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Evaluation of brinjal genotypes for growth and reproductive characters with seasonal variation

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ABSTRACT

The present study was carried out involving twelve genotypes of brinjal to evaluate their performance and to find out cultivars suitable for summer-rainy and autumn-winter seasons of southern Bengal. Observations on eleven growth and reproductive characters including yield / plant were recorded. In general, all the genotypes performed better in the autumn-winter season. During summer, day temperature goes above 35^{0}C which hampers fruit-setting. In high temperature and high moisture conditions fruit development was lower, which might have happened due to excessive vegetative growth and subsequent retarded partitioning of photosynthates to the economic sink. Higher ratio of long/ medium: short/pseudo-short style flowers and fruit number per plant, along with better fruit weight were found to be the premium traits for better yield. BCB-23, 38 and 57 yielded better in the autumn-winter season while BCB-43 was found to be the best yielder in summer-rainy season.

Key words: **Brinjal, flowering, seasonal variation, yield**

Brinjal (*Solanum melongena* L.) is the second major vegetable crop in India. Though it is cultivated throughout the year, the two distinct main seasons in West Bengal are autumn-winter and summer-rainy seasons. Autumn-winter is the popular season and it stretches from August to February; the summer-rainy season covers February to August. Several high yielding and improved varieties of brinjal are available for the autumn-winter season which perform better due to low incidence of insect-pests (Nath et al, 2008) and appropriate climatic conditions i.e. low to moderate night temperature with no heavy shower during the first couple of days after anthesis (Singh and Kalda, 2000) during the winter months. But farmers often complain for not having suitable good yielding varieties for summer-rainy season. The available cultivars give poor yield in summer owing to prevailing high temperature, often with strong wind, which has a marked effect on fruit-set (Singh and Kalda, 2000). Normal temperature for fruit-set in brinjal is 18-21^{0}C (Charles and Harris, 1972, Vijay et al, 1977, Nath et al, 2008) but during summer, day temperature goes above 35^{0}C which hampers fruit-setting. The ability of the genotypes varies greatly for setting fruits under high temperature condition. This study is therefore carried out to evaluate comparative performance of the brinjal genotypes for their performance in summer-rainy and autumn-winter seasons.

MATERIALS AND METHODS

The experiment was carried out at the Central Research Farm, Gayeshpur, Bidhan Chandra Krishi Viswavidyalaya, situated at 22^0 57′ N latitude and 88^0 20′ E longitude with a mean altitude of 9.75m AMSL.The soil of the experimental site is Gangetic new alluvial, which is sandy-loam and slightly acidic (pH 6.5)in nature. Twelve locally popular genotypes with good agronomic characters were taken for the study. These were BCB-14 (Muktakeshi), BCB-15 (Bhangar), BCB-20 (Bangladesh Singhnath), BCB-23 (Nadia Summer Local), BCB-34 (Shyamala), BCB-38 (HE-12), BCB-42 (SM-59), BCB-43 (Pusa Purple Cluster), BCB-45 (Pusa Anupam), BCB-48 (BB-40), BCB-57 (KS 352), BCB-75 (Uttara). The experimental design was two factor Randomized Block Design. Sixteen plants were planted at a spacing of 60cm x 60cm in each plot measuring 2.4m x 2.4m. Observations on eleven growth and reproductive characters including yield / plant were recorded. These characters satisfactorily reflect the flowering and fruiting habits and many of them contribute directly to yield. The characters are plant height (cm), number of primary branches per plant, days to flowering, ratio of long/medium: short/pseudo-short styled flowers, length of long style, pollen viability, number of fruits per plant, length of fruit (cm), fruit diameter (cm), fruit weight (g) and yield per plant (kg). Standard crop husbandry recommendations were followed to raise the crop.

RESULTS AND DISCUSSION

Significant variation was found in plant height among the genotypes in both the seasons (150.50 cm and 86.37 cm in summer-rainy and autumn-winter season, respectively). Summer-rainy season recorded higher plant height than autumn-winter season with a range of 86.97-150.53 cm. So season had a marked influence on plant height and year X genotype component of variation was found to be highly significant (Table 1.). Excessive growth under warm and humid condition as reflected in

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luxurious plant height increase in all the genotypes during summer –rainy season might have caused decrease in both the fruit number and weight, mirroring low fruit yield (Table 1 and 2). The number of primary branches on the other hand, was higher in the autumn-winter season in all the genotypes and BCB-34 recorded highest number of primary branches per plant in both the seasons (16.8 in summer-rainy and 16.9 in autumn-winter).

Regarding days required to flowering, the genotypes showed significant variation in both the seasons. The days required for flowering was much longer in summer season and BCB-57 needed least days (66.8), whereas, in autumn-winter, all genotypes produced flower earlier and BCB-38 needed least days (37.80). Though brinjal is basically a day neutral plant but marked difference in requirement for days to first flowering in two distinct seasons proved its thermo-sensitiveness. It is also observed that high day and night temperature not only favoured the stem elongation but also kept the plant vegetative for long. Negi *et al.* (1999) also recorded the onset of blooming as high as 76 days in brinjal in high temperature condition. In autumn-winter, the days to flowering ranged from37.80-48 days with an average of 43.53 days, which is significantly different from that of the summer-rainy season (77.90 days).

The ratio of long/medium to short/ pseudo-short style flowers did significantly vary among the genotypes and in general, autumn-winter season produced higher ratio, though with some exceptions. The influence of high temperature on production of long/medium style or short/pseudo-short style flowers was not linear. In the autumn-winter season, the ratio ranged from 1.15 -9.91, while in the summer-rainy, the range spanned from 0.99 to 6.16. Highest ratio was recorded in BCB-43 (6.16 in summer-rainy and 9.91 in autumn-winter). But such was not the trend with the least ratio; in summer-rainy season the least ratio was recorded in BCB-15 (0.99), while in autumn-winter, it was 1.15 in BCB-48. Interestingly BCB-48, BCB-57 and BCB-75 recorded higher ratios in the summer-rainy season, which are exceptions from the general trend. The genotype BCB-43 though exhibited the highest ratio of long/ medium: short/ pseudo-short styled flowers in both the seasons, yet suffered the most in the summer-rainy season, which indicates the temperature sensitivity for not only total flower production but expression of fertile flowers too (i.e. long or medium styled) in the plant.

Significant variation was noted in length of long style in both the seasons. Length was increased in all the genotypes grown under summer-rainy season with highest value in BCB-23 (13.73 mm). BCB-20 recorded only an increase of 1.17 mm in the summer-rainy indicating that it had been affected the least by the seasonal factors. It can be predicted that increased length of long style was due to stigma exsertion; increased length of the style, on an average by more than 2 cm in the summer-rainy season over that in the autumn-winter season might have resulted in lesser number of fruit set due to inaccessibility of the pollen to reach the stigma head. Hence , lesser production of flowers, coupled with reduced expression of environmentally influenced sterility due to excessive length of style have contributed cumulatively to lower fruit set and ultimate fruit yield in the summer- rainy season. It is a well known fact that stigma exsertion by the influence of high temperature hampers self-pollination in brinjal. So heterostyly is a factor for cross pollination in brinjal. Shanmugavelu (1989) reported that long and medium style flowers were produced in higher proportion in the autumn-winter season than the summer-rainy season. Several workers reported that stigma exsertion under high temperature condition hampers self-pollination and fruit-set in tomato (Saito and Ito, 1976; Abdalla and Verkerk, 1968). Style length plays very important role in fruit-set in brinjal. Since pollens are liberated from the pores at the apex of the anther cone, much exserted stigma are unable to reach it effectively, resulting in poor fruit-set.

Pollen viability significantly varied among the genotypes but the two seasons did not show significant variation. In fact summer-rainy season showed slight decrease in pollen viability. Generally pollen viability in brinjal is reduced beyond 35^0C day temperature. In this study, during summer-rainy condition the reproductive phase of the plant was mostly exposed to 31-32^0C day temperature. Pollens usually remain viable for a day during summer (Ram, 1998).This temperature range possibly did not harm pollen viability but might have influenced the elongation of style length and stigma exsertion. So due to high flower drop that resulted from non-fertilization of flowers, low fruit-set in the summer-rainy season was noted.

It is clear from table 2 that fruit number per plant significantly differed among the genotypes and summer-rainy season recorded much less number of fruits per plant. In this season, BCB-43 showed the highest number of fruits/plant (42.33). Kalloo et al. (1989), Mahanty and Prusti (2000) also recorded similar results. The fruit length, fruit diameter and fruit weight did significantly vary among the genotypes and in all these parameters much reduced values were recorded in summer-rainy season. BCB-14 produced the heaviest fruit (154.43g) in autumn-winter season but in summer-rainy season it produced fruit with much lesser weight (51.03g). In summer-rainy season, BCB-48 produced the heaviest fruit (59.6g). Environment played a significant role in fruit weight of genotypes. Cooler climate produced

Table 1: Performance of brinjal genotypes for growth and flower characters

Genotypes	Plant height (cm)		Primary branches plant^{-1}		Days to flowering		Long/ medium: short/pseudo-short style		Length of long style		Pollen viability	
	S-R	A-W	S-R	A-W	S-R	A-W	S-R	A-W	S-R	A-W	S-R	A-W
BCB-14	150.53	86.37	12.07	12.90	91.00	48.00	3.05	3.90	12.33	10.27	93.87	95.13
BCB-15	138.67	58.43	9.27	10.30	90.60	47.20	0.99	1.34	13.53	10.40	96.62	97.11
BCB-20	148.00	98.47	9.70	14.27	79.87	43.87	1.49	1.62	11.57	10.42	96.44	96.43
BCB-23	116.62	64.10	11.23	12.50	80.33	43.67	2.18	2.41	13.73	10.37	97.16	97.83
BCB-34	99.64	67.67	16.80	16.90	73.00	40.27	1.74	2.49	11.93	10.10	94.69	94.31
BCB-38	86.97	68.00	12.53	14.70	74.03	37.80	2.38	2.78	11.97	9.83	93.18	92.52
BCB-42	106.90	68.83	13.47	13.80	71.13	45.33	2.76	4.37	11.37	9.67	96.00	96.71
BCB-43	119.53	69.43	9.40	12.40	77.06	43.37	6.16	9.91	11.53	9.80	95.67	95.99
BCB-45	124.87	81.20	11.10	15.83	70.80	46.93	1.33	1.81	10.93	9.87	98.04	98.35
BCB-48	120.30	85.57	12.33	16.33	81.63	40.43	1.79	1.15	11.73	9.53	93.76	96.53
BCB-57	150.43	77.87	14,27	17.00	66.80	45.40	1.56	1.16	12.43	10.03	95.94	97.11
BCB-75	106.20	81.10	14.33	15.70	78.57	40.03	1.85	1.39	12.77	9.97	96.49	96.90
Mean	**122.39**	**76.59**	**12.21**	**14.39**	**77.90**	**43.53**	**2.27**	**2.29**	**12.15**	**10.01**	**95.66**	**96.24**
LSD(0.05)												
Genotype	**7.78**		**1.80**		**2.01**		**0.58**		**0.61**		**2.21**	
Year	**3.18**		**0.73**		**0.82**		**0.24**		**0.25**		**NS**	
Year X Genotype	**11.01**		**NS**		**2.84**		**0.82**		**0.87**		**NS**	

NS- Not Significant, S-R = Summer- Rainy, A-W= Autumn – Winter seasons

Table 2: Performance of brinjal genotypes for fruit characters and yield

Genotypes	No. of fruits plant^{-1}		Length of fruits (cm)		Fruit diameter (cm)		Fruit weight (g)		Yield. plant^{-1} (kg)	
	S-R	A-W	S-R	A-W	S-R	A-W	S-R	A-W	S-R	A-W
BCB-14	0.97	15.43	8.17	13.70	5.33	5.37	51.03	154.43	0.06	2.53
BCB-15	1.20	5.53	10.79	11.80	5.97	6.80	57.77	143.60	0.07	0.81
BCB-20	4.83	40.57	15.60	20.43	2.23	2.27	26.93	53.13	0.16	2.80
BCB-23	28.50	87.30	10.27	12.60	3.13	4.20	42.57	61.63	1.32	4.81
BCB-34	14.37	55.33	8.83	11.80	2.80	2.20	28.93	27.27	0.40	1.53
BCB-38	18.73	101.90	10.46	12.40	2.33	3.31	16.30	50.17	0.40	5.25
BCB-42	36.57	44.87	7.50	7.57	2.80	5.63	34.20	88.80	1.26	2.72
BCB-43	42.33	60.93	8.73	11.80	3.03	3.53	31.50	61.00	1.36	3.37
BCB-45	23.47	85.70	9.47	14.60	3.47	4.00	35.73	39.40	0.99	3.36
BCB-48	9.90	16.03	10.17	9.47	3.77	6.03	59.60	97.60	0.66	1.39
BCB-57	15.97	45.13	11.70	16.30	3.47	4.80	49.63	122.40	0.87	4.51
BCB-75	10.43	51.10	8.27	12.43	3.65	4.10	35.47	77.43	0.44	3.77
Mean	**17.27**	**50.81**	**9.99**	**12.19**	**3.55**	**4.35**	**39.14**	**81.44**	**0.67**	**3.07**
LSD(0.05)										
Genotype	**8.23**		**1.07**		**0.09**		**22.13**		**0.31**	
Year	**3.36**		**0.43**		**0.23**		**9.04**		**0.11**	
Year x Genotype	**11.63**		**1.47**		**0.31**		**31.30**		**0.44**	

NS- Not Significant, S-R = Summer- Rainy, A-W= Autumn – Winter seasons heavier fruits. In high temperature and high moisture conditions fruit development was lower, which might have happened due to excessive vegetative growth (Table 1) and subsequent lean carbohydrate translocation to the fruits.

In both the seasons, significant variation was observed in yield per plant among the genotypes. Fruit yield was considerably reduced in summer-rainy season and the highest value was marked in BCB-43 (1.36 kg/plant) and as it registered the highest fruit yield, it may be tried in this season. Drastic lowering in fruit yield under high temperature owing to low fruit-set was reported by several workers (Kalloo, 1990; Kumar *et al.*, 2000; Mahanty and Prusti, 2000).The low yield in summer-rainy season is possibly due to reduced fruit size, both, length and width-wise, coupled with lighter fruit weight. So the yield potentiality of a genotype largely depends on environmental conditions. The superiority of BCB-43 seems to be due to higher proportion of long or medium-styled flowers.

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