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GENE ACTION FOR DETERMINING YIELD AND YIELD ATTRIBUTING TRAITS IN BRINJAL (*SOLANUM MELONGENA* L.)

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Abstract

The present investigation was carried out to evaluate the 30 F_1 hybrids derived from 6 x 5 full diallel fashion along with six parents in randomized block design with three replications during winter season at the Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram during 2017. The genetic components of variation were determined for fifteen characters *viz*., plant height, number of primary branches per plant, number of secondary branches per plant, number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per plant, number of flowers per plant, days to I[st] flowering, number of fruits per plant, fruit set percentage, shoot and fruit borer incidence, fruit length, fruit girth, fruit weight and fruit yield per plant. The genetic components $\hat{D}$, $\hat{H}_1$ and $\hat{H}_2$ were significant for plant height, number of secondary branches per plant, number of fruits per plant, shoot and fruit borer incidence, fruit weight and fruit yield per plant indicating the importance of both additive and dominant gene effects in regulating these traits. However, higher value of $\hat{H}_1$ and $\hat{H}_2$ compared to for all the characters except number of flowers per plant, fruit length and fruit girth, average degree of dominance $\left(\hat{H}/\hat{D}\right)^{1/2}$ and ratio of KD/KR for yield and other traits including quality parameters showed the preponderance of dominance genes and hence, suggested that hybrid breeding can be used efficiently to improve yield together with quality traits in brinjal.

Key words : *Solanum melongena*, gene action, yield parameters, diallel.

Introduction

Brinjal or eggplant a member of Solanaceae family is normally an often cross-pollinated annual. Varied forms, colours and shapes of brinjal are found throughout South and Southeast Asia.

In India, it is mainly grown for its immature, unripe fruits, which are used in various ways as cooked vegetable. It is popular among people of all social strata and hence, it is called as vegetable of masses (Patel and Sarnaik, 2004). Brinjal is considered to have originated in Indo-Myanmar region (Vavilo, 1928) as it posses marked diversity. According to Zeven and Zhukovsky (1975) it originated in India and have secondary center of variation in China. Most of the local varieties, which are grown by the farmers of India have not been fully utilized in any genetic improvement programme. The development of cultivars with improved fruit quality for better market value, through breeding has received relatively little attention in vegetables especially in brinjal. For the improvement in brinjal, one needs to elucidate the genetic nature and magnitude of quantitative inherited traits and estimate prepotency of parents in combinations. The information generated in the process can be used to understand the magnitude of heterosis. However, genetic control of different yield related as well as agronomic traits has been studied extensively (Chadha *et al*., 1990) in brinjal. Direct selection for quality traits in eggplant, same as in all other crops, will not be successful due to interaction of many genes with environment.

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Knowledge of the genetic controlling system of the character to be selected and genetic variation are the pre-requisite for viable breeding strategy. Therefore, the present study entitled Gene action for determining yield and yield attributing traits in brinjal is undertaken to understand the nature of gene effects involved in the expression of a character in interacting and non-interacting crosses. An assessment of these genetic parameters will allow for the development of efficient breeding strategies for brinjal cultivar improvement.

Materials and Methods

The experimental material for this investigation comprised of 6 genotypes *viz*., Thovalai local, Pechiparai local, Pechiparai- Mothiramalai local, IC 127063 and Annamalai brinjal which were selected based on their diversity for various traits and were crossed in all possible combinations excluding reciprocal to develop 30 F_1 using full diallel mating fashion. These 30 F_1 hybrids and six parents including commercial check comprised the material for gene action studies which were evaluated in randomized block design with three replications at the New vegetable area, Department of Horticulture, Faculty of Agriculture, Annamalai University, Chidambaram during February 2017.

The 35 days old seedlings of each cross and parents were transplanted in rows spaced at 60 cm with plant to plant spacing of 45 cm apart. All the recommended package and practices was followed to grow a successful crop. Observations were recorded on plant height (cm), number of primary branches per plant, number of secondary branches per plant, number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per pant, number of flowers per plant, days to Ist flowering, number of fruits per plant, fruit set percentage, shoot and fruit borer incidence, fruit length (cm), fruit girth (cm), fruit weight (g) and fruit yield per plant (g). The genetic components were derived from the mean values over replications. The data were analyzed as per the method given by Hayman (1954).

Results and Discussion

In the present investigation, the estimates of genetic components of variance (table 1) revealed that additive $(\hat{D})$ and dominance $(\hat{H}_1 \text{ and } \hat{H}_2)$ components were significant and positive for plant height, number of secondary branches per plant, number of fruits per plant, shoot and fruit borer incidence, fruit weight and fruit yield per plant, which indicated both additive and dominance gene action conditions in expression of these characters and was similar to the findings of Dhameliya and Dobariya (2009). Further, estimates of higher and significant dominance components of variance $(\hat{H}_1 \text{ and } \hat{H}_2)$ than additive genetic variance $(\hat{D})$ again confirmed the dominance gene action and dominant genes were also in favorable direction for expression of these characters except number of flowers per plant, fruit length and fruit girth.

Tha *et al*. (2006), Monpara and Kamani (2007) and Thangavel *et al*. (2011) also reported involvement of non-additive gene action in the inheritance of yield and yield related traits. However, number of long styled flowers per plant, number of short styled flowers per plant and fruit set percentage exhibited non-significant and low estimate of $(\hat{D})$ in comparison to $(\hat{H}_1 \text{ and } \hat{H}_2)$ confirmed the predominant effect of dominance gene action for expression of these characters. Simillar results was reported by Deshmukh *et al*. (2014) and Yadav *et al*. (2017).

Further, the estimates of additive genotypic variance $(\hat{D})$ was lower in magnitude than dominant components $(\hat{H}_1 \text{ and } \hat{H}_2)$ of genotypic variance for all the traits except number of flowers per plant, fruit length and fruit girth which showed preponderance of dominance effects in the expression of fruit yield and its attributes and governed by dominance type of gene action. Tha *et al*. (2006) Monpara and Kamani (2007) and Thangavel *et al*. (2011) also reported involvement of non-additive gene action in the inheritance of yield and yield related traits. The estimates of $(\hat{H}_1 \text{ and } \hat{H}_2)$ were unequal plant height, number of primary branches per plant, number of secondary branches per plant, number of flowers per plant, days to Ist flowering, shoot and fruit borer incidence, fruit length, fruit girth, fruit weight and fruit yield per plant indicating thereby unbalanced distribution of dominance and recessive alleles while most similar estimates of these two components showed balanced distribution of both dominant and recessive alleles in case of number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per plant, number of fruits per plant and fruit set percentage.

However, the positive and significant estimates of both $\hat{H}_1$ and $\hat{H}_2$ reflected the effects of dominance gene in favorable as well as positive direction for all the traits except number of medium styled flowers per plant, number of short styled flowers per plant, number of flowers per plant, fruit length and fruit girth under studied.

Table 1 : Estimates of genetic parameters for fifteen characters of brinjal.

S. no.	Characters	$\hat{D}$	$\hat{F}$	$\hat{H}_1$	$\hat{H}_2$	$\hat{h}_2$	$\hat{E}$
1.	Plant height	13.80±4.52*	10.82±11.04	47.92±11.48*	30.65±10.25*	54.67±6.90*	3.92±1.71*
2.	Number of primary branches per plant	0.10±0.03*	0.24±0.07*	0.21±0.07*	0.05±0.06	-0.04±0.04	0.12±0.01*
3.	Number of secondary branches per plant	1.63±0.22*	2.07±0.55*	2.16±0.57*	1.29±0.51*	0.23±0.34	0.04±0.08
4.	Number of long styled flowers per plant	0.73±1.22	-1.45±2.97	6.52±3.09*	6.92±2..76*	26.24±1.86*	2.51±0.46*
5.	Number of medium styled flowers per plant	2.83±0.91*	1.08±2.22	3.52±2.31	3.06±2.06	6.47±1.39*	1.52±0.34*
6.	Number of short styled flowers per plant	-0.98±1.01	-0.91±2.47	4.54±2.57	4.18±2.29	17.27±1.54*	1.66±0.38*
7.	Number of flowers per plant	10.61±3.15*	8.68±7.69	0.50±8.00	-0.90±7.14	7.24±4.81	8.58±1.19*
8.	Days to Ist flowering	11.96±2.35*	7.40±5.75	13.80±5.98*	9.42±5.34	4.03±3.59	1.13±0.89
9.	Number of fruits per plant	10.66±2.75*	0.75±6.71	44.93±6.97*	43.75±6.23*	133.53±4.19*	2.74±2.64
10.	Fruit set percentage	-1.31±2.15	-9.72±5.25	44.54±5.46*	43.88±4.87*	171.48±3.28*	6.76±0.81*
11.	Shoot and fruit borer incidence	32.67±14.80*	64.81±36.15	207.34±37.57*	143.70±33.56*	128.11±22.59*	4.18±5.59
12.	Fruit length	2.14±0.29*	-0.30±0.70	0.91±0.73	1.15±0.65	4.53±0.44*	0.66±0.11*
13.	Fruit girth	7.42±1.13*	0.92±2.77	5.24±2.87	4.62±2.57	2.89±1.73	0.10±0.43
14.	Fruit weight	61.27±14.55*	31.91±35.55	243.96±36.94*	224.75±33.00*	566.56±22.21*	7.24±5.50
15.	Fruit yield per plant	216.40±32.64*	518.60±80.08	984.40±83.13*	968.40±74.46*	2380.00±50.51*	196.85±12.24

*- Significant at 1 per cent.

The $\hat{F}$ value was positive for plant height, number of primary branches per plant, number of secondary branches per plant, number of medium styled flowers per plant, number of flowers per plant, days to Ist flowering, number of fruits per plant, shoot and fruit borer incidence, fruit girth, fruit weight and fruit yield per plant which showed that dominance alleles in parents. On the other hand, the negative estimates of $\hat{F}$ were observed for number of long styled flowers per plant, number of short styled flowers per plant, fruit set percentage and fruit length indicated that recessive alleles are more prevalent than dominant alleles.

Asymmetrical distribution of dominance and recessive genes in parents for various traits were observed by Tha *et al*. (2006), Monpara and Kamani (2007), Thangavel *et al*. (2011) and Deshmukh *et al*. (2014). Significant value of h^2 for plant height, number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per plant, number of fruits per plant, fruit set percentage, shoot and fruit borer incidence, fruit length, fruit weight and fruit yield per plant revealed the important effect of heterozygous loci in expression of these traits. The average degree of dominance $(H_1/D)^{1/2}$ involved in the action of genes was observed greater than unity for all the traits except number of short styled flowers per plant, number of flowers per plant, fruit set percentage, fruit length and fruit girth. This indicated that presence of over dominance for these traits and therefore, it is suggested that heterosis breeding might be advantageous for improvement of yield and its attributing traits in brinjal. These findings are in conformity with those of Kumar *et al*. (2011) and Deshmukh *et al*. (2014).

The $H_2/4H_1$ estimate was not equal to 0.25 for all traits except fruit set percentage and fruit yield per plant confirmed the asymmetrical distribution of dominance and recessive genes among parents as also observed in the estimate of $\hat{F}$.

This was in general accordance with the findings of Desmukh *et al*. (2014). The ratio of dominance and recessive alleles (KD/KR) *i.e.* $[(4DH1)^{1/2} + F/(4DH1)^{1/2} - F]$ was observed more than unity for plant height, number of primary branches per plant, number of secondary branches per plant, number of

Table 2 : Ratios of genetic parameters for sixteen characters of brinjal.

S. no.	Characters	$(H_1/D)^{1/2}$	$H_2/4H_1$	$\frac{(4DH_1)^{1/2}+F}{(4DH_1)^{1/2}-F}$	h^2/H_2	Heritability in narrow sense (per cent)
1.	Plant height	1.86	0.16	1.53	1.78	0.35
2.	Number of primary branches per plant	1.47	0.05	12.92	-0.91	0.03
3.	Number of secondary branches per plant	1.15	0.15	3.46	0.18	0.08
4.	Number of long styled flowers per plant	2.98	0.27	0.50	3.79	0.76
5.	Number of medium styled flowers per plant	1.12	0.22	1.41	2.11	0.37
6.	Number of short styled flowers per plant	-2.15	0.23	0.64	4.13	0.54
7.	Number of flowers per plant	0.22	-0.45	-3.27	-8.05	0.16
8.	Days to Ist flowering	1.07	0.17	1.81	0.43	0.31
9.	Number of fruits per plant	2.05	0.24	1.04	3.05	0.32
10.	Fruit set percentage	-5.84	0.25	0.22	3.91	0.78
11.	Shoot and fruit borer incidence	2.52	0.17	2.30	0.89	0.14
12.	Fruit length	0.65	0.32	0.80	3.92	1.01
13.	Fruit girth	0.84	0.22	1.16	0.63	0.63
14.	Fruit weight	2.00	0.23	1.30	2.52	0.22
15.	Fruit yield per plant	2.13	0.25	1.12	2.46	0.24

(KD/KR) = $[(4DH1)^{1/2} + F/ (4DH1)^{1/2} – F]$

medium styled flowers per plant, days to Ist flowering, number of fruits per plant, shoot and fruit borer incidence, fruit girth, fruit weight and fruit yield per plant showed the majority of dominant alleles and minority of recessive alleles among the parental strain for these characters. The higher of proportion of dominant genes observed for most of the characters are in agreement with the findings of Tha *et al*. (2006), Dhameliya and Dobariya (2009) and Deshmukh *et al*. (2014). The value of h^2/H_2 was less than unity for all the characters except plant height, number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per plant, number of fruits per plant, fruit set percentage, fruit length, fruit weight and fruit yield per plant reflected that one major gene group involved for most of the characters, which may be due to conceding effects of dominate genes with positive and negative effect, which nullify the effects of each other. These findings are in agreement with Tha *et al*. (2006) and Kumar *et al*. (2011) for fruit yield and fruit weight in brinjal.

In the present study, genetic components $\hat{D}$, $\hat{H}_1$ and $\hat{H}_2$ were significant for plant height, number of secondary branches per plant, number of fruits per plant, shoot and fruit borer incidence, fruit weight and fruit yield per plant indicating the importance of both additive and dominance gene effects in regulating these characters. However, higher estimate value of $\hat{H}_1$ and $\hat{H}_2$ compare to for all the traits except number of flowers per plant, fruit length and fruit girth showed that non-additive gene effect have a greater role than additive gene effects. The positive estimate of dominance components $(\hat{H}_1$ and $\hat{H}_2)$ also suggest that the dominance genes were in the favourable and positive direction for all the traits. The significance value of h^2 for plant height, number of long styled flowers per plant, number of medium styled flowers per plant, number of short styled flowers per plant, number of fruits per plant, fruit set percentage, shoot and fruit borer incidence, fruit length, fruit weight and fruit yield per plant showed the importance of heterozygous loci for dominance effect in the expression of all these traits. The average degree of dominance $(H_1/D)^{1/2}$ over all loci was more than unity for all the traits except number of short styled flowers per plant, number of flowers per plant, fruit set percentage, fruit length and fruit girth suggesting the prevalence of over dominance. The ratio of KD/KR was more than unity for all the traits except number of long styled flowers per plant, number of short styled flowers per plant, number of flowers per plant, fruit set percentage and fruit length signifying the excess of dominant genes than recessive among the parents. Therefore, the present study showed preponderance of dominance genes in the expression of yield and other traits suggesting that hybrid breeding can be used efficiently to improve yield together with quality traits in brinjal.

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