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Short Communication

GENE ACTION OF ECONOMIC TRAITS IN BRINJAL (*SOLANUM MELONGENA* L.)

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Brinjal (*Solanum melongena* L.), known as eggplant, is an indigenous vegetable crop grown in an area of 0.51 m ha with low productivity of 17.73 t/ ha. A number of brinjal hybrids and cultivars are under cultivation throughout the country which differ based on yield, fruit quality (taste, seed to pulp ratio, shelf life, moisture content, blossom-end scar size, etc.) and consumers' preference (colour, shape, size and shining of fruit, spininess, calyx colour, etc.). Now fruit quality and consumer's preference are playing a major role in determining its market demand and rate also. The crop exhibits rich genetic diversity for various economic traits and has a great scope for improvement. Based on its rising demand especially of traits of consumers' preference, it is necessary to develop high yielding high quality cultivars/ hybrids of this crop. The gene actions among economic traits are the basis for initiating the effective breeding programme. Therefore, present study was conceived to generate information on genetic architecture of quantitative traits.

The experimental materials for the present study comprised of eight genetically diverse parents *viz.*, Pusa Purple Long, Green Long, BB-44, Gulabi Long, Manjary Gota, Black Beauty, Pusa Purple Round and Surati Ravaiya. The parents were transplanted during kharif 2005-06 and crossed in diallel fashion excluding reciprocals (partial diallel) to get appropriate amount of cross seeds. The seedlings of eight parents along with 28 crosses (36 genotypes) were raised and transplanted during kharif 2006-07 in a randomized block design with three replications having 21 plants in each plot.

The data were recorded for economic traits *viz.*, plant height at first flowering (cm), plant height at last picking (cm), number of primary branches per plant, number of secondary branches per plant, days to 50 % flowering, days to first fruit picking, fruit setting flowers (%), non-setting flowers (%), volume of fruit (ml), moisture content in fruit (%), length of fruit (cm), breadth of fruit (cm), seed to pulp ratio (%), number of marketable fruits per plant, number of unmarketable fruits per plant, yield of marketable fruits per plant (kg), yield of unmarketable fruits plant (kg), and average fruit weight (g). Analysis of variance, genetic components and related statistical parameters were calculated as per formulae of Hayman (1954 a, 1954 b).

Mean squares due to genotypes were highly significant for all the economic traits except plant height at first flowering indicating the presence of sufficient amount of variation among the genotypes for all the traits under study, which is prerequisite to initiate any breeding programme. Estimates of genetic components of variation (D, H_1, H_2, F, E and h^2) along with their standard errors (SE) and related statistical ratios were calculated (Table 1) to find the genetic architecture for various characters. Estimates of additive genetic variance (D) were significant for plant height at last picking, days to first fruit picking, fruit setting flowers, fruit volume, fruit length, fruit breadth, seed to pulp ratio, number of marketable fruits per plant, yield of marketable fruits per plant and average fruit weight. The negative sign of additive genetic variance (-D) for plant height at first flowering and number primary branches per plant indicates that environmental component of variance was more than parental variance for these two traits. Dominance geneic variance (H_1 and H_2) were significant for all traits under study except plant height at first flowering, days to 50 % flowering and moisture content in fruits. The significance of additive and dominance variance components suggests that both these gene actions are important in the expression of their characters. The

Table 1. Estimates of components of variation and other statistical parameters for eighteen traits in brinjal

Components of variation and related statistics	Plant height at first flowering	Plant height at last picking	No. of primary branches/ plant	No. of secondary branches/ plant	Days to 50 % flowering	Days to first fruit picking	Fruit setting flowers	Non-setting flowers	Volume of fruits (ml)
D	-1713.93	67.92*	-0.02	3.71	1.30	5.57*	78.45*	78.47	370.95*
	(2832.67)	(12.87)	(0.15)	(2.80)	(10.26)	(0.89)	(26.30)	(27009)	(43.27)
H_1	3509.66	157.08*	0.82*	17.81*	38.56	11.65*	574.41*	571.04*	419.11*
	(6511.90)	(29.60)	(0.35)	(6.43)	(23.5)	(2.05)	(60.46)	(62.29)	(99.46)
H_2	3985.42	133.53*	0.65*	14.48*	33.67	8.40*	536.57*	530.00*	316.31*
	(5665.35)	(25.75)	(0.30)	(5.60)	(20.52)	(1.78)	(52.60)	(54.19)	(86.53)
F	-2618.09	47.57	0.08	4.99	-1.52	0.90	59.12	62.99	208.00*
	(6693.34)	(30.42)	(0.36)	(6.61)	(24.2)	(2.11)	(62.14)	(64.02)	(102.23)
h^2	-81.34	415.48*	0.12	4.39	1.80	0.20	360.65*	368.63*	83.73
	(3799.42)	(17.27)	(0.20)	(3.75)	(13.7)	(1.20)	(35.28)	(36.34)	(58.03)
E	1737.88	19.59*	0.15*	2.24*	0.79	0.86*	4.43	4.41	13.11
	(3944.22)	(4.29)	(0.05)	(0.93)	(342)	(0.30)	(8.77)	(9.30)	(14.42)
$(H_1/D)^{1/2}$	1.43	1.52	6.40	2.19	5.44	1.45	2.71	2.70	1.06
$H_2/4H_1$	0.28	0.21	0.2	0.2	0.22	0.18	0.23	0.23	0.19
$(4DH_1)^{1/2}$ + F (4D $H_1)^{1/2}$-F or (KD/KR)	0.30	1.60	1.90	1.88	0.80	1.12	1.32	1.35	1.72
h^2/H_2	0.02	3.11	0.18	0.30	0.05	0.02	0.67	0.69	0.26
r	0.134	-0.67	-0.23	-0.24	0.183	28.20	12.83	12.98	58.46

Table contd.

Components of variation and related statistics	Moisture content in fruit	Length of fruit (cm)	Breadth of fruit (cm)	Seed to pulp ratio	No. of marketable fruits/ plant	No. of unmarketable fruits/ plant	Yield of marketable fruits/ plant (kg)	Yield of unmarketable fruits/ plant (kg)	Average fruit weight (g)
D	1.44	20.61*	3.82*	9.66*	133.73*	9.97	1.01*	0.04	3383.31*
	(3.30)	(0.51)	(0.10)	(1.47)	(17.36)	(10.38)	(0.13)	(0.06)	(417.47)
H_1	16.54	5.94*	0.84*	21.05*	149.82*	84.81*	1.91*	0.45*	2951.51*
	(12.19)	(1.18)	(0.22)	(3.39)	(39.90)	(23.86)	(0.26)	(0.14)	(959.71)
H_2	13.73	4.71*	0.57*	16.69*	105.95*	63.31*	1.16*	0.32*	2341.42*
	(10.61)	(1.02)	(0.19)	(2.95)	(34.73)	(20.76)	(0.17)	(0.13)	(834.95)
F	2.84	7.56*	0.36	8.67*	-15.05	9.93	0.86*	0.05	2588.91*
	(12.53)	(1.21)	(0.23)	(3.48)	(41.01)	(24.52)	(0.30)	(0.15)	(986.45)
h^2	1.86	1.43*	-0.03	-0.21	87.00*	58.43*	0.03	0.24*	444.22
	(7.11)	(0.69)	(0.13)	(1.98)	(23.28)	(13.92)	(0.04)	(0.08)	(559.95)
E	2.71	0.31	0.08*	0.49	3.15	1.56	0.03	0.01	19.82
	(1.77)	(0.17)	(0.03)	(0.49)	(5.79)	(3.46)	(0.04)	(0.02)	(139.16)
$(H_1/D)^{1/2}$	3.38	0.54	0.47	1.48	1.06	2.92	1.38	3.29	0.93
$H_2/4H_1$	0.21	0.20	0.17	0.20	0.18	0.19	0.15	0.18	0.20
$(4DH_1)^{1/2}$ + F(4D $H_1)^{1/2}$-F or (KD/KR)	1.82	2.04	1.22	1.87	0.90	1.41	1.90	1.40	2.39
h^2/H_2	0.13	0.30	0.05	-0.01	0.82	0.92	0.02	0.75	0.19
r	5.55	101.75	82.88	40.26	42.97	10.94	0.33	-0.34	0.25

* Significant at 5 % level
SE given in parenthesis.

measure of dominance effect (h^2) was significant for seven traits namely, plant height at last picking, fruit setting flowers, non-setting flowers, fruit length, number of marketable fruits per plant, number of unmarketable fruits per plant and yield of unmarketable fruits per plant.

H_1 was greater than D for all traits except fruit length, fruit breadth and average fruit weight. It is inferred that manifestation of 15 traits are mainly governed by dominant gene action and could be exploited through heterosis breeding, nevertheless fruit size and weight could be improved through hybridization followed by selection. Peter (1971), Chaudhary (1999), Chezhian *et al.* (2000), Chaudhary and Malhotra (2000) and Panda *et al.* (2005) reported higher amount of non-additive components than additive components for days to 50 per cent flowering, plant height, number of primary branches per plant, number of marketable fruits per plant and fruit yield per plant. The present results are also in agreement with the findings of aforementioned workers.

The mean degree of dominance $(H_1/D)^{1/2}$ was found to be over dominance (>1) for plant height at first flowering, plant height at last picking, number of primary branches per plant, number of secondary branches per plant, days to 50 % flowering, days to first fruit picking, fruit setting flowers, non-setting flowers, moisture content of fruits, seed to pulp ratio, number of unmarketable fruits per plant, yield of marketable fruits per plant and yield of unmarketable fruit per plant; whereas for fruit volume and number of marketable fruits per plant complete dominance (approximately 1) was recorded. Partial dominance (<1) was expressed for fruit length, fruit breadth and average fruit weight. It is evident from the above findings that 13 traits exhibited over dominance, two characters showed complete dominance and three traits expressed partial dominance. These results indicate the importance of non-additive and additive gene action both. Therefore, both types of gene actions should be taken into consideration while formulating breeding programme.

The estimate of F was non-significant for 13 traits and five traits (fruit volume, fruit length, seed to pulp ratio, yield of marketable fruits per plant and average fruit weight) showed significant value. Positive sign of F was expressed by 15 economic traits (plant height at last picking, number of primary branches per plant, number of secondary branches per plant, days to first fruit picking, fruit setting flowers, non-setting flowers, fruit volume, moisture content of fruit, fruit length, fruit breadth, seed to pulp ratio, number of unmarketable fruits per plant, yield of marketable fruits per plant, yield of unmarketable fruits per plant and average fruit weight) which indicates the presence of more dominant alleles in the parents, nevertheless more recessive alleles were present for plant height at first flowering, days to 50 % flowering and number of marketable fruits per plant. These findings are further confirmed by KD/KR ratio which shows proportion of total number of dominant and recessive genes in the parents. The ratio was more than unity (excess of dominant genes) for the traits having positive sign of F and less than unity (excess of recessive genes) for the traits showing negative sign for F value. It is, therefore, inferred that there is greater scopes for heterosis breeding for the traits having dominant genes and dominant alleles.

The estimate of H_2 was smaller than that of H_1 for all the characters except plant height at first flowering. The ratio of $H_2/4H_1$ was found close to 0.25 (the theoretical value) for fruit setting flowers and non-setting flowers which indicates symmetrical distribution of positive and negative alleles among the parents. Nevertheless, in majority of the traits the ratio was not quite close to 0.25 denoting slight asymmetric pattern in the distribution of positive and negative alleles at loci. The ratio of h^2/H_2 was greater than one only for plant height at last picking indicating that more than one dominant genes controlling the expression of aforementioned trait. It does not mean, however, that the characters showing ratio less than one do not have dominant genes. Such situation may arise by canceling out the effects of positive and negative genes. Often, this ratio under-estimates the number of genes and provides no valid interpretation about gene groups exhibiting dominance, for example, complementary gene interaction also depresses this ratio. Hence the number of gene groups recorded in this study for several attributes perhaps is lower than the actual number involved. Such low estimates of genes have also been reported by Lal *et al.* (1971). The coefficient of correlation (r) between the parental order of dominance and parental measurement was negative for four traits namely, plant height at last picking, number of primary branches per plant, number of secondary branches per plant and yield of unmarketable fruits per plant indicating the presence of dominant genes in parents.

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