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Study of morphological characters of parents and its hybrids of eggplant (*Solanum melongena* L.)

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Abstract
Brinjal or eggplant belongs to family nightshade (solanaceae) is one of the most popular and widely grown vegetable in India. Eggplant is a good source of minerals and vitamins in the tropical diets. Assessment of genetic resources is the starting point of any crop improvement programme. Present investigation was carried out in brinjal crop to study the frequency distributions of 15 morphological characters namely plant growth habit, plant branching, stem pigmentation, leaf blade colour, leaf blade length, leaf blade width, leaf blade lobing, leaf prickle, flowering habit, flower colour, stigma colour, fruit shape, fruit curved, fruit apex shape and fruit colour showed wide range of variable characters. Most of genotypes showed intermediate growth habit, purple stem pigment, green stem colour, intermediate leaf lobbing. Most of genotypes were early to mid-early flowering and were born in three patterns *i.e.* solitary,cyme and mixed (both solitary and cyme). The fruit shape was observed to variable and found oblong, round, medium long and long. The genotypes fell into six fruit colour groups namely green, purple, white and light purple. The wide regional variations for plant, flower and fruit descriptors revealed enough scope for improvement of yield characters by selection. The genetic differences among the landraces are potentially relevant to breeding programmes in that the variability created through hybridization of the contrasting forms could be exploited.

Keywords: Eggplant, genotypes, variability, landrace

Introduction
Eggplant (*Solanum melongena* L.) or brinjal, worldwide known as aubergine or guinea squash, is one of the most popular and major vegetable crops in India and other parts of the world, belonging to the nightshade family Solanaceae. It is an often cross pollinated annual herbaceous plant, originated in India and shows secondary diversity in South East Asia (Haushna, 2009) [3]. Brinjal fruits are rich sources of minerals like calcium, magnesium, potassium, iron, zinc and copper. It is also a good source of fatty acids and it is used for medicinal purposes in curing diabetes, asthma, cholera, bronchitis and diarrhoea. It is reported to stimulate the intra-peptic metabolism of blood cholesterol. Leaf and fruit, fresh or dry produce marked drop in blood cholesterol level. The hypo cholesterolemic 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 %) (Timmapur, 2007) [10]. Germplasm is the basic raw material for any crop improvement programme. Conservation and use of genetic resources have a great significance. It may either be introduced from other sources or may be developed by concerned breeder from his own material. The availability of genetic variability in germplasm and its proper use is very important. For maintaining adequate variability, the germplasm should include land races, obsolete varieties, varieties and parents of hybrids, breeding lines with genetic markers and other morphological variants, wild forms and their relatives. Hence, collection, evaluation, maintenance, categorization and utilization of germplasm have special significance. Involvement of genetically diverse parents is essential to generate new variability and to look for desirable recombinants with respect to enhanced yield, quality and resistance to several important diseases. Genetically diverse parents are likely to segregates and or to produce high heterotic crosses. More diverse the parents, greater are the chances of obtaining high heterotic F_1s and broad spectrum of variability in segregating generations (Arunachalam, 1984) [1]. The subject of this study was to introduce morphological characteristics of new cultivars that have high potential yield.

Materials and Methods

The experimental material comprised of 36 diverse entries were taken, the field experiment was conducted at Vegetable Research Centre at GBPAU& T Pantnagar in the *kharif* season during 2018. Each entry was sown at spacing of 75 x 60 cm with three replications accommodating 10 seedlings in each plot. All the recommended cultural practices and plant protection measures were followed data were recorded for 15 characters *viz.*, plant growth habit, plant branching, stem pigmentation, leaf blade colour, leaf blade length, leaf blade width, leaf blade lobing, leaf prickle, flowering habit, flower colour, stigma colour, fruit shape, fruit curved, fruit apex shape and fruit colour.Some promising genotypes that would be new cultivar candidates have been selected from these brinjal improvement programme. All genotypes were evaluated for morphological and phenological characters and fresh fruits yield.

Result and Discussion

Three growth habit could be recognized namely, upright or erect (strong and stiff stem), intermediate or semi-spreading (strong but not so stiffed stem) and prostrate or spreading (very weak stem revealing somewhat decumbent habit). The morphological study revealed that plants of eight parents *viz.* SMB-115, BARI, Pant Samrat, PB101, *S.gilo* are erect type plant growth habit whereas Pant Rituraj had semi erect type plant growth habit and remaining two parents, namely PB-6, Pusa Upkar had spreading type plant growth habit. Out of 28 crosses, 2 crosses namely SMB-115 x Bari and Pant Rituraj x PB-101 had intermediate or semi-spreading growth habit, 24 crosses had upright and 2 crosses Pant Samrat x PB-6 and Pant Rituraj x PB-6 had spreading or prostrate growth habit. The variations in different growth habit of brinjal was also reported by Tambe *et al*. (1992), Hazra *et al.* (2003), Shukla (2012), Shinde *et al*. (2012), Khan and Singh (2014) and Tiwari *et al*. (2016) [9, 2, 7, 6, 4, 11]. Considering number of branches per plant, very weak to very strong plant branching habits were found in brinjal. Parent SMB-115, BARI, Pant Samrat had strong plant branching Pant Rituraj and Pusa Upkar had weak plant branching. Similary PB-6 had very weak plant branching and PB-101 and *S.gilo* had very strong plant branching. Most of the 16 crosses had to strong branching habit while the crosses with *S.gilo* had very strong branching habit and 3 crosses had weak branching habit, and 1 had very weak branching habit.Anthocyanin is the main pigment of brinjal which produces purple and violet colour in different plant parts and chlorophyll content is responsible for darkening effect on colour (Nothmann *et al*., 1976) [8]. Pigment production and expression could be regarded as a common feature in brinjal, Parent SMB-115, BARI and PB-6, PB-101, *S.gilo* had white while Pant Samrat, Pant Rituraj and Pusa Upkar had purple Stem pigmentation. Out of 28 crosses, 27 had purple pigmentation followed by 1 had greenish pigmentation.

Expression of pigment in different plant parts is not uniform. Parents SMB115, PB-6 and PB-101 had light green leaf blade colour while Leaf blade BARI, Pant Samrat, Pant Rituraj had violet colour was leaf blade colour. Only parent *S.gilo* had dark green leaf blade colour. Out of green in 27 crosses followed by 1 dark green. Similar findings was reported by Shukla (2012) and Khan and Singh (2014) [7, 4].

In case of leaf blade length ranged from <10 cm to >30 cm. SMB115, Pant Samrat, Pant Rituraj Pusa Upkar and PB-101 had short leaf blade length while BARI had intermediate type leaf blade length. Whereas, PB-6 and *S.gilo* had Long leaf blade length. Out of 28 crosses, 26 genotypes had shortest leaf blade length followed by only 2 crosses which had long leaf blade length.In respect to leaf blade width parents SMB-115, Pusa Upkar had wide type of leaf blade width and remaining parents had narrow type leaf blade width. Most of the crosses had only narrow (5 cm). In respect to leaf blade lobing maximum parents had intermidate type leaf blade lobing. Only one parent *S.gilo* had weak type of leaf blade lobing pattern. Out of 28 crosses, 22 crosses were found on class intermediate leaf blade lobing, whereas, 6 crosses had weak respectively.

Development of prickles in different plant parts was a predominant character of brinjal. Morphological study revealed that all most parents had non spiny leaf. Most of genotypes had non spiny leaf. Similar findings were also reported by Tambe *et al*. (1992) [9], Hazra *et al.* (2003) [2], Shinde *et al*. (2012) [6] and Khan and Singh (2014) [4]. According to Hazra *et al*. (2003) [2] prickles appeared either at one of the plant part (only in calyx including peduncle) or at different parts in combinations. Propensity of prickle development in stem, petiole and calyx were almost same and it appeared less frequently in the leaves.

Flowering in brinjal was axillary and borne in three pattern: solitary, cyme (cluster) and mixed (both solitary and cyme). Maximum parents had cyme type of flowering habit while remaining two namely BARI and Pusa Upkar had solitary. Most of the crosses cyme flowering habit whereas, 7 crosses produced only mixed flowering habit. Solitary flowers and the basal flowers of the cyme (connected with its pedicel directly to the stem) were either long styled with plump ovary (style protrudes over anther tip) or medium styled with developed ovary (style just below the anther tip), and were functionally fertile. However, fruit settings were higher in the long styled compared to medium styled flower. Majority of the additional flower of the cyme (other flowers of the same inflorescence borne on the separate axis) were functionally sterile by having pseudo-short styled flower with under developed ovary (style length almost half of that of anther) and short styled flower with rudimentary ovary (very small style).Flower color showed a continuous range of colour, majority were violet coloured followed by pale violet and white. Parents SMB-115 and PB-6 had pale violet and remaining five BARI, Pant Samrat, Pant Rituraj, Pusa Upkar and PB-101 had violet flower colour. Only one parent *S.gilo* had white flower colour. Out of 28 crosses 21 were having violet colour flowers, 7 were with pale violet, while 1 had purple colour flowers.

Stigma colour of parents varies white, yellow, light green to purple. Maximum parents had light green stigma colour whereas paretnt Pusa Upkar had purple stigma colour and *S.gilo* had yellow stigma colour. Stigma colour scored light green colour in maximum crosses followed by 4 crosses purple colour respectively.Fruit shape varies oblong, very long long to round. Parents SMB-115 and PB-101 had oblong and BARI had very long. Pant Rituraj, Pusa Upkar and *S.gilo* had round type of fruit shape and Pant Samrat and PB-6 had long type of fruit type. The fruit shape was observed to be varying and was oblong in 9 crosses round in 2 crosses, long in 8 crosses respectively. Similar variation in fruit shape was also observed by Shinde *et al.* (2012) [6] and Khan and Singh (2014) [4], while Hazra *et al.* (2003) [2] observed most of genotypes had either oval or oblong fruits. Maximum parents had straight type of fruit cured while BARI had cured type of fruit cured. Out of 28 crosses most of crosses had straight. Maximum parents had round type of fruit apex shape while SMB-115 had depressed type of fruit apex shape. Pant Samrat

had protruded type of fruit apex shape Most of crosses were found to have round fruit apex shape.

Colour development in the fruits appeared to be a pronounced character in brinjal as all the genotypes showed fruit coloration. However, intensity of the basic purple fruit colour varied with the genotypes presumably due to different anthocyanin and chlorophyll contents in the fruits. Parent SMB-115 had Light purple type fruit colour whereas, BARI, Pant Samrat and Pant Rituraj had purple type of fruit colour. PB-101 had milky white fruit colour and PB-6 had light green. Pusa Upkar had dark purple and *S.gilo* had dark green fruit colour. Most of crosses had fruit colour was found purple whereas, only 1 had light purple and 1 had white fruit colour. The variations in different colour behaviour of brinjal fruits were also reported by Tambe *et al*. (1992) [9], Singh *et al*. (1999) [5], Hazra *et al*. (2003) [2], Shinde *et al*. (2012) [6], Shukla (2012) [7], Khan and Singh (2014) [4] and Tiwari *et al*. (2016) [11]. The results are presented in Table 4.1.

Table 4.1: Morphological description of Parents & hybrids

Genotype	Plant growth habit	Plant branching	Stem pigmentation	Leaf blade colour	Leaf blade length	Leaf blade width	Leaf blade lobing	Leaf prickle	Flowering habit
SMB-115	E	S	W	LG	S	W	I	NS	C
Bari	E	S	W	V	I	N	I	NS	S
Pant Samrat	E	S	P	V	S	N	I	NS	C
Pant Rituraj	SE	W	P	V	S	N	I	NS	C
PB-6	S	VW	W	LG	L	N	I	NS	C
Pusa Upkar	S	W	P	V	S	W	I	NS	S
PB-101	E	VS	W	LG	S	N	I	NS	C
S.gilo	E	VS	W	DG	L	N	W	NS	C
SMB-115 XBari	E	S	P	G	S	N	I	NS	C
SMB-115 Xpant Samrat	E	S	P	G	S	N	I	NS	M
SMB-115 X Pant Rituraj	SE	S	P	G	S	N	I	NS	M
SMB-115 x PB-6	E	S	P	G	S	N	I	NS	C
SMB-115 X Pusa Upkar	E	S	P	G	S	N	I	NS	M
SMB-115 X PB-101	E	S	P	G	S	N	W	NS	C
SMB-115 X S gilo	E	VS	P	G	S	N	W	NS	C
Bari X Pant Samrat	E	S	P	G	S	N	I	NS	C
Bari x Pant Rituraj	E	S	P	G	S	N	I	NS	M
Bari x PB-6	E	S	P	G	S	N	I	NS	C
Bari X Pusa Upkar	E	W	P	G	S	N	I	NS	M
Bari x PB-101	S	S	P	G	L	N	I	NS	C
Bari x *S.gilo*	E	VS	P	G	S	N	W	NS	C
Pant Samrat x Pant Rituraj	E	S	P	G	S	N	I	NS	C
Pant Samrat x PB-6	S	S	P	G	S	N	I	NS	C
Pant Samrat x Pusa Upkar	S	S	P	G	S	N	I	NS	C
Pant Samrat XPB-101	E	S	P	G	S	N	I	NS	M
Pant Samrat x *S.gilo*	E	VS	P	G	S	N	W	NS	C
Pant Rituraj x PB-6	S	W	P	G	S	N	I	NS	C
Pant Rituraj x Pusa Upkar	E	VW	P	G	S	N	I	NS	M
Pant Rituraj x PB-101	SE	S	P	G	S	N	I	NS	C
Pant Rituraj x *S.gilo*	E	VS	P	G	S	N	W	NS	C
PB-6 X Pusa Upkar	E	W	P	G	S	N	I	NS	C
PB-6 X PB-101	E	S	W	LG	L	N	I	NS	C
PB-6 x *S.gilo*	E	VS	P	G	S	N	W	NS	C
Pusa Upkar x PB-101	E	S	P	G	S	N	I	NS	C
Pusa Upkar X *S.gilo*	E	VS	P	G	S	N	I	NS	C
PB-101 X S.glio	E	VS	P	G	S	N	I	NS	C

E = Erect, SE = Semi Erect, VS = Very Strong, W = Weak, S= Strong, W = White, P = Purple, LG = Light Green, G = Green, DG = Dark Green, V = Violet, S = Small, I = Intermediate, L = Long, NS = Non- Spine, C = Cluster, M = Mixed, S = Solitary

Genotype	Flower colour	Stigma colour	Fruit shape	Fruit curved	Fruit apex shape	Fruit colour
SMB-115	PV	LG	O	S	D	LP
Bari	V	LG	VL	C	R	P
Pant Samrat	V	LG	L	S	P	P
Pant Rituraj	V	LG	R	S	R	P
PB-6	PV	LG	L	S	R	LG
Pusa Upkar	V	P	R	S	R	DP
PB-101	V	LG	O	S	R	MW
S.gilo	W	Y	R	S	R	DG
SMB-115 XBari	V	LG	L	S	R	P
SMB-115 Xpant Samrat	V	LG	O	S	R	P
SMB-115 X Pant Rituraj	V	LG	O	S	R	P
SMB-115 x PB-6	V	LG	L	S	R	P
SMB-115 X Pusa Upkar	V	P	O	S	R	P

SMB-115 X PB-101	V	LG	O	S	R	P
SMB-115 X *S.gilo*	PV	LG	-	-	-	-
Bari X Pant Samrat	V	LG	L	S	R	P
Bari x Pant Rituraj	V	LG	L	S	R	P
Bari x PB-6	V	LG	L	S	R	P
Bari X Pusa Upkar	V	P	L	S	R	P
Bari x PB-101	V	LG	L	S	R	P
Bari x *S.gilo*	PV	LG	-	-	-	P
Pant Samrat x Pant Rituraj	V	LG	O	S	R	P
Pant Samrat x PB-6	V	LG	L	S	R	P
Pant Samrat x Pusa Upkar	V	LG	O	S	R	P
Pant Samrat XPB-101	V	LG	O	S	R	
Pant Samrat x *S.gilo*	PV	LG	-	-	-	-
Pant Rituraj x PB-6	V	LG	O	S	R	LP
Pant Rituraj x Pusa Upkar	V	P	R	S	R	P
Pant Rituraj x PB-101	V	LG	R	S	R	P
Pant Rituraj x *S.gilo*	PV	LG	-	-	R	P
PB-6 X Pusa Upkar	V	P	L	S	R	W
PB-6 X PB-101	V	LG	L	S	R	P
PB-6 x *S.gilo*	PV	LG	-	S	R	-
Pusa Upkar x PB-101	P	LG	O	S	R	
Pusa Upkar X *S.gilo*	PV	LG	-	-	-	-
PB-101 X S.glio	PV	LG	-	-	-	-

PV = Pale Violet, Y = Yellow, O = Oblong, L = Long, VL = Very Long, S = Stright, C= Curved, D = Depressed, R = Round, P = Purple, LG = Light Green, DP = Dark Purple, MW = Milky White, DG = Dark Green, W = White

The crop is extremely variable in India because of highly differential selection pressures according to regional preferences for plant and particularly fruit characters. Hence, it is necessary to characterize the genotypes of brinjal having better acceptance and wide adoptability in the country. The geographical situations for brinjal adaptability should be essentially considered while characterizing brinjal genotypes. The elite varieties, land races, local types, wild relatives, stable breeding lines, indigenous cultivars should be characterized for different qualitative and quantitative characters and utilized for breeding programme in brinjal. The characters which govern the quality of brinjal *viz.*, fruit colour, fruit shape, spinyness, higher yield, errect and compact growth habit, solitary fruiting habit, earliness, resistance to biotic and abiotic stress should be considered for improvement of the brinjal in future.

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