectives for the improvement of this crop. Hence, the present investigation was carried out to find out the gene action of different traits in bottle gourd.

MATERIALS AND METHODS

Eight diverse lines of bottle gourd *viz.*, ABG-1, Pusa Naveen, PBOG-90, NDBG(Round)-2, VR-2, NDBG-104, JBOGL-01-6 and Bhagirathi were crossed in 8 × 8 diallel fashion excluding reciprocal to obtain 28 F_1s. A total of 28 F_1 crosses along with 8 parental lines were planted in a randomized block design with three replications with 10 plants per plot. Each plot consisted 5.0 m long pair rows with row to row and plant to plant distance of 2.0 m and 1.0 m, respectively in spring summer season-2009. Recommended agronomic practices and plant protection measures were followed throughout the growth period. Observations were recorded from five plants for each plot on 12 quantitative characters *viz.*, days to first female flower, days to first male flower, node at which first female flower appeared, node at which first male flower appeared, vine length (m), days to first fruit picking, number of fruits per plant, fruit length (cm), fruit equatorial diameter (cm), average fruit weight (g), days to last fruit picking and fruit yield per plant. The diallel analysis was carried out as per the method given by Hayman (1954).

RESULTS AND DISCUSSION

The analysis of variance showed highly significant differences among the mean squares due to genotypes for all the nine characters studied indicating considerable genetic diversity among the parents and crosses.

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Table 1 Estimation of genetic components of variation for different characters in bottle gourd.

Components/ ratios	Days to first female flower	Days to first male flower	Node at which first female flower appeared	Node at which first male flower appeared	Vine length	Days to first fruit picking	Number of fruits per plant	Fruit length	Fruit equatorial diameter	Average fruit weight	Days to last fruit picking	Fruit yield per plant
D	20.82**	9.86**	1.41	1.68**	0.04**	45.42**	8.18**	38.33**	4.23**	3129.46**	63.80**	2.89**
	±2.64	±1.71	±0.94	±0.14	±0.05	±4.21	±0.98	±4.54	±1.08	±1048.49	±7.41	±0.48
H_1	13.33**	3.42	4.89*	1.58**	0.14**	14.69*	5.03*	31.53**	4.23	6091.90*	6.98	2.52*
	±6.05	±3.92	±2.17	±0.32	±0.05	±9.68	±2.26	±10.43	±2.48	±2410.31	±17.03	±1.14
H_2	14.60**	4.81	3.54	1.30**	0.10*	14.61*	4.22*	26.44**	3.67	5249.01*	8.58	2.12*
	±5.28	±3.41	±1.89	±0.28	±0.04	±8.42	±1.97	±9.08	±2.17	±2096.98	±14.82	±0.99
h^2	6.06	11.75*	-0.09	-0.001	0.06*	-2.37	0.42	22.29**	0.04	633.41	-2.50	0.31±
	±3.54	±2.29	±1.27	±0.19	±0.03	±5.65	±1.31	±6.09	±1.44	±1406.31	±9.92	0.65
F	6.91	1.36	1.45*	0.65	0.03	19.19	-3.22	-10.49	1.16	1524.79	-1.30	-0.51
	±6.22	±4.03	±2.23	±0.33	±0.05	±9.95	±2.32	±10.73	±2.55	±2477.47	±17.50	±1.17
E	6.92**	5.99**	0.28	0.11*	0.03**	8.69**	0.25±	0.74	0.11	311.03	16.58**	0.09
	±0.88	±0.57	±0.30	±0.05	±0.007	±1.40	0.33	±1.51	±0.35	±349.49	±2.47	±0.15
$(H_1/D)^{1/2}$	0.80	0.59	1.86	0.97	0.52	0.57	0.78	0.91	1.00	1.40	0.33	0.94
$H_2/4\ H_1$	0.27	0.35	0.18	0.21	0.18	0.25	0.21	0.21	0.22	0.21	0.31	0.21
K_D/K_R	1.52	1.27	1.76	1.50	1.15	2.18	0.60	0.74	1.32	1.42	0.94	0.83
h^2/H_2	0.42	2.44	-0.03	-0.00	0.62	-0.16	0.10	0.84	0.01	0.12	-0.29	0.15
Heritability (ns) %	37.40	33.10	36.20	59.90	80.60	51.60	82.50	78.60	63.90	43.00	62.90	75.30
B	1.71**	1.91**	7.76**	0.76	0.51	1.47**	2.24**	0.92	2.62**	2.25**	1.73**	2.35**
	±0.14	±0.11	±0.00	±0.48	±0.63	±0.19	±0.07	±0.39	±0.04	±0.07	±0.14	±0.06
t^2	0.78	0.87	7.71*	0.03	0.00	0.49	2.09	0.02	2.10	0.69	1.00	1.82

*,** significant at five and one per cent levels, respectively.

Additive (D) and dominance (H_1) components of gene action were significant for all the characters (Table 1) except for days to first male flower, fruit equatorial diameter, days to last fruit picking where only D was significant, while for node at which first female flower appeared only H has significant indicating the presence of additive and non-additive gene actions in the expression of different characters. The magnitude of D was higher than of H_1 for days to first female flower, days to first male flower, node at which first male flower appeared, days to first fruit picking, number of fruits per plant, fruit length, days to last fruit picking and fruit yield per plant. The presence of additive genes for these characters indicated the possibilities of fixing these characters by selection. Similar findings were also reported by Sharma *et al.*, (1983) for days to first male and female flower opening; Sirohi *et al.*, (1986) for days to first male and female flower opening, fruit length and fruit girth; Ghevaria *et al.*, (1995) for crop span, fruit length and fruit girth and Sit and Sirohi (2008) for fruit length in bottle gourd. The dominance component (H_1) was higher than the additive (D) for node at which first male flower appeared, vine length and average fruit weight.

The estimates of average degree of dominance $(H_1/D)^{1/2}$ were in the range of partial dominance for all the characters except for node at which first female flower appeared, fruit equatorial diameter and average fruit weight, indicating the importance of additive genetic system. Similar findings were reported by Sirohi *et al.*, (1986) for days to first male and female flower, fruit length, fruit girth; Ghevaria *et al.*, (1995) for crop span, length of fruit, girth of fruit and Singh *et al.*, (2003) for fruit length, number of fruits per plant, vine length and fruit yield per plant in bottle gourd. Complete dominance was observed for fruit equatorial diameter and over dominance was operating for nodes at which first female flower appeared and average fruit weight.

The estimates of genes with positive and negative effects in parents ($H_2/4H_1$) were not in the range of 0.23 to 0.27, indicating asymmetrical distribution of positive and negative genes in the parents for all the characters except for days to first female flower and days to first fruit picking which symmetrical distribution of positive and negative genes in the parents were noted. Similar findings were reported by Sirohi *et al.*, (1986) for vine length, days to first male and female flower, days to first harvest, fruit length, fruit girth, number of fruits per plant, fruit weight and total yield per plant; Ghevaria *et al.*, (1995) for crop span, fruit girth, number of fruits per plant and fruit yield per plant and Sit and Sirohi (2008) for vine length, days to first female flower opening, days to first fruit harvest, fruit length, fruit girth, number of fruits per plant and fruit weight.

The directional element of dominance (F) was non-significant for all the characters except for node at which first female flower appeared indicating the presence of ambidirectional dominance and alleles with increasing and decreasing effects appear to be dominant and recessive to the same extent.

The proportion of dominant and recessive genes in the parents (K_D/K_R) was more than unity for all the characters except for number of fruits per plant, fruit length, days to last fruit picking and fruit yield per plant, indicating asymmetry of gene distribution among the parents with excess of dominant genes in the parents. These were confirmed by the positive value of F for all the characters. This finding was in accordance with Sirohi *et al.*, (1986); Ghevaria *et al.*, (1995); Singh *et al.*, (2003) and Sit and Sirohi (2008) in bottle gourd.

The ratio of h^2/H_2 was revealed that either one or two gene groups which control the characters and exhibited dominance for all the characters except for node at which first female flower appeared, node at which first male flower appeared, days to first fruit picking and days to last fruit picking, whose values were negative which could not be estimated and interpreted properly.

The estimates of heritability in the narrow sense (Table 1) was quite high for vine length, number of fruits per plant, fruit length and fruit yield per plant; moderate for node at which first female flower appeared, node at which first male flower appeared, days to first fruit picking, fruit equatorial diameter, average fruit weight and days to last fruit picking and low for days to first male and female flower. Moderate to high heritability values were also reported by Sirohi *et al.*, (1986) and Sit and Sirohi (2008) for vine length, days to first male and female flower, days to first fruit harvest, fruit weight and total yield per plant; Ghevaria *et al.*, (1995) reported low narrow sense heritability for days to first picking, number of fruits per plant and yield per plant in bottle gourd. For vine length, number of fruits per plant, fruit length and fruit yield per plant, high heritability estimates coupled with preponderance of additive gene action was observed indicating that simple selection would be effective for improvement of these traits. Low heritability estimates for days to first female and male flower indicated that both additive and non-additive components were important in the inheritance of these traits. Therefore, recurrent selection would be fruitful for effective utilization of both type of gene actions, as it would select for

desirable alleles and at the same time it maintain sufficient heterozygosity for the exploitation of dominance gene action in the population.

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