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Studies on genetic variability, heritability in narrow sense and genetic advance in percent of mean in brinjal (*Solanum melongena* L.)

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Abstract
The present investigation entiled "Studies on genetic variability, heritability in narrow sense and genetic advance in percent of mean in brinjal (*Solanum melongena* L.)" was conducted -during *Rabi* season of 2018-19 (E1 and 2019-20 (E2) heritability and genetic advance using diallel mating design (excluding reciprocal) at the Main Experiment Station (MES) of the Department of Vegetable Science, Acharya Narendra Deva University of agriculture & Technology, Narendra nagar, Kumarganj, Ayodhya (U.P.) India. Ten diverse parents of brinjal ware crossed in a diallel fusion (excluding reciprocals) for generating experimental material. All the Ten parents and their 45 hybrids ware grown in randomized block design with three replications. Observation were recorded on the 16 characters *viz*., days to 50% flowering, leaf length (cm), leaf width, number of flower per inflorescence, days to first harvesting, plant height (cm), primary branches per plant, number of fruit per cluster, number of fruits per plant, average fruit weight (g), fruit length (cm), fruit circumference (cm), yield per plant (g), specific gravity, TSS (%) and dry weight/ 100g.
High heritability (broad sense) along with high genetic advance in per cent of mean were observed for most of important economic traits showing ample scope of crop improvement by selection.

Keywords: Brinjal, heritability, genetic advance, yield

Introduction
Eggplant or brinjal (*Solanum melongena* L. 2n=2x= 24) is a solanaceous vegetable, which is known by various name in India *viz*., Baigan (Hindi) and worldwide known as Aubergine (France) or Guinea squash, is one of the most popular and major vegetable crop in India and other parts of the world. It is an often-pollinated and annual herbaceous crop, originated in India and shows secondary diversity in South East Asia. It is being grown extensively in India, Bangladesh, Pakistan, China, Japan, Philippines, France, Italy and U.S.A. Brinjal has got much potential as raw material in pickle making and dehydration industries. It is highly productive and usually finds its place as the poor man's vegetable. In India, it is being consumed as a cooked vegetable in many ways and also liked by both poor and rich. Availability round the year, easy culture, moderate to high yield and consumption in varieties of ways like salad, bhaji, stuffed brinjal, bhartha, pickles etc., has made brinjal the king of vegetable in India. Further, in recent years, brinjal is being exported in the form of product like Baigan bhartha, pickles etc. to Middle East countries. Brinjal belongs to the family Solanaceae and botanically known as *Solanum melongena* L. The family contains 75 genera and over 2000 species, out of which, about 150-200 are tuber bearing and belong to section Tuberarium. The majority of species (about 1800) are non-tuber bearing. Cytological studies have indicated that chromosome number 2n = 24 is same in almost all species. There are 3 main botanical varieties under the species melongena (Choudhury, 2014) [3]. The common brinjal, to which large, round or egg-shaped fruited forms belong, are grouped under var. *esculentum*. The long, slender types are included under var. *serpentinum* and the dwarf brinjal plants are put under var. *depressum.*
Brinjal is considered a native to India where the major domestication of large fruited cultivars occurred. In "Origin of cultivated plants" published in 1886 De Candolle, stated that the species *S. melongena* has been known in India from ancient times and regarded it as a native of Asia. Vavilov (1928) was of the opinion that its center of origin was in the Indo-Burma region. Globally, India ranked second in vegetable production and contributed 15.8 and 14% to global

vegetable area and production, respectively. In India, vegetable alone contributes 60.32% of total horticultural production. In India, eggplant occupies an area of 0.733 million ha with annual production of 12.51 million tones and productivity stand at 18.9 mt./ha. In Uttar Pradesh, brinjal is being cultivated on an area of 8.01 mha with annual production of 275.40 million tones. In Uttar Pradesh, Agra, Meerut, Lucknow, Kanpur, Aligarh, Chitrakoot and Gorakhpur districts contribute more area and production to the state pool (Anonymous, 2019) [2]. efforts must be put to exploit regional genetic resources without tossing consumers preferences. Thus under such circumstances, it is necessary to improve these genotypes or to develop hybrids superior to these types of qualitative and quantitative characters.

Material and Methods

The present investigation entitled "Studies on genetic variability, heritability in narrow sense and genetic advance in percent of mean in brinjal (*Solanum melongena* L.)" was carried out at Main Experiment Station (Vegetable Research Farm), Narendra Nagar (Kumarganj), Ayodhya (U.P.) India, during Rabi season of 2018-19 (E1) and 2019-20 (E2).

The experimental materials for the present investigation was comprised of ten promising and diverse pure lines/varieties of fenugreek 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.). The selected parental lines *i.e*. NDB-51(P_1), Punjab Sadabahar (P_2), MK (P_3), KS-224 (P_4), NDB-3 (P_5), NDB-2 (P_6), Pant Rituraj (P_7), Pant Smart (P_8), Arka Nidhi (P_9) and White (P_{10}) were crossed in the all possible combinations, excluding reciprocals, during the *Rabi* season of 2017-18. The experiment was laid out during *Rabi* seasons of 2018-19 and 2019-20 in Randomized Block Design including 10 parents and 45 F_1s with three replication. The observation were recorded *viz.*, Days to 50 per cent flowering, Days to first fruit harvest, Number of flowers per inflorescence, Leaf Length (cm), Leaf Width (cm), Number of primary branches per plant, Plant height, Number of fruits per cluster, Fruit length (cm), Fruit circumference (cm), Number of fruits per plant, Average fruit weight (kg), Fruit yield per plant (kg), Specific gravity, Dry matter content, Total soluble solids (TSS). All the recommended agronomic package of practices and plant protection measures were followed to raise good crops.

Result ad Discussion

Estimates of heritability in narrow sense (h^2 ns) and genetic advance in per cent of mean were estimated for all the sixteen characters and results have been presented in Table-1. In respect to facilitate the description of the estimates of heritability (h^2 ns), the observed values of the estimates were classified according to Robinson (1966), as (i) High (> 30%), (ii) Moderate (above 10% to 30%) and low (< 10%).

The higher values of heritability (h^2 ns) estimates (> 30) were observed only for days to 50% flowering (76.30%, 75.70% and 91.10%), leaf length (49.70%, 52.60% and 56.60%), leaf width (49.80%, 56.60% and 66.30%), number of flower per inflorescence (71.80%, 50.80% and 78.60%), days to first fruit harvest (58.30%, 60.70% and 50%), plant height (35%, 30.90% and 34.90%), primary branches per plant (36.10%, 36.60% and 36.30%), number of fruit per cluster (68.60%, 77.80% and 43.00%), number of fruit per plant (51.90%, 68.20% and 59.80%), average fruit weight (33.70%, and 90.20%), fruit length (49.50%, 47.40% and 68.10%), fruit circumference (70.90% and 84.70%), yield per plant (61.80%, 61.90% and 64.60%), specific gravity (33.20%, 30.90% and 66.61%), total soluble solids (39.40%, 39.40% and 34.30%) and dry weight/100g (68.50% and 68.20%) during both the seasons and pooled, respectively. However, moderate heritability (10-30%) was average fruit weight (23.82%), fruit circumference (28.49%) and dry weight/100g (29.80%) during both the seasons $E_1$and pooled. Whereas, low heritability (<10%) were not observed for any characters during both the seasons and pooled.

Table 1: Heritability (ns) and genetic advance in brinjal over two seasons (E_1, E_2) and pooled.

Characters	seasons	Heritability in broad sense (%)	Heritability in narrow sense (%)	Genetic advance in per cent of mean
Days to 50% flowering	E_1	36.10	76.30	4.99
	E_2	38.60	75.70	5.14
	Pooled	49.50	77.80	6.71
Leaf length(cm)	E_1	57.10	4.10	10.57
	E_2	65.70	6.60	12.17
	Pooled	68.70	56.60	12.73
Leaf width (cm)	E_1	63.00	49.80	13.73
	E_2	64.60	52.60	14.53
	Pooled	70.50	66.30	15.63
No. of flower inflorenece	E_1	86.40	71.80	34.38
	E_2	86.40	50.80	34.40
	Pooled	89.10	78.60	35.46
Days to first fruit harvest	E_1	23.70	58.30	3.23
	E_2	65.80	60.70	7.25
	Pooled	53.00	50.21	6.53
Plant height (cm)	E_1	85.20	35.00	14.86
	E_2	72.20	30.90	12.94
	Pooled	80.80	34.90	14.29
Primary branches per plant	E_1	89.30	36.10	30.89
	E_2	84.10	36.60	29.08
	Pooled	87.20	5.90	30.17
No. of fruit per cluster	E_1	77.40	68.60	23.16
	E_2	86.00	77.80	24.17
	Pooled	76.70	43.00	13.08

No. of Fruits per plant	E_1	98.50	6.40	51.37
	E_2	98.40	7.70	91.75
	Pooled	98.70	59.80	91.81

In order to facilitate the interpretation of the estimates of heritability in broad sense (h^2 b) were classified according to Robinson (1966), as (i) High (> 75%), (ii) moderate (> 50 to 75%), (iii) low (< 50%). The high estimates of heritability in broad sense (> 75%) were observed for number of flower per inflorescence (86.40%, 86.40% and 89.10%), plant height (85.20%, and 80.80%), primary branches per plant (89.30%, 84.10% and 87.20%), number of fruit per cluster (77.40%, 86.00% and 76.70%), number of fruit per plant (98.50%, 98.40% and 98.70%), average fruit weight (94.80%, 94.90% and 96.90%), fruit length (89.10%, 88.80% and 91.00%), fruit circumference (97.30%, 97.30% and 97.50%), yield per plant (97.20%, 97.10% and 97.30%), specific gravity (99.80%, 99.30% and 99.60%), total soluble solids (90.90%, 83.50% and 89.10%) and dry weight/100g (90.60%, 90.40% and 92.10%) during both the seasons and pooled, respectively. However, moderate heritability (50-75%) were observed for leaf length (57.10%, 65.70% and 68.70%), leaf width (63.00%, 64.60% and 70.50%) and plant height (72.20%) during both the seasons E_2 and pooled. whereas, low heritability (< 50%), was not observed for any characters during both the seasons and pooled.

Table 2: Heritability sense Heritability in narrow sense Genetic advance in per cent of mean

Characters	seasons	Heritability in broad sense (%)	Heritability in narrow sense (%)	Genetic advance in per cent of mean
Average fruit weight (g)	E_1	94.80	23.82	61.80
	E_2	94.90	33.70	61.32
	Pooled	96.90	90.20	61.94
Fruit length (cm)	E_1	89.10	49.50	29.83
	E_2	88.80	47.40	30.02
	Pooled	91.00	67.10	30.62
Fruit circumference	E_1	97.30	28.49	68.51
	E_2	97.30	70.90	68.64
	Pooled	97.50	84.70	8.77
Yield per plant (kg)	E_1	97.20	61.80	67.33
	E_2	97.10	61.90	70.37
	Pooled	97.30	64.60	69.01
Specific gravity	E_1	99.80	33.20	63.94
	E_2	99.30	30.90	63.75
	Pooled	99.60	66.61	63.87
Total soluble solids (%)	E_1	90,90	25.33	11.38
	E_2	83.50	25.40	10.83
	Pooled	89.10	34.30	11.37
Dry weight /100g	E_1	90.60	68.50	14.82
	E_2	90.40	68.20	15.04
	Pooled	92.10	29.80	15.20

For easy explanation, genetic advance was classified into three groups such as (i) High (20%) (ii) moderate (> 10% to 20%) and (iii) low (< 10%). High genetic advance in per cent of mean were estimated for number of flower per inflorescence (34.38%, 34.40% and 35.46%), primary branches per plant (30.89%, 29.08% and 30.17%), no. of fruits per plant (51.37%, 91.75% and 91.81%), average fruit weight (61.80%, 61.32% and 61.94%), fruit length (29.83%, 30.02% and 30.62%), fruit circumference (68.51%, 68.64% and 68.77%), yield per plant (67.33%, 70.37% and 69.01%) and specific gravity (63.94%, 63.75% and 63.87%) during both the seasons (E_1, E_2) and pooled.

The moderate genetic advance (>10 to 20%) were observed for leaf length (10.57%, 12.17% and 12.73%), leaf width (13.73%, 14.53% and 15.63%), number of fruit per cluster (13.08% pooled), total soluble solids (11.38%, 10.83% and 11.37%) and dry weight/100g (14.82%, 15.04% and 15.20%) during both the seasons and pooled, while low genetic advance was observed only for days to 50% flowering (4.99%, 5.14% and 6.71%) during both the seasons (E_1, E_2) and pooled**.** Similar were the findings of Karak *et al.* (2012) [5]; Sherly and Shanthi (2008) [9]; Prabhu *et al.* (2009) [8] Golani *et al.* (2007) [4] Yadav *et al.* (2018) [10] and Kumar *et al.* (2019) [6].

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