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VARIATION IN MORPHOLOGICAL ATTRIBUTES AND YIELD OF TOMATO CULTIVARS

Amit Malaker[1], AKM Zakir Hossain[2], Tahmina Akter[3*] and Md. Shariful Hasan Khan[4]

[1]Department of Seed Science and Technology, [2]Department of Crop Botany, [3]Department of Biochemistry and Molecular Biology and [4]Department of Soil Science; Faculty of Agriculture, Bangladesh Agricultural University, Mymensingh-2202, Bangladesh

***Corresponding author:** Tahmina Akter; E-mail: tahminataniabmb@gmail.com

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ABSTRACT

A pot experiment was carried out in the grill house of the Department of Seed Science and Technology, Bangladesh Agricultural University (BAU), Mymensingh during the period of mid December 2014 to mid April 2015. The experiment conducted with five treatments (five tomato genotypes) and employed in Completely Randomized Design (CRD) with four replications. Of the five genotypes two were obtained Japan (Pasta and Mimi) and the rest three from Bangladesh Agricultural Research Institute (BARI). Genetic variations appeared for morphological and phenological characters and yield attributes in the five tomato genotypes. Taller plants with higher number of branches were observed in the Japanese genotype (Mimi) while number of days required to initiate flower and fruit initiation and fruit maturity were shorter in BARI tomato 12 and BARI tomato 14. Flower and fruit productions plant^{-1} was higher in BARI released tomato cultivars, therefore, the tomato yield was also higher in those cultivars.

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INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.) is one of the most important edible and nutritious vegetable all over the world and it belongs to the family Solanaceae. Because of its wide adaptability, tomato is grown throughout the world. It ranks next to potato and cassava in respect of vegetable production in the world (FAO, 2013). In Bangladesh, it ranks 2nd which is next to potato (BBS, 2010) and top the list of canned vegetables. A large number of tomato varieties are growing in Bangladesh and those are exotic in origin and developed long before. Most of them lost their potentiality due to genetic deterioration, diseases and insect infestations. So, in order to increase the tomato production in Bangladesh, it is very much essential to find out the varieties capable of growing round the year, higher yield and resistant to disease and insect pests. Recently various research organizations have developed a few high yielding, disease and insect resistant varieties but these do not show better performance throughout the year because of photo-sensitiveness and insufficient wider adaptability.

In Bangladesh, tomato has great demand throughout the year especially in early winter and its production is mainly concentrated during the winter season. Recent statistics showed that tomato was grown in 15,790 hectares of land and the total production was approximately 102,000 metric tons in 2010-11. Thus the average yield of tomato was 1.29 t ha^{-1}(BBS. 2010), while it was 69.41 t ha^{-1}in USA, 14.27 t ha^{-1}in India, 26.13 t ha^{-1}in China, 13.25 t ha^{-1}in Indonesia and 59.6 t ha^{-1}in Japan (FAO, 2009). To meet nutritional demand of population, it is highly important to increase the yield of tomato per unit area of land. Increase of production depends on many factors, such as the use of improved varieties, proper management and awareness about improved production technologies. So, using different types of techniques, such as nuclear techniques, fertilizer management, proper spacing, applying plant growth regulator, synthetic mulching, natural mulching and even conventional breeding methods may improve production level and quality under the existing environmental conditions. Inventing morphological characters is required to identify important canopy features and yield attributes in tomato. Such studies are also necessary for varietal improvement. The purposes of this study is to evaluate some morphological attributes and yield of tomato genotypes and to select the better genotypes of tomato in respect of yield performance from five elite local and exotic tomato varieties.

MATERIALS AND METHODS

Experimental site and time

The experiment was conducted at the grill of the Department of Seed Science and Technology, Bangladesh Agricultural University (BAU), Mymensingh, during the period from mid December 2014 to mid April 2015.

Experimental materials

Five tomato genotypes Japanese tomato (Pasta), Japanese tomato (Mimi), BARI tomato 2, BARI tomato 12 and BARI tomato 14 used as experimental materials. The seed of Japanese tomato genotypes were collected from Japan (Kaneko Seed Co. Ltd.) and BARI tomato variety from Horticulture division of Bangladesh Agricultural Research Institute (BARI), Gazipur.

Treatments

Five tomato genotypes considered as five different treatments and four replications were used in the experiment.

Preparation of pot

Pots were used for the experiment (20 inch) and total numbers of pots were 20. The selected pots were filled with soil. Then the soil mixed with organic manure and fertilizer (urea 2.09 g, MoP 0.99 g, cowdung 400 g and compost 50 g pot^{-1})

Statistical analysis

Yield and yield contributing data were collected and analyzed statically following the analysis of variance (ANOVA) technique and the mean differences were adjudged by Duncan's Multiple Range test (DMRT) using the statistical computer package program, MSTAT-C (Gomez and Gomez, 1984).

RESULTS

Percent germination of seeds

The highest germination percentage of seeds (89.30%) was recorded in BARI tomato 14 followed by BARI tomato 12. On the contrary, the lowest germination percentage of seeds (74.70%) was observed in Japanese tomato PASTA which was also statistically different from other genotypes (Figure 1). Variation of seed germination might be due to genotypic effect.

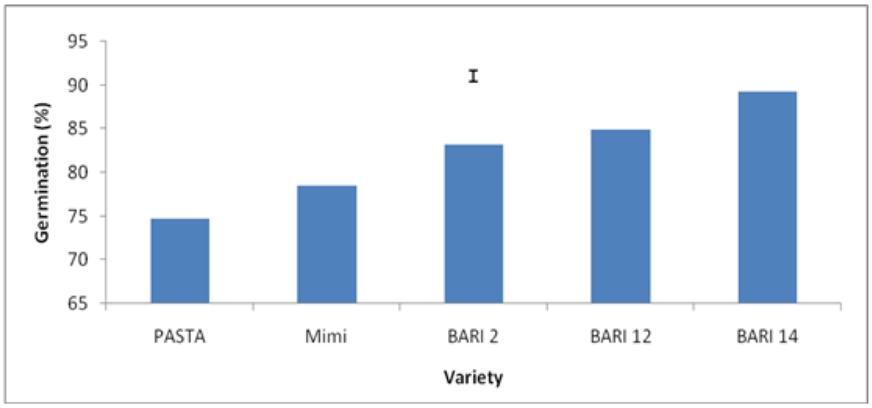

Figure 1. Effect of different genotypes of tomato on germination percentage of seeds
(Vertical bar represents LSD at 0.5 % level of significance)

Plant height (cm)

The highest plant height (80.67cm) was recorded in Mini and the lowest (62.00cm) was recorded in BARI 2 which was statistically identical with PASTA (64.00cm) but statistically different from other genotypes (Table 1).

Number of branches plant^{-1}

The maximum (21.0) number of branches plant^{-1} was found in Japanese tomato Mini which was statistically differed from other genotypes (table 1). The minimum number of branches (13.0) was recorded in Japanese tomato Pasta while same (13.0) number of branches plant^{-1} was also recorded in BARI tomato 14.

Leaf size

The highest leaf size (5.30cm) was recorded in BARI tomato 14 which was statistically similar to BARI tomato 2 (5.20cm^2). On the other hand, the lowest leaf size (2.50cm^2) was obtained from the genotype Japanese tomato Mimi which was statistically differed from other genotypes (Table 2).

Number of leaves branch^{-1}

The highest number of leaves branch^{-1} (15.00) was produced from the both genotypes of BARI tomato 12 and BARI tomato 14 while Japanese tomato Pasta also produced statistically identical highest number of leaves branch^{-1} (13.33) in this study. On the other hand, the lowest number of leaves branch^{-1} (11.00) was found in BARI tomato 2 while it was statistically close to Mimi (13.00) (Table 2).

Days to flower initiation

Days to flower initiation showed highly significant variation among the genotypes. Among the genotypes, Japanese tomato Pasta required more time (38.90 DAT) for initiation of flowering while Japanese tomato Mini also required the statistically similar time (38.60 DAT) for flower initiation. In contrast, the genotype BARI tomato 14 showed the lowest time (31.30 DAT) for flower initiation which was statistically differed from other genotypes of the study (Figure 2).

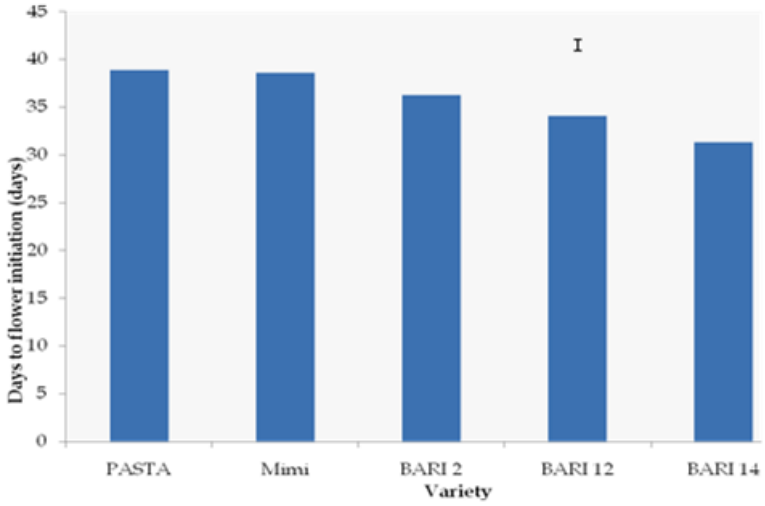

Figure 2. Effect of different genotypes of tomato on days of flower initiation
(Vertical bar represents LSD at 0.5 % level of significance)

Days to fruit initiation

The mean value for the first fruit setting of different genotype ranged from 35.10 to 42.90 DAT (Figure 3). Mean data showed that the BARI tomato 14 provided very earlier (35.10 DAT) fruit setting and the Japanese tomato Pasta showed delayed fruit setting (42.90 DAT) which was statistically close to Japanese tomato Mimi (41.10 DAT).

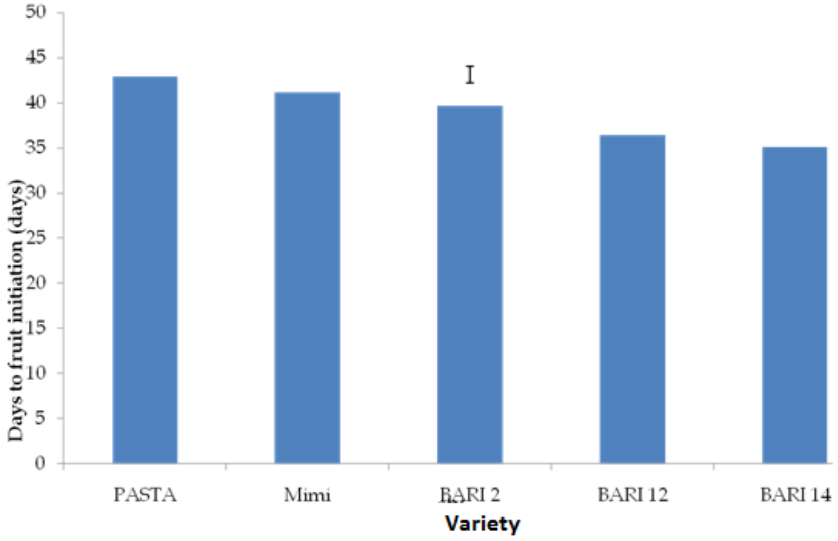

Figure 3. Effect of different genotypes of tomato on days to fruit initiation
(Vertical bar represents LSD at 0.5 % level of significance)

Number of flowers cluster plant^{-1}

The highest number of flowers cluster plant^{-1} (7.90) was obtained in BARI tomato 14 which was statistically close to BARI tomato 12 (7.25). The lowest number of flowers cluster plant^{-1} (5.70) was found in Japanese tomato pasta (Table 3).

Number of fruits cluster plant^{-1}

The maximum number of fruits cluster plant^{-1} (5.67) was produced in BARI tomato 2 which was statistically similar to BARI tomato 12 and BARI tomato 14 (both same 5.33) (Table 3). The minimum number of fruits cluster^{-1} (4.00) was found in Japanese tomato Pasta while Mimi also showed the statistically similar fruits cluster plant^{-1} (4.33).

Table 1. Plant height and number of branches in five tomato cultivars

Variety	Plant height (cm)	Number of branches plant^{-1}
PASTA	64.00	13.00
Mimi	80.67	21.00
BARI 2	62.00	15.00
BARI 12	70.67	14.33
BARI 14	73.00	13.00
$LSD_{(0.05)}$	**3.36**	**1.475**
Level of significance	**	**
CV (%)	**2.55**	**5.147**

Table 2. Leaf size and No. of leaf/branch in five tomato cultivars

Variety	Leaf size (cm^2)	Number of leaves branch^{-1}
PASTA	3.30	13.33
Mimi	2.50	13.00
BARI 2	5.20	11.00
BARI 12	5.00	15.00
BARI 14	5.30	15.00
$LSD_{(0.05)}$	**0.164**	**2.110**
Level of significance	**	*
CV (%)	**2.095**	**8.353**

Table 3. Flower and fruit production in five tomato cultivars

Variety	Number of flowers cluster plant^{-1}	Number of flowers plant^{-1}	Number of fruits plant^{-1}	Number of fruit cluster plant^{-1}
PASTA	5.70	9.70	7.33	4.00
Mimi	5.90	12.00	9.00	4.33
BARI 2	6.10	16.15	10.66	5.66
BARI 12	7.25	17.35	11.00	5.33
BARI 14	7.90	19.90	12.00	5.33
LSD $_{0.05}$	0.951	2.117	1.646	0.972
Level of significance	**	**	**	*
CV (%)	7.31	9.01	8.759	10.465

Number of flowers plant^{-1}

At harvest, the maximum number of flowers plant^{-1} (19.90) was recorded in BARI tomato 14 and the minimum number of flowers plant^{-1} (9.105) was recorded in Japanese tomato Pasta (Table 3).

Number of fruits plant^{-1}

The maximum number of fruits plant^{-1} (12.00) was recorded in BARI tomato 14 which was statistically similar to BARI tomato 2 (10.66) and BARI tomato 12 (11.00). On the other hand, the minimum number of fruits plant^{-1} (7.33) was obtained in Japanese tomato Pasta which was statistically differed from other genotypes of the study (Table 3).

Weight of individual fruit

The highest weigh of individual fruit (35.44g) was obtained in the genotypes BARI tomato 14 which was statistically identical to BARI tomato 12 (35.21g). The lowest weight of individual fruit (23.17g) was found in Japanese tomato Pasta which was statistically differed from other genotypes (Figure 4).

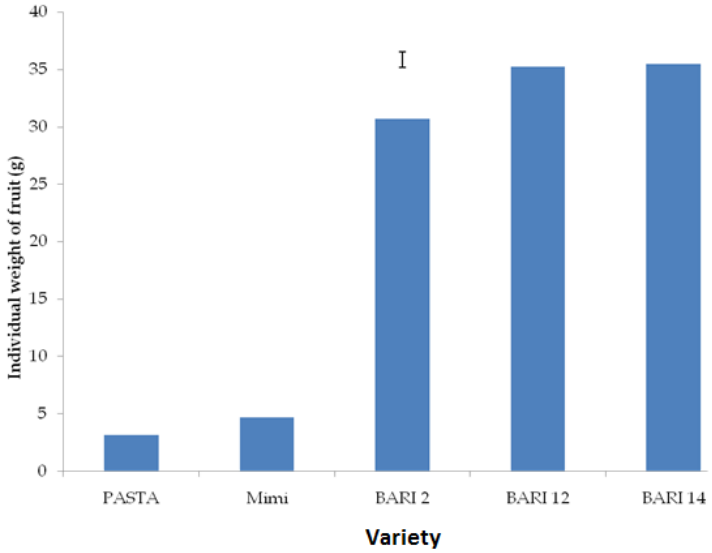

Figure 4. Effect of different genotypes of tomato on individual weight of fruit.
(Vertical bar represents LSD at 0.5 % level of significance)

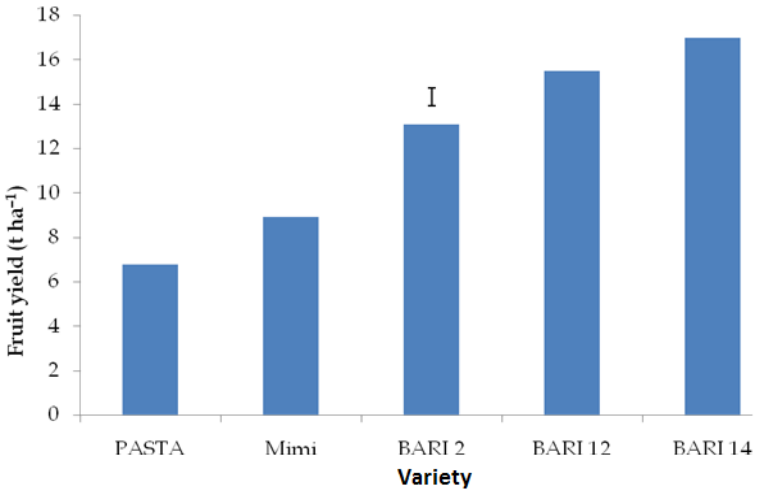

Figure 5. Effect of different genotypes of tomato on yield of fruit per ha.
(Vertical bar represents LSD at 0.5 % level of significance)

Fruit yield (t ha^{-1})

The highest fruit yield (17.011 tha^{-1}) was found in BARI tomato 14 followed by BARI tomato 12 (15.492 tha^{-1}). The lowest fruit yield (6.796 tha^{-1}) was obtained in Japanese tomato Pasta which was statistically different from other genotypes of the study (Figure 5).

DISCUSSION

In the conducted study, genotypic effect was significantly influenced the studied whole traits regarding morpho–physiological, fruit yield and yield attributes where most of the characters were highly influenced by different genotype BARI tomato 14. Germination percentage different significantly due to genotypes while BARI tomato 14 had more significant than other varieties which might be due to the variation in genetic characteristics of the studied varieties. The same observation was also found by the researchers named Kabir (2004), Hussain (2001),Khokhar (2001) and Ahmed *et al*.(1986). They also found significant variation on seed germination due to the variation in genetic makeup of the studied genotypes. Similar effect due to genotypes was also obtained on the various types of morphological and growth characters of the tomato plant such as plant height, branches plant^{-1}, leaf size and leaves branch^{-1}. Genotypic variation of the studied genotypes was more effective for the above variation in morphological and growth characters while climatic factors and soil nutrients were also effective for the above variation. The agreement of the present study were also similar to the study. Singh et al. (2002), Kabir (2004),Hossain (2003) and karim (2005) who also reported that the morphological and growth characters of tomato were varied significantly due to varieties. Due to more number of flower cluster represents the highest yield Plant^{-1}. In this study we also found that, more flower cluster (BARI tomato 14) had more productive than other varieties.

Phookan et al. (1998), Sing et al. (1997) and Sonone et at. (1986) who also reported that the morphological and growth characters of tomato were varied significantly due to varieties. Fruit yield and yield attributes of the present study due to varieties were also significant where BARI tomato 14 were more effective and highly influenced the fruit yield due to more number of flowers and fruits plant^{-1} and highest weight of individual fruits were also achieved in this genotype. The genotype BARI tomato 14 had more productive which might be due to the variation in genetic make up of the varieties and also the variation in adaptability with the studied regional weather condition and soil nutrients.

CONCLUSION

The genotype BARI tomato14 produced the highest number of flower clusters plant^{-1} and fruit clusters plant^{-1}. Japanese tomato Mimi and BARI tomato12 showed higher plant height and in a total maximum number of primary branches plant^{-1} was found in Japanese tomato Pasta and BARI tomato 14 produced the highest number of fruits and fruit yield. BARI tomato 14 showed the best yield performance in compare to other genotypes.

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