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Assessment of variability and heritability for quantitative and qualitative traits of brinjal

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Abstract
The present investigation was conducted to know the diversity among the F_1 hybrids developed through diallel mating design with the using 8 diverse parents for quantitative and qualitative traits. The study was conducted with the field evaluation of 28 F_1 hybrids and 8 parents during two consecutive years. The perusal of results indicated that the high genotypic coefficient of variation as well as phenotypic coefficient of variation recorded for fruit circumference, average fruit weight and number of fruits per plant, marketable yield, unmarketable yield and yield per plant during both the years. The present investigation indicated that the high heritability in narrow sense observed for fruit length and fruit circumference during both the years. Whereas, plant height and dry matter content were recorded high heritability in narrow sense during Y_1. The that high heritability (h^2ns) coupled with high genetic advance as per cent of mean were observed for fruit length and fruit circumference, indicating thereby that these traits were less influenced by environment and were mainly under control of additive genes.

Keywords: Heritability (narrow sense & broad sense), GCV, PCV, Brinjal

Introduction
Brinjal fruits are rich source of minerals like calcium, magnesium, potassium, iron, zinc and copper. It is also a fair source of fatty acids and it is used for medicinal purposes in curing diabetes, asthma, cholera, bronchitis and diarrhea. It is reported to stimulate the intrapeptic metabolism of blood cholesterol. Leaf and fruit, fresh or dry produce marked drop in blood cholesterol level. The de-cholestrolizing action is attributed to the presence of polyunsaturated fatty acids (lionleic and linolenic) which are present in flesh and seeds of the fruit in higher amount (65.1%). The presence of magnesium and potassium salts also helps in decholesterolizing action. Aqueous extracts of fruit inhibit choline esterase activity of human plasma. Dry fruit is reported to contain goitrogenic principles.
Looking to the increasing population, it is clear that we are not meeting the demand at present. So eggplant welcomes breeders for improvement for the reasons cited above. There are specific genotypes suited for specific preparations apart from the large genetic variation observed with regard to colour, shape and size of fruits. In addition, variation is also noticed for characters like vegetative growth, maturity and presence or absence of spines on leaves, stem and fruit calyx among the indigenous material. To have such kind of plant profile, we have to have some different breeding methods. One of such method is exploitation of hybrid vigour through hybridization. Bailey and Munson (1892) [1] reported artificial hybridization in brinjal for the first time. However, none of the hybrids exhibited any heterosis. Nagai and Kida (1926) [10] were probably the first to observe hybrid vigour, hoping some commercial acceptance in crosses among some Japanese varieties. Since then many public and private sectors have developed various hybrids in India, but these hybrids lacked regional preferences for colour, shape and presence or absence of spines and lacked suitability to specific product preparations.
Heritability estimates along with genetic advance are normally more helpful in predicting the gain under selection than heritability estimates alone. However, it is not necessary that a character showing high heritability will also exhibit high genetic advance (Johnson *et al.*, 1955) [6].

Materials and methods
The experimental materials for the present study comprised of eight promising and diverse pure lines/varieties of brinjal selected on the basis of genetic variability from the germplasm stock maintained in the Department of Vegetable Science, A.N.D. University of Agriculture & Technology, Kumarganj, Ayodhya (U.P.) India. The selected parental lines *i.e.* NDB-S-1 (P_1), Pb. Sadabahar (P_2), NDB-2 (P_3), NDB-3 (P_4), Narendra Ujala (P_5), Pant Rituraj (P_6), NDB-S-2

(P_7) and NDB-S-3 (P_8) were crossed in the all possible combinations, excluding reciprocal during *Kharif*, 2017 to get 28 F_1.
The experiments were conducted in a Randomized Complete Block Design (RBD) with three replications to assess the performance of 28 F_1 hybrids and their 8 parental lines.
Observations on all the quantitative characters, except length of edible fruit and fruit circumference were made on five randomly selected plant of genotype/crosses separately in each replications. The observation on quantitative traits were done on visual basis for every genotype/crosses.

Results and Discussion

The perusal of results indicated that the high genotypic coefficient of variation as well as phenotypic coefficient of variation recorded for fruit circumference, average fruit weight, number of fruits per plant, marketable yield, unmarketable yield and yield per plant during both the years and fruit length in Y_1. On other hand moderate estimates of phenotypic and genotypic coefficient of variation recorded for plant height, primary branches per plant and total soluble solids during both the years.
The knowledge of heritability of a character is important to the breeder since it indicates the possibility and extent to which improvement is possible through selection (Robinson *et al.*, 1949) [14]. Heritability, which denotes the proportion of additive genetic variance to the total variability, is a measure of genetic relationship between parents and progeny and has been widely used in determining the degree to which character may be transmitted from parent to offspring. Singh *et al.* (2005) [16] pointed out that the heritability in combination with intensity of selection and amount of variability present in the population influences the gains to be obtained from selection. Since the genetic gain is yet another important selection parameter which is although dependent and represents the expected genetic gain under selection. It measures the differences between the mean genotypic values of the selected lines and mean genotypic value of base population from which these lines were selected. Thus, it is necessary to utilize the heritability in conjunction with selection differential, which would indicate the expected genetic gain. The estimate of heritability with genetic advance as per cent of mean provides a better picture to the breeders during the process of selection.
The present investigation indicated that the high heritability in narrow sense observed for fruit length and fruit circumference during both the years. Whereas, plant height and dry matter content were recorded high heritability in narrow sense during Y_1. The moderate estimates of narrow sense heritability were observed for average fruit weight and number of fruits per plant during both the years while, plant height, dry matter content and unmarketable fruit yield in Y_2. The remaining traits showed low estimates of heritability in narrow sense.
Heritability in broad sense, high estimates were calculated for days to first fruit harvest, fruit length, fruit circumference, average fruit weight, plant height, primary branches per plant, marketable yield, unmarketable yield, dry matter content, total soluble solids and yield per plant during both the years.
The findings of the present investigation revealed that high heritability (h^2ns) coupled with high genetic advance as per cent of mean were observed for fruit length and fruit circumference, indicating thereby that these traits were less influenced by environment and were mainly under control of additive genes. This suggested that these characters could be improved through appropriate selection procedures. High heritability along with high genetic advance for these traits are in close agreement with the findings of Doshi *et al.* (1999), Mohanty, (2001) [9], Chaudhary, (2001) [2]; Dhameliya and Dobariya (2009) [4] and Chourasia and Sangeeta (2012) [3].
High heritabilities (h^2ns) coupled with moderate to low genetic advance were observed for plant height and dry matter content in Y_1 (Table-4.8). It indicated the less influence of non-additive gene action for these traits. The high heritability is being exhibited due to favourable influences of environment rather than genotype and selection for such traits may not be rewarding. Similar were the findings of Sherly and Shanthi (2008) [15]; Prabhu *et al.* (2009) [13] and Golani *et al.* (2007) [5] and Karak *et al.* (2012) [7].
The estimates of moderate heritability accompanied with high genetic advance were observed for average fruit weight, number of fruits per plant in both the years and unmarketable fruit yield in Y_2. This indicates major contribution of non-additive genes and suggests heterosis breeding approach for improvement of these traits. Similar findings were also reported by Naliyadhara *et al.* (2007) [7]; Lohakare *et al.* (2008) [8]; Pod *et al.* (2010) [12]; Prabhu *et al.* (2009) [13] and Thangavel *et al.* (2011) [17].

Table 1: Estimates of mean, range, coefficient of variation, heritability and genetic advance in brinjal over two years (Y_1, Y_2)

Characters	Years	Grand mean	Range of mean values		Coefficient of variation			Heritability in narrow sense (%)	Heritability in broad sense (%)	Genetic advance 5%	Genetic advance as per cent of mean 5%
			Parents	Crosses	ECV	GCV	PCV				
		1	2	3	4	5	6	7	8	9	10
Days to 50% flowering	Y_1	48.33	46.33-49.33	43.66-52.66	5.81	2.83	6.46	6.42	41.66	1.23	2.55
	Y_2	48.18	45.33-49.00	43.00-53.33	5.38	3.70	6.53	8.08	58.60	2.08	4.32
Days to first fruit harvest	Y_1	61.17	49.33-65.66	57.33-66.33	2.60	3.34	4.24	-14.30	83.03	3.32	5.43
	Y_2	60.58	57.33-64.0	56.33-64.66	2.23	3.53	4.17	-0.81	88.58	3.72	6.14
Fruit length (cm)	Y_1	16.71	12.20-26.40	12.86-23.63	7.47	20.13	21.47	54.03	95.10	6.50	38.88
	Y_2	16.78	12.40-26.06	12.73-23.56	6.80	19.42	20.57	50.66	95.56	6.33	37.75
Fruit circumference (cm)	Y_1	16.61	9.33-30.00	10.00-26.86	6.8	32.63	33.35	57.43	98.43	10.93	65.77
	Y_2	16.90	9.60-30.60	10.53-27.23	6.73	32.29	32.99	57.16	98.48	11.01	65.13
Average fruit weight (kg)	Y_1	107.53	63.33-156.66	73.33-186.66	4.32	26.08	26.44	24.54	99.05	56.99	53.00
	Y_2	107.61	63.00-156.33	69.66-186.66	4.79	25.98	26.42	24.71	98.75	56.64	52.64
Plant height (cm)	Y_1	84.11	64.20-87.06	72.08-104.26	4.21	12.00	12.72	31.02	96.41	19.62	23.33
	Y_2	84.02	64.36-87.03	73.06-108.33	3.87	11.78	12.40	23.11	96.47	19.36	23.05
Primary branches per plant (cm)	Y_1	5.83	4.20-6.06	4.80-7.33	8.51	12.64	15.24	5.29	87.17	1.26	21.60
	Y_2	5.80	4.13-6.00	4.76-7.30	7.15	12.29	14.22	7.57	89.61	1.27	21.89
Number of fruits per plant	Y_1	21.86	15.23-27.38	10.20-38.10	7.21	27.48	28. 41	28.32	98.53	11.97	54.76
	Y_2	22.93	13.06-28.55	13.03-39.40	8.00	26.81	27.98	28.17	97.07	12.13	52.93

*, ** Significant at 5 per cent and 1 per cent probability levels, respectively.

Characters	Years	Grand mean	Range of mean values		Coefficient of variation			Heritability in narrow sense (%)	Heritability in broad sense (%)	Genetic advance 5%	Genetic advance as per cent of mean 5%
			Parents	Crosses	ECV	GCV	PCV				
		1	2	3	4	5	6	7	8	9	10
Marketable yield (kg)	Y_1	1.72	1.05-2.03	0.76-3.44	10.58	29.04	30.90	12.01	95.63	0.97	56.20
	Y_2	1.95	1.27-2.12	1.01-3.77	7.33	27.56	28.52	9.38	97.69	1.07	54.87
Unmarketable yield (kg)	Y_1	0.54	0.29-1.07	0.27-1.19	10.15	39.21	40.50	3.22	97.45	0.42	78.20
	Y_2	0.47	0.22-0.52	0.29-0.73	11.42	28.17	30.40	22.88	94.32	0.25	53.78
Crop duration (days)	Y_1	214.23	207.00-227.33	181.66-229.33	6.78	3.90	7.82	-0.82	49.22	8.57	4.00
	Y_2	213.95	193.33-222.66	185.00-231.00	6.76	2.90	7.36	0.97	39.14	5.05	2.36
Dry matter content (%)	Y_1	5.75	4.73-6.00	5.12-6.21	1.67	6.70	6.91	31.12	97.92	0.77	13.40
	Y_2	5.76	4.76-6.03	5.06-6.18	1.61	6.75	6.95	29.31	98.07	0.78	13.54
Total soluble solid (TSS%)	Y_1	7.19	6.63-7.80	5.36-9.76	2.56	12.38	12.65	8.16	98.58	1.79	24.99
	Y_2	7.10	6.60-7.73	5.33-9.46	2.29	12.46	12.67	7.84	98.87	1.79	25.24
Yield per plant (kg)	Y_1	2.30	1.47-2.44	1.13-4.63	6.09	27.82	28.48	11.39	98.36	1.28	55.98
	Y_2	2.42	1.66-2.64	1.47-4.73	10.86	26.13	28.30	13.55	94.29	1.20	49.71

*, ** Significant at 5 per cent and 1 per cent probability levels, respectively.

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