



## **Influence of Flower Types on Fruit Setting and Yield Dynamics of Summer Brinjal (*Solanum melongena* L.)**

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### **Authors' contributions**

*This work was carried out in collaboration between all authors. Author SCB designed the study, performed the statistical analysis, wrote the protocol and first draft of the manuscript. Authors SI and MNU managed the analyses of the study. Authors BS and DDC managed the literature searches. All authors read and approved the final manuscript.*

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### **ABSTRACT**

The study was conducted at the research field of Olericulture Division, Horticulture Research Centre, Bangladesh Agricultural Research Institute (BARI), Gazipur to study the relationship among fruit setting and flower types and yield potentials of brinjal under summer condition during May to November 2013. Fourteen germplasms were evaluated in a Randomized Complete Block Design with three replications. Marked variation was observed among the studied germplasms. The lowest number of clusters per plant (13.78) and it was highest (6.31) recorded from the genotype SM 011. The total floral bud(s) per plant was recorded highest in SM 58-1 and SM 58-2 (127.62) and the lowest from SM 021 (37.31). The highest percentage of long styled flowers per plant counted from the genotype SM 58-1 (64.37%). The highest percentage of medium styled

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flower was counted from the genotype SM 200 (34.15%). BARI Begun -4 and SM 211 had the highest fruit setting percentage 75.17% and 72.56%, respectively. The lowest fruit setting percentage was recorded from the genotype SM 235 (30.27%). The highest yield loss per plant due to pest infestation was recorded from the genotype SM 58-2 (304.00 g) and the lowest from the genotype SM 011 (100.17 g). BARI Begun -4 produced the maximum number of edible fruits per plant (32.13) and BARI Begun -5 produced the minimum number of edible fruits per plant (8.10). The yield (edible fruit) per plant was found the highest in BARI Begun -4 (2.62 kg) and the lowest in SM 011(0.92 kg). The highest individual fruit weight (304.00 g) was obtained in EGN 10 and the lowest was 55.10 g in SM 011. Fruit setting percentage and yield were found more in that germplasms which produced relatively higher percentage of long and medium styled flower.

*Keywords: Brinjal; germplasm; fruit setting; boxplot; long styled flower; medium styled flower; cluster; fruit yield.*

## 1. INTRODUCTION

Brinjal/Eggplant (*Solanum melongena* L.) is the second most important vegetable after potato in respect of total acreage and production in Bangladesh and equally preferred by all classes [1]. It is a versatile annual crop and extensively cultivated in different agro climatic regions and can be grown throughout the year [2]. It occupies an area of 28.75 thousand hectares in winter season and 17.8 thousand hectares in summer season. The production of brinjal during winter season was before 215,490 metric tons and only 124,384 metric tons during summer season in the year of 2010-2011 [1]. It is grown in homestead and as field crop in both winter and summer seasons but the production of brinjal during summer is low. The low production depends on several factors, amongst them lack of suitable summer type variety is one of the main reasons.

There are four types of flowers found in brinjal depending on the length style, viz. long styled with big size ovary, medium styled with medium size ovary, pseudo short styled with rudimentary ovary and true short styled with very rudimentary ovary [3]. Fruit setting percentage is high in long styled and medium long styled flowers, while true short styled and pseudo short styled flowers do not set fruits at all [4,5].

Flowering and fruit setting are two most important factors determining the yield of cultivated eggplants, especially the style length which determines the effectiveness of fruit setting [6]. Poor fruit setting during summer season is one of the major causes of low brinjal production. Such poor fruit setting might be due to adverse effect of environmental factors like high temperature, excessive humidity, strong wind and heavy rainfall upon the embryological

processes [7]. Brinjal normally requires 25-28°C and 15-20°C day and night temperature respectively, for higher fruit setting [8]. During summer season, day temperatures (above 32°C) and night (above 20°C) remains high in Bangladesh. Other than these environmental factors, flower type is a major factor of fruit setting in eggplant [9]. Although brinjal is a year round crop but unfortunately good heat tolerant variety are not available for summer cultivation in Bangladesh. That's why this study was conducted to study the relationship among fruit setting and flower types and yield potentials of brinjal under summer condition.

## 2. MATERIALS AND METHODS

The experiment was conducted at the research field of Olericulture Division, Horticulture Research Centre (HRC), Bangladesh Agricultural Research Institute (BARI) with 12 germplasms viz. SM 011, SM 021, SM 58-1, SM 58-2, SM 200, SM 203, SM 204, SM 206, SM 211, SM 235, SM 236, EGN 10 and 2 varieties viz. BARI Begun -4, BARI Begun -5 of brinjal during May to November 2013. The experiment was laid out in a Randomized Complete Block Design (RCBD) with three replications. The unit plot size was 0.75 m x 7.0 m with plant spacing of 70 cm in single row maintaining 30 cm drain between the plots. Each replication contained ten plants and germplasms were randomly distributed to unit plot within each block. Soil pH ranged from 6.0-6.6 and had organic matter 1.1%. Experimental area is flat having available irrigation and drainage system. The crop was fertilized with cattle dung 15 ton, Urea 375 kg, TSP 150 kg and MP 250 kg commercial product per ha [10]. The entire amount of cattle dung and TSP and one-third of the Urea and MP were applied in the field during final land preparation as basal dose. The remaining

amount of Urea and MP were applied to the plant in three equal installments as top dressing after 15, 30 and 50 days of transplantation. Seeds were sown in the well prepared seedbed on 3 May 2013 and 35 days old seedlings were transplanted in the well-prepared experimental plot on 7 June 2013 with proper care and management. After transplantation, different essential intercultural operations were accomplished for optimum growth and development of the plants including gap filling, pruning and staking, earthing up, weeding, irrigation etc. Data were recorded from five randomly selected plants which were then analyzed through Statistical Tool for Agricultural Research (STAR) programme. The means were separated by Tukeys's Honest Significant Difference (HSD) Tests at 5% or 1% level of probability.

### 3. RESULTS AND DISCUSSION

#### 3.1 Days to Fifty Percent Plant Flowering

Significant variations were found in fifty percent plant flowering among the studied germplasms (Table 1). It was ranged from 48.32 to 58.10 days from the transplantation. The early flowering was observed in the genotype SM 011 (48.32 days) which was statistically similar to the germplasm SM 203 (49.43 day), BARI Begun -5 (50.32 day) and SM 58-1 (50.77 day). This result is in line with the findings of [11] and [12].

#### 3.2 Number of Clusters per Plant

Significant variations were found in number of clusters per plant and ranged from 13.78 to 68.05 (Fig. 1). The genotype BARI Begun -5

produced the maximum number of clusters per plant (68.05) (Table 1). The boxplot (Fig.1) indicated that number of clusters of 50% germplasm ranged from 39 to 56. The germplasms are SM 236 (55.87), BARI Begun -4 (55.38), SM 58-2 (53.77) SM 206 (55.56), SM 211 (44.48), SM 204 (45.12) and SM 203 (43.20). The median value of number of clusters was about 48. The germplasm SM 011 produced lowest number of clusters per plant (13.78) [13].

#### 3.3 Number of Floral Buds per Cluster

The genotype SM 011 produced the maximum number of floral bud(s) per cluster (6.31) followed by the germplasm SM 58-1(3.14), SM 206 (3.08) and BARI Begun -4 (2.87) (Table 1). The germplasm SM 203, SM 204, BARI Begun -5 and EGN 10 produced the lowest number of floral bud(s) per cluster (1.00) that means they produced solitary floral bud(s) and solitary flower produces large sized fruit. This result is similar to Hepper [14], Som and Maity's [15] findings.

#### 3.4 Total Number of Floral Bud(S) per Plant

The studied germplasms showed a significant variation in case of total number of floral bud(s) per plant (Table 1). The total number of floral bud(s) per plant ranged from 37.31 to 127.62. The germplasm SM 58-1 and SM 58-2 produced the maximum number of floral bud(s) per plant (127.62) followed by the germplasm SM 236 (113.91), BARI Begun-4 (108.46), SM 206 (104.41) and SM 011 (91.81). The germplasm SM 021 produced the lowest number of floral bud(s) per plant (37.31).

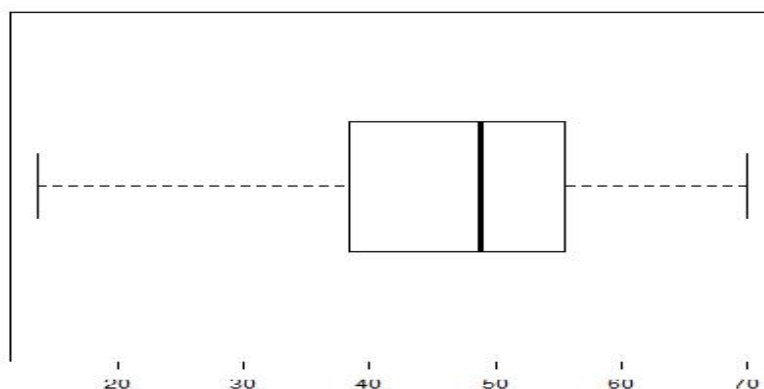


Fig.1. Boxplot of number of clusters per plant of studied germplasms

**Table 1. Days to 50% flowering, number of clusters per plant, number of floral bud(s) per cluster and total number of floral bud(s) per plant of studied brinjal germplasms**

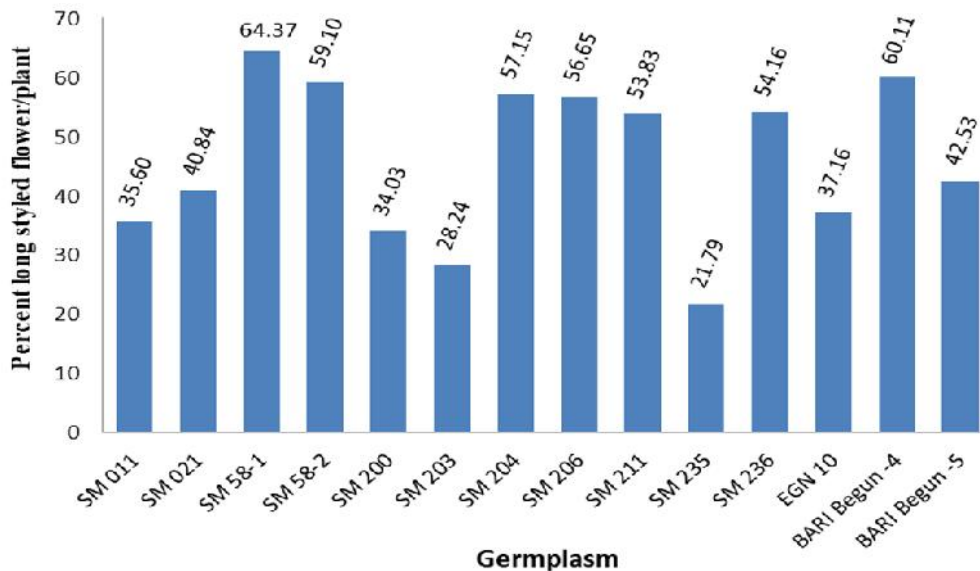
Germplasms	Days to 50% flowering	Number of clusters/plant	Number of floral bud(s)/cluster	Total number of floral bud(s)/plant
SM 011	48.32h	13.78i	6.31a	91.81c
SM 021	57.03ab	32.30g	1.11h	37.31h
SM 058-1	50.77e-h	56.77b	3.14b	127.62a
SM 058-2	51.58e-g	53.29c	2.56d	127.62a
SM 200	53.22d-f	30.33h	1.42g	49.97fg
SM 203	49.43gh	43.20e	1.00i	49.71fg
SM 204	56.51a-c	45.12d	1.00i	48.14fg
SM 206	53.54c-e	55.56b	3.08b	104.41b
SM 211	54.77b-d	44.48de	1.52f	49.95fg
SM 235	55.33a-d	38.13f	2.11e	88.04c
SM 236	58.10a	55.87b	2.85c	113.91b
EGN 10	56.27a-d	57.10b	1.01i	64.95de
BARI Begun-4	55.38a-d	55.38b	2.87c	108.46b
BARI Begun-5	50.32f-h	68.05a	1.00i	61.15de
Level of sig.	**	**	**	**
CV%	1.92	1.37	1.26	2.08

Means with the same letter(s) in a column are not significantly different at 1% level of significance. \*\* indicates significant at 1% level of significance

### 3.5 Percent Long Styled Flower per Plant

Percentage of long styled flower varied significantly among the studied germplasms (Fig. 2). The percent of long styled flower of different germplasms ranged from 64.37 to 21.79. It was found that the germplasm SM 58-1 had the highest percentage of long styled flowers (64.37) followed by BARI Begun -4 (60.11), SM 58-2 (59.10), SM 204 (57.15), SM 206 (56.65), SM 211 (53.83), SM 236 (54.16), EGN 10 (37.16), SM 021 (40.84), SM 011 (35.60), SM 200 (34.03), SM 203 (28.24), SM 235 (21.79) and BARI Begun -5 (42.53).

SM 206 (56.65). The lowest percent of long styled flower (21.79) was recorded from the germplasm SM 235, which was statistically similar to the germplasm SM 203 (28.24). Pradeepa [16] reported that the percentage of long styled flower was majority among all flower types on a plant and it was about 58.9 percent. Germplasm which produces higher long styled flower indicates the potentiality of high fruit setting and yield.



**Fig. 2. Percent long styled flower per plant among the studied brinjal germplasms**

### 3.6 Percent Medium Styled Flower per Plant

Significant variations were found in percentage of medium styled flower among the studied brinjal germplasms (Fig. 3). The medium styled flower percent of different germplasms ranged from 8.01 to 34.15. It was found that the genotype SM 200 had the highest percentage of medium styled flower (34.15) followed by SM 203 (30.33), SM 211 (26.30) and BARI Begun -4 (25.33). Germplasm SM 200 has high potentiality of fruit setting and yield. The lowest percentage of medium styled flower (8.01) was recorded from the genotype SM 58-1. Passam and Bolmatis [5] reported that the medium styled flower percentage of different brinjal germplasms ranges from 10 to 20.

### 3.7 Percent Pseudo-short Styled Flower per Plant

Significant variations were found in percentage of pseudo-short styled flower among the germplasms (Fig. 4). From this observation it was found that the germplasm SM 235 had the highest percentage of pseudo-short styled flower (28.65) followed by SM 58-1 (24.64) and SM 011 (22.07). The lowest percentage of pseudo-short styled flower (5.27) was recorded from the germplasm SM 211, which was statistically similar to the variety BARI Begun -4 (5.28) and SM 204 (5.34). The percent of pseudo-short styled flower of different germplasms ranged from 28.65 to 4.86.

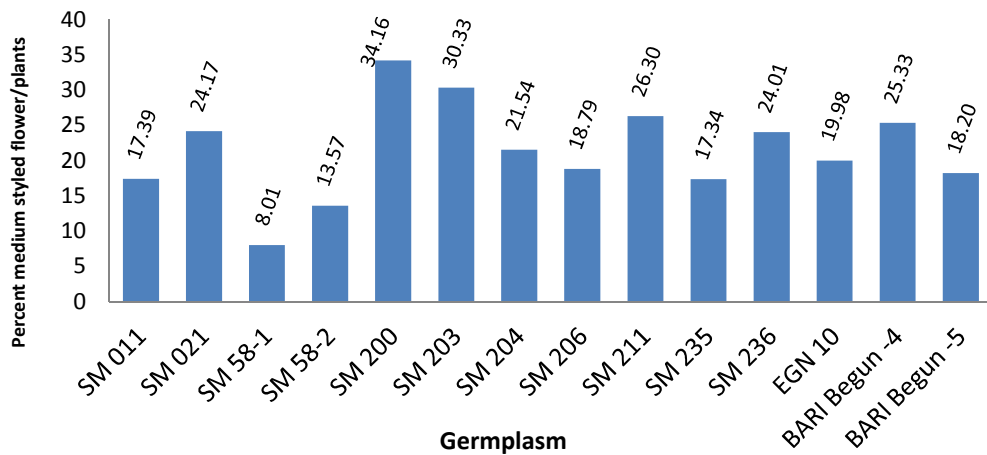


Fig. 3. Percent medium styled flower per plant among the studied Brinjal germplasms

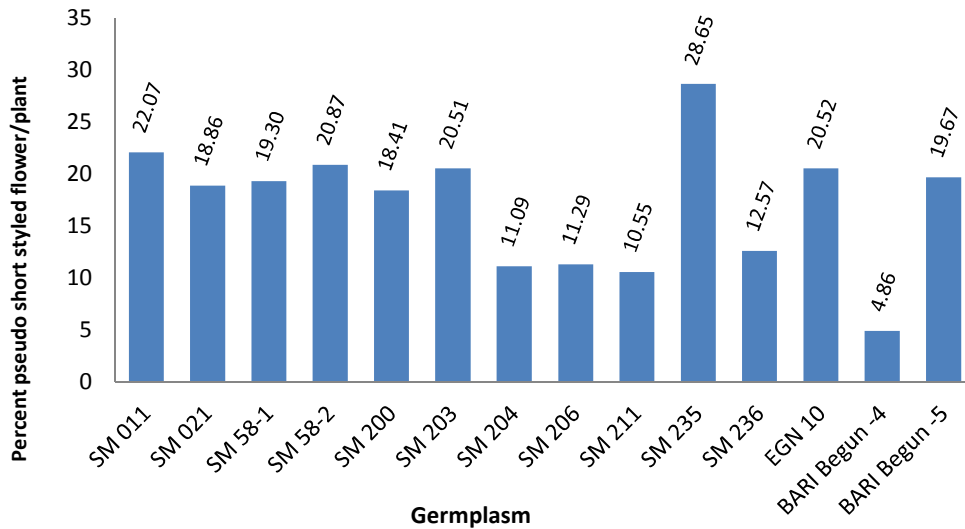


Fig. 4. Percent pseudo short styled flower per plant among the studied Brinjal germplasms

### 3.8 Percent True Short Styled Flower per Plant

Significant variations were found in the percentage of true short styled flower among the studied germplasms (Fig. 5). The percentage of true short styled flower of different germplasms ranged from 32.22 to 6.46. From this observation it was found that the germplasm SM 235 had the highest percentage of true short styled flower (32.22) followed by SM 011 (24.94), EGN 10 (22.34), SM 203 (20.92) and BARI Begun -5 (19.60). The lowest percentage of true short styled flower (6.46) was recorded from the germplasm SM 58-2.

### 3.9 Percent Fruit Setting

The Fruit setting percentage of different germplasms ranged from 30.27 percent to 75.17 percent (Table 2). From this experimental data it was observed that, the genotype BARI Begun -4 had the highest fruit setting percentage (75.17%) followed by the germplasm SM 211 (72.56%), SM 58-2 (68.00%), SM 236 (65.07%) and SM 204 (64.67%). The lowest fruit setting percentage per plant (30.27%) was recorded from the germplasm SM 235, which were close to the germplasm SM 011 (40.17%) and BARI Begun -5 (46.23%). Flower dropping rate was found higher in SM 236, SM 011, SM 58-1 and SM 58-2. Grażyna [17] found that fruit setting in long styled flower and medium styled flower ranges from 49% to 100% and 46% to 85% respectively, in different varieties.

### 3.10 Number of Edible Fruits per Plant

Number of edible fruits per plant was significantly different among the studied germplasms (Table 2). The total number of edible fruits per plant ranged from 32.13 to 8.10. The germplasm BARI Begun -4 produced the maximum number of edible fruits per plant (32.13) followed by the germplasm SM 206 (18.17), SM 011 (16.50). The variety BARI Begun -5 produced lowest number of edible fruits per plant (8.10) which was statistically similar to the germplasm EGN 10 (9.20), SM 203 (9.77) and SM 204 (10.50). Due to high temperature and heavy rainfall during summer season, flower and fruit dropping rate was high after fertilization. Islam and Uddin [18] found that number of fruits produced per plant ranged from 6.60 to 46.60.

### 3.11 Single Fruit Weight

Significant variation was found in single fruit weight among the studied brinjal germplasms (Table 2). Single fruit weight of different germplasms ranged from 55.10 g to 199.87 g. Fruits produced from solitary flower were heavier while fruits produced from clusters were lighter. The highest fruit weight was recorded in the germplasm EGN 10 (199.87 g) followed by SM 203 (199.80 g), SM 021 (147.50 g) and BARI Begun -5 (137.00 g). The lowest fruit weight was 55.10 g recorded from the germplasm SM 011 which was statistically identical to SM 206 (72.93 g). Similar trend of result was found by Islam and Uddin [18].

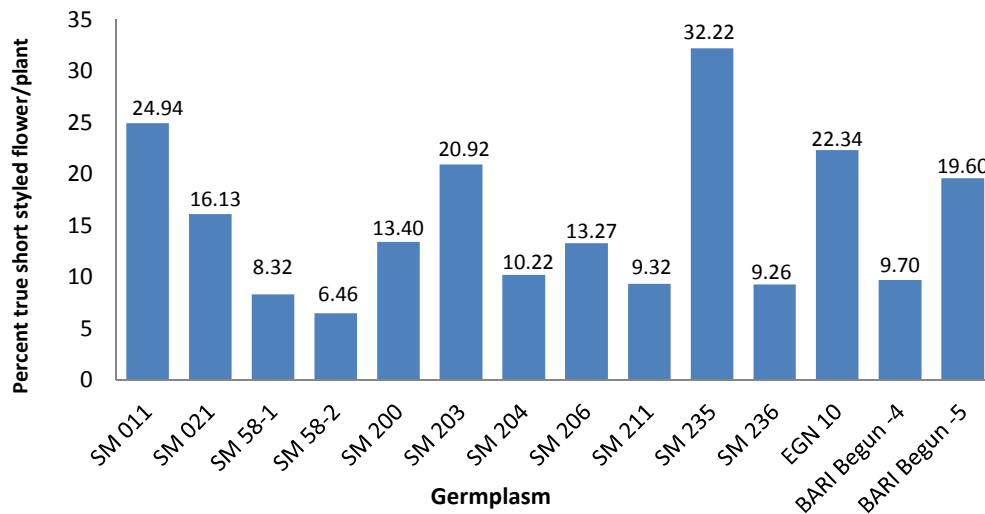
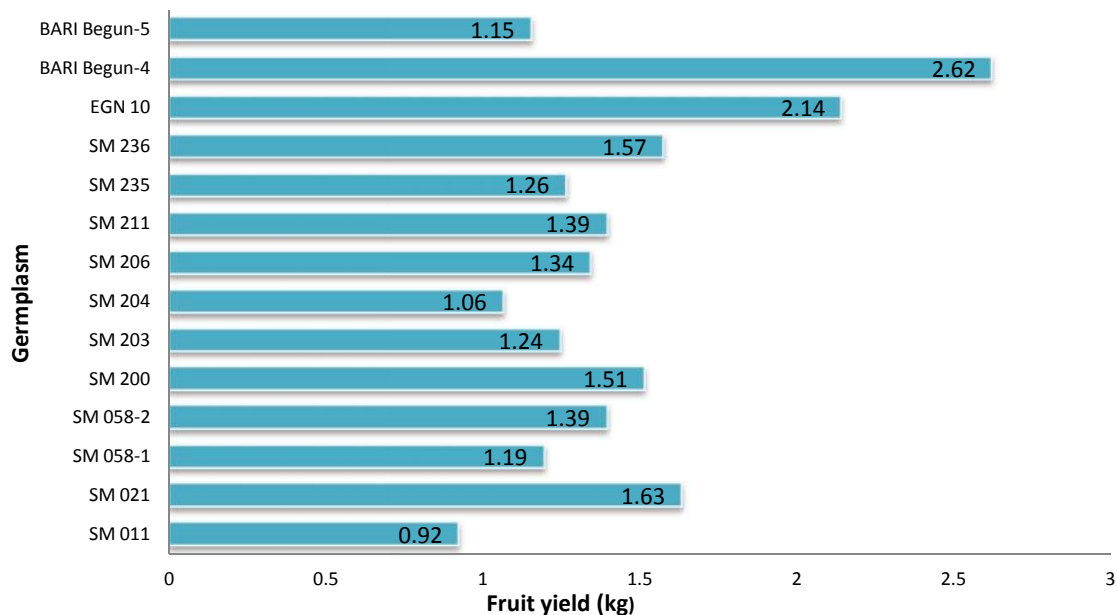


Fig. 5. Percent true short styled flower per plant among the studied brinjal germplasms

**Table 2. Percent fruit setting, number of edible fruits per plant, infested fruit per plant and single fruit weight of studied brinjal germplasms**

Germplasms	Percent fruit setting	Number of edible fruits per plant	Weight of infested fruit per plant (g)	Single fruit weight (g)
SM 011	40.17g	16.50bc	100.17e	55.10h
SM 021	50.00f	10.59e-g	130.67c-e	147.50b
SM 058-1	62.60c-e	14.90b-d	118.00c-e	77.97g
SM 058-2	68.00bc	15.90b-d	142.67c-e	87.93fg
SM 200	57.67e	11.94d-g	146.67c-e	125.00cd
SM 203	57.37e	9.77e-g	258.33ab	199.80a
SM 204	64.67cd	10.50e-g	147.33c-e	93.10e-g
SM 206	60.87de	18.17b	133.00c-e	72.93gh
SM 211	72.56ab	12.53c-f	186.33bc	112.67de
SM 235	30.27h	13.59c-e	172.33c-e	93.00e-g
SM 236	65.07cd	13.63c-e	181.67b-d	114.33de
EGN 10	57.43e	9.20fg	304.00a	199.87a
BARI Begun-4	75.17a	32.13a	276.30a	100.93ef
BARI Begun-5	46.23f	8.10g	104.33de	137.00bc
Level of sig.	**	**	**	**
CV%	3.14	9.88	15.44	6.46

Means with the same letter(s) in a column are not significantly different at 1% level of significance. \*\* indicates significant at 1% level of significance



**Fig. 6. Fruit yield (kg) per plant among the studied brinjal germplasms and varieties**

### 3.12 Weight of Infested Fruit per Plant

The weight (g) of infested fruit per plant varied significantly from 100.17 g to 304.0 g (Table 2). From this observation it was found that the genotype EGN 10 had the highest weight (g) of infested fruit per plant (304.0 g) which was statistically similar to the variety BARI Begun -4

(276.30 g) and SM 203 (258.33 g). The lowest weight (g) of infested fruit per plant (100.17 g) was recorded from the germplasm SM 211, which was statistically similar to the variety BARI Begun -5 (104.33 g), SM 58-1 (118.00 g), SM 206 (133.00 g) and SM 58-2 (142.67 g). Islam and Uddin [18] found that incidence of brinjal shoot and fruit borer (BSFB) infestation per plant



ranged from 3.0% to 20.6% of fruit yield; it supports the present study findings.

### 3.13 Fruit Yield per Plant

Significant variations were found in fruit yield (edible fruit) per plant (kg) among the studied germplasm. The fruit yield of different germplasms ranged from 0.92 kg to 2.62 kg (Figure 6). From this observation it was found that the variety BARI Begun -4 had the highest fruit yield per plant (2.62 kg) followed by germplasm EGN 10 (2.14 kg) and SM 021 (1.63 kg). The lowest fruit yield per plant (0.92 kg) was recorded from the germplasm SM 011, which was statistically similar to SM 204 (1.06 kg), BARI Begun -5 (1.15 kg), SM 58-1 (1.19 kg). Rahman [19] reported that yield per plant during summer season ranged from 1.60 kg to 2.64 kg in brinjal. The present finding is lower than this result in case of lowest limit of yield per plant than the reported results. It may be happened due to difference of variety as well as the environment and pest infestation. Kumar and Arumugam [20] found marketable fruit yield per plant ranges from 1.93 kg to 0.76 kg.

## 4. CONCLUSION

Wide range of variation was recorded in case of flower types, fruit and yield characteristics among the studied germplasms. Fruit setting percentage and yield were found more in germplasms (BARI Begun -4, SM 211, SM 236, SM 204, SM 206, SM 58-2) which produced relatively higher percentage of long and medium styled flower. The variety BARI Begun -4 and EGN 10 were found promising for fruit yield during summer, as they produced 2.62 kg and 2.14 kg of edible fruits per plant respectively. Specially EGN 10 and SM 021 will be very good materials for the farmers due to high yield and attractive size.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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