Vegetable Science (2020) 47 (1) : 124-126

Short Communication

Studies on gene action expression of yield and yield related traits of brinjal (*Solanum melongena* L.)

Saurabh Kasera*, S Saravanan, Vijay Bahadur and VM Prasad

Received: April 2020 / Accepted: July 2020

Brinjal (*Solanum melongena* L.) is one of the most important solanaceous vegetable crop of sub-tropics and tropics having diploid chromosome number 2n=2x=24. It is a versatile crop adapted to different agro-climatic regions and can be grown throughout the year. India is regarded as the primary centre of origin/diversity of brinjal (Bhaduri 1951 and Vavilov 1931). In India, brinjal occupies an area of 6.69 lakh hectare with estimated annual production of 12.4 million tonnes in 2016-17. In Uttar Pradesh, brinjal is being cultivated on an area of 7.83 thousand ha with annual production of 0.269 million tones (NHB 2016-17). Brinjal has Ayurvedic medicinal properties. It has also been recommended as an excellent remedy for liver complaints and diabetic patients (Tiwari et al. 2009). White brinjal is good for diabetic patients. Being rich in fiber, potassium, vitamin B-6 and phytonutrients like flavonoids, this vegetable lowers the risk of heart disease (Chauhan et al. 2017). Fruits are widely used in various culinary preparations *viz.,* sliced *bhaji*, stuffed curry, *bertha*, *chutni, vangibath, pickles* etc and are rich source of various nutrients (Hedges and Lister 2007). An analysis of the above figure indicates that the productivity of Brinjal is low in India. In Uttar Pradesh, the productivity is still lesser than the national average. The reasons attributed are, use of low yielding cultivars grown for local preferences. Highly varied consumer acceptance from region to region also demands for development of many high yielding F_1 hybrids. Direct selection for quality traits is not successful due to interaction of gene with environment. The knowledge of nature and magnitude of gene effects controlling inheritance related to productivity would add in the choice of efficient breeding methods and thus accelerate the pace of its genetic improvement and breaking the yield barriers. Considering the importance of such information, an experiment was conducted to understand the gene effects for various yield and related traits in brinjal.

Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Naini, Prayagraj-211007, UP
*Corresponding author, Email: saurabhkaseraag@gmail.com

Present investigation was conducted at Horticulture Experiment Station, Department of Horticulture, Sam Higginbottom University of Agriculture, Technology & Sciences, Prayagraj, (U.P.) during winter season 2017-18. The experiment site had sandy loam soil, low in organic carbon and slightly alkaline having pH=7.4. Crosses developed by crossing 10 lines of brinjal (Azad B-4, Green Long, DBR-31, Azad B-2, Punjab Shree, Utkal Anushri, Aruna, J.B.Round, VR-2 and Punjab Barsati) with 3 testers (Arka Nidhi, DBR-8 and Kashi Prakash) using line x tester mating design in the year 2016. 30 F1 along with their parents were evaluated in randomize block design. Eighteen plants were raised separately for each accession in 4m^2 plot at spacing of 60cm×60cm under three replications. The observations were recorded on thirteen quantitative and qualitative traits i.e. Plant height (cm), Number of primary branches per plant, Leaf length (cm), Leaf width (cm), Number of flowers per cluster, Days to 50% flowering, Fruit length (cm), Fruit circumference (cm), Number of fruits per plant, Average fruit weight (g), Yield per plot (kg), Ascorbic acid (%) and TSS (ÚBrix). The data was analyzed as per the method recommended by Kempthorne (1957).

The nature of gene action has been inferred from estimates of GCA and SCA variances. The estimates of variances due to gca (ä^{2}g) variance, sca (ä^{2}s) variance, average degree of dominance (ä^{2}s/(2ä^{2}g), predictability ratio (2ä^{2}g/2ä^{2}g + ä^{2}s), additive variance (ä^{2}A) and dominance variance (ä^{2}D) for 13 characters have been given in Table 1 and proportional contribution of lines, testers and their interaction are presented in Table 2. The value of table 1 depicted that the estimates of variance due to sca (ä^{2}s) were observed to be much higher than gca variance (ä^{2}g) for the yield traits i.e. avg. fruit weight and total yield per plot, environment indicating the greater importance of specific combining ability in the inheritance of these traits. While variance due to gca (ä^{2}g) were recorded maximum for the parameters like plant height, number of fruits per plant, days to 50% flowering, fruit circumference, fruit length, leaf length, leaf width, dry matter content, no. of primary branches per plant, number of flowers per cluster and TSS. This indicates that both testers and lines have more diversity for the respective traits. This might be attributed to the fact that statistically GCA variance is the additive portion of variability, but it also includes additive x additive and higher order of epistatic interactions (Matzinger and Kempthorne 1956). Hayman (1957) also pointed out that in the presence of SCA, GCA was a compound of dominance, or epitasis, or both, with additive genetic effects. These results are in accordance with Prasad et al. (2010), Choudhary and Didel (2014), Prakash (2008), Muthulakshmi (2007) and Suneetha (2006).

The estimates of average degree of dominance for various traits showed role of over dominance for all the characters. Higher magnitude of ä^{2}sca and ä^{2}D values, coupled with over dominance for the yield characters like avg. fruit weight and total yield per plot, indicated non-additive genetic components. On the contrary higher estimates of ä^{2}A than ä^{2}D for plant height, Leaf Length (cm), Leaf Width (cm), Days to 50% Flowering, number of fruits per plant, Avg. Fruit Weight (gm), Fruit Length (cm), Fruit Circumference (cm) and Dry Matter Content (%) revealed that additive genetic component played a substantial role in the expression of this character. Predominant role of additive genes in the expression of various quantitative characters in brinjal has also been reported by Saritha et al. (2005) and Ajith and Manju (2006). The investigation like Jadhav et al. (2001-2002), Khalil et al. (2004) and Patel et al. (2004) however, suggested the importance of both additive and non-additive genes in the expression of various characters. The perusal value of Table 2 revealed that the proportional contribution of testers in creating variations among the crosses were lower than the lines and l x t interaction for the characters viz. avg. fruit weight (gm), total yield/ plot (kg), leaf width (cm) and TSS (°Brix). The contribution of testers varied from 3.44 (TSS) to 58.33 per cent (Days to 50% Flowering). The proportional contribution of lines ranged from 30.46 (No. of fruits per plant) to 83.97 per cent (No. of primary branches/ plant), which was greater than that of lines x testers for all the traits. The per cent contribution of lines was observed more than 50 per cent for plant height, No. of primary branches/ plant, leaf width, avg. fruit weight, fruit length, total fruit yield per plot, dry matter content and TSS (°Brix). The per cent contribution of l x t interaction ranged from 4.78 (No. of primary branches/ plant) to 42.16 per cent (total fruit yield per plot), which was more than 30 per cent as well as much greater than that of avg. fruit weight and total fruit yield per plot. These results revealed the greater importance of fixable variability in the expression of most of the traits. This is also supported by the relatively greater importance/magnitude of sca variance than gca variance for most of the characters. These results are in

Table 2: Proportional contribution of lines, testers and their interaction in a set of line x tester crosses in brinjal

S. No.	Characters	Contribution (%)		
		Lines	Testers	Lines x Testers
1.	Days to 50% Flowering	35.33	58.33	6.34
2.	Plant Height (cm)	65.62	23.72	10.66
3.	No. of Primary Branches/ Plant	83.97	11.25	4.78
4.	Leaf Length (cm)	45.46	35.85	18.69
5.	Leaf Width (cm)	73.23	12.91	13.85
6.	No. of Flowers/ Clusters	40.46	48.16	11.39
7.	No. of Fruits Per Plant	30.46	53.13	16.41
8.	Avg. Fruit Weight (gm)	52.29	13.93	33.78
9.	Fruit Length (cm)	53.64	32.86	13.50
10.	Fruit Circumference (cm)	35.84	46.04	18.11
11.	Total Yield/ Plot (kg)	53.62	4.21	42.16
12.	Dry Matter Content %	51.43	37.45	11.11
13.	TSS (°Brix)	76.42	3.44	20.14

Table 1: Estimates of components of genetic variance for 13 characters in brinjal

S. No.	Characters	GCA variance ($\sigma^2 g$)	SCA variance ($\sigma^2 s$)	Average degree of dominance ($\sigma^2 s/2(\sigma^2 g)$)	Predictability Ratio ($2\delta^2 g/2\ \delta^2 g + \delta^2 s$)	$\sigma^2 A$	$\sigma^2 D$
1.	Days to 50% Flowering	12.60	-8.76	0.59	1.53	25.19	-8.76
2.	Plant Height (cm)	36.097	5.71	0.28	0.93	72.19	5.71
3.	No. of Primary Branches/ Plant	0.257	0.02	0.19	0.96	0.52	0.02
4.	Leaf Length (cm)	1.74	0.46	0.36	0.88	3.48	0.46
5.	Leaf Width (cm)	0.88	0.29	0.40	0.86	1.77	0.29
6.	No. of Flowers/ Clusters	0.23	0.03	0.26	0.93	0.46	0.03
7.	No. of Fruits Per Plant	10.58	3.54	0.40	0.86	21.16	3.54
8.	Avg. Fruit Weight (gm)	323.70	589.59	0.95	0.52	647.41	589.59
9.	Fruit Length (cm)	2.32	0.83	0.42	0.85	4.64	0.83
10.	Fruit Circumference (cm)	7.01	2.94	0.46	0.83	14.03	2.94
11.	Total Yield/ Plot (kg)	1.77	6.60	1.36	0.35	3.55	6.60
12.	Dry Matter Content %	0.89	0.13	0.26	0.93	1.79	0.13
13.	TSS (°Brix)	0.073	0.06	0.61	0.73	0.15	0.06

association with the finding of Pramila et al. (2018) and Mistry et al. (2016).

It is thus, evidenced that the genotypes under study have reached a plateau of performance with respect to majority of characters, as the variance due to non-additive gene action was very meagre in the expression of all characters except plant height, number of fruits per plant, avg. fruit weight, fruit circumference and total yield per plot. This implies that a hybridization programme must be resorted, to infuse more favourable genes and fully realize the level of performance of characters to boost further expression of ultimate end-products i.e. yield.

References

Ajith PM and Manju P (2006) Genetic variation for yield and anthracnose resistance in chilli (*Capsicum annum* L.). Indian J Genet 66(2): 161-162.

Bhaduri PN (1951) Inter-relationship of non-tuberiferous species of *Solanum* with some consideration on the origin of brinjal (*S. melongena* L.). The Indian J Genetics Plant Breed 11: 75-82.

Chauhan A, Chandel KS and Shiv Pratap (2017) Correlation studies in segregating population of brinjal (*Solanum melongena* L.) developed through bi-parental mating using bacterial wilt resistant varieties. Int J Curr Microbiol App Sci 6(8):1936-1943.

Choudhary S and Didel RP (2014) Combining ability analysis for growth and yield components in brinjal (*Solanum melongena* L.). Asian J Bio Sci 9(1): 88-92.

Hayman BI (1957) Interactions-heterosis and diallel crosses. Genetics 42:336-355.

Hedges LJ and Lister CE (2007) Nutritional attributes of spinach, silver beet and eggplant. Crop Food Res Confidential Rep No. 1928.

Jadhav MG, Burli AV, More SM and Gare BN (2001, 2002) Combining ability and gene action for quantitative characters in chilli. J Maharashtra Agri Uni 26(3): 252- 253.

Kempthorne D (1957) An introduction to genetic statistics. John Wiley & Sons, New York, pp 468-471.

Khalil RM, Ai FA, Metwally AM and Farag ST (2004) Breeding studies on pepper. Acta Horticulturae 637: 161-168.

Matzinger DF and Kempthorne 0 (1956) The modified diallel table with partial inbreeding and interactions with environment. Genetics 41: 822-833.

Mistry C, Keshubhai KB, Sabolu S, Kumar S (2016) Heritability and gene effect for yield related quantitative traits in eggplant. Annals Agric Sci 61(2): 237-246.

Muthulakshmi R (2007) Heterosis and LinexTester analysis of combining ability in brinjal (*S. melongena* L.). M.Sc. (Hort.) Thesis, Agricultural College and Research Institute, Madurai, Tamil Nadu.

NHB (2017) Horticultural statistics at a glance. Indian Horticulture Database. National Horticulture Board.

Patel JA, Patel MJ, Acharya RR, Bhanvadia AS and Bhalala MK (2004) Hybrid vigour, gene action and combining ability in chilli (*Capsium annum* L.) hybrids involving male sterile lines. Indian J Genet 64(1): 81-82.

Prakash T (2008) Heterosis and combining ability studies in brinjal (*Solanum melongena* L.). M.Sc. (Hort.) thesis, University of Agricultural Sciences, Dharwad, Karnataka.

Pramila, Kushwaha ML and Singh YP (2018) Gene action studies in brinjal (*Solanum melongena* L.) for yield and yield component. Int J Curr Microbiol App Sci (Special Issue) 7: 4627-4631.

Prasad V, Dwivedi VK, Deshpande AA and Singh BK (2010) Gene action of economic traits in brinjal (*Solanum melongena* L.). Vegetable Science 37 (1): 97-99.

Saritha JK, Kulkarni RS, Mohan Rao A and Manjunath A (2005) Genetic divergence as a function of combining ability in chilli (*Capsicum annum* L.). Indian J Genet Plant Breed 64(4): 331-322.

Suneetha Y (2006) Heterosis and association analysis for yield quality and physiological characters in late summer brinjal. J Res ANGRAU 34:18-24.

Tiwari A, Rajesh SJ, Piyush T and Nayak S (2009) Phytochemical investigations of crown of *Solanum melongena* (L.) fruit. Int J Phytomed 1:9-11.

Vavilov NI (1931) The role of central Asia in the origin of cultivated plants. Bulletin of Applied Botany Genetics and Plant Breeding 26(3): 3-44.