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Adaptibility of tomato genotypes suitable for coastal region of Patuakhali in Bangladesh

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Abstract

A field experiment was carried out at the Regional Horticultural Research Station, Lebukhali, Patuakhali, during the winter. The experiment was conducted to find out adaptive tomato genotypes suitable for coastal Patuakhali region considering their growth and yield performance. The genotypes of this experiment showed significant influence independently on different parameters of tomato plant. The maximum plant height (86.80 cm) was found in BARI tomato-3. The maximum primary (2.55), secondary (9.55) and tertiary branch (4.48) were obtained from BARI tomato-14. The maximum number of leaves (34.93) obtained from BARI tomato-14. The highest length of largest leaves (35.87 mm) was recorded in BARI tomato-3. The maximum number of flower clusters plant^{-1} (19.47), number of flowers cluster^{-1} (6.62), number of fruit cluster^{-1} (4.84), number of flowers plant^{-1} (126.3), number of fruits plant^{-1} (88.0), minimum date for 50% flowering(53.33), highest percentage of fruit setting (76.27), minimum days to first harvest (101.7) were obtained from BARI tomato-14. Moreover, BARI tomato-14 also performed better in respect of yield (3.51 kg/plant and 124.8 t/ha). It may therefore concluded that the genotype BARI tomato-14 showed better growth and yield performance under the coastal condition and suitable for Patuakhali region.

Key words: Tomato, genotypes, coastal region, growth and yield

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Introduction

Tomato (*Lycopersiconesculentum*Mill.) is one of the most popular and versatile vegetable in the tropical and subtropical areas including Bangladesh. It is cultivated in almost all home gardens and also in the field due to its adaptability to wide ranges of soil and climate (Ahmed, 1976). lt ranks next to potato and sweet potato in the world vegetable production (Rashid, 1983). Tomato ranks third in terms of world vegetable production (FAO, 2000) and tops the list of canned vegetables (Chaudhury, 1979). However, the yield of the crop in this country is very low compared to those of some advanced countries (Sharfuddin and Siddique, 1985). Tomatoes are the important source of lycopene, ascorbic acid and β-carotene and valued for its color and flavor. Among the vegetables tomato is important for vitamin A, C and minerals (Islam *et al.*, 1996). Yield of tomato varies in different agro-ecological zones. Yield as a complex character depends on many quantitative components and is influenced by environmental factors. Yield also expression of a genotype is mainly governed by environment and other management factors. Tomato yield in the tropics is much lower than that in the temperate zone due to several factors like high humidity high temperature, excessive rainfall, disease and pest. Yield variation may also be occurred due to variation in cultural practices. Tomato production in Bangladesh is constrained by many factors of which seasonality (grow only winter) and diseases are main problems. Although tomato can grow under a wide range of climatic conditions, they are extremely sensitive to hot and wet growing condition, limiting its adaptation in humid tropics, the weather which prevails in the summer - rainy season of Bangladesh. Fruit setting in tomato is reportedly interrupted at temperature above 26 °Cday and 20 °C night, respectively and is often completely arrested above 38°C day and 27 °C night (Kuo*et al.*, 1979, Stevens and Rudich, 1978). For optimum fruit setting, tomato requires a night temperature of 15 to 20 °C (Verkerk, 1955; Osborne and Went, 1953). The optimum condition for fruit setting in Bangladesh is only available in winter season (November to February). Farmers generally grow the local genotypes and thus losing interest in producing tomato due to low income per unit of resource invested. Therefore, this study was carried out to investigate the productivity and variations of growth, development and yield of tomato genotypes grown under the coastal condition of Patuakhali region.

Materials and Methods

A field experiment was conducted at the Research field of Regional Horticulture Research Station (RHRS), Lebukhali, Patuakhali during the winter. The research farm is located at 22^0 37′ N latitude and 89^0 10′ E longitudes. The area is situated on Ganges Tidal Floodplains and falls under Agro-ecological Zone “AEZ– 13”. The area lies at 0.9 to 2.1 meter above mean sea level (Iftekhar and Islam, 2004). The soil of the experimental field was siltycaly loam having pH value of 6.8. The organic carbon content (0.93%) found low in most cases. Deficiency of nitrogen is acute and widespread. Status of exchangeable potassium is almost satisfactory. Eight tomato genotypes (LE-009, TLB-130, VRT-005, VRT-007, BARI tomato-3, BARI tomato-8, BARI tomato-14, and BARI tomato-15)were used in this experiment. The seeds of tomato genotypes were collected from Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur. The experiment was laid out in a Randomized Completely Block Design (RCBD) with three replications. Each replication consists of 24 plants with the spacing of 60 cm x 40 cm (Razzak*et al.,* 2000). Seedlings were raised in separate seed beds under special cares. Manures and fertilizers were applied according to the recommendation guide (BARI, 2004). Total amount of well decomposed cow dung and TSP were applied during the final land preparation. Urea and MoP were applied as top dressing in two equal installments. Healthy seedlings of 30 days aged of uniform size were transplanted to the experimental plots during afternoon. Various intercultural operations were accomplished for better growth and development of the plants, which includes – irrigation, weeding, gap filling, staking, and management. During foggy weather preventive measure against disease was taken by spraying Diathane M-45 fortnightly @ 2 g L^{-1} of water, at the early vegetative stage. Fruits were harvested during early ripening stage when they become slightly red in color. Number of fruits harvested from five tagged plants at each picking (harvest) were counted and total number of fruits per plant was calculated. Randomly selected five plants were used for recording different morphological data (plant height) at 15 days interval starting from 15 DAT to 75 DAT and yield parameters (days to 50% flowering, % fruit sets, days to harvest, number of cluster $plant^{-1}$, flower $cluster^{-1}$, flower $plant^{-1}$, fruits $cluster^{-1}$, fruits $plant^{-1}$, length and diameter of fruit, pericarp thickness, fruit weight) were recorded during harvest.

Plant height was measured by using centimeter scale and was expressed in cm.The total number of clusters in individual plant was counted to calculate number of cluster per plant. Total number of flowers was divided by the total number of clusters to get flower numbers per cluster. The total number of flowers in each plant was counted to get flower number per plant. The days required for the blooming of flowering at least 50% flower was counted as 50% flowering days. Total number of fruits of each plant was divided by the total number of clusters and the mean value of fruit per cluster was calculated. The total number of fruits in each plant was counted to get fruit number per plant. Total number of fruits of each plant was divided by the total number of flowers and the value is multiply with 100 to count percent of fruit setting. The days required for first harvesting of fruit of a plant was counted as days of first harvest. The pericarp of fruit was measured as the outer side to fleshy part (mesocarp) in cm with a centimeter scale. The length of fruit was measured as the vertical distance from one side to another of the sectioned fruit in cm. The diameter of fruit was measured with a centimeter scale as the horizontal distance from one side to another of the sectioned fruits. Five fruits were randomly selected from each plant, weighed and averaged to get individual fruit weight which was expressed in gram. Thus total weight was calculated to get fruit weight per plant and expressed in kilogram. The total weight of fruits harvested from sample plant and each picking was added and average yield per plant was calculated and expressed in kilogram per plant. Later the yield per hectare was calculated and expressed as tons per hectare.

The collected data were analyzed statistically to obtain the level of significance following the analysis of variance (ANOVA). The mean differences were compared by Duncan's Multiple Range Test at 5% level of probability using the statistical computer package program, MSTAT-C (Russell, 1986).

Results and Discussion

***Plant height*:** Plant height varied significantly at different days after transplanting (DAT) for different genotypes (Figure 1). At 15 DAT the maximum (21.37 cm) plant height was obtained from VRT-005, while the minimum (9.967 cm) was recorded from BARI tomato-14. The maximum (27.20 cm) plant height was recorded from VRT-005 and the minimum (15.07 cm) was found from BARI tomato-15 at 30 DAT. At 45 DAT the maximum (37.40 cm) plant height was recorded from VRT-005 and the minimum (25.30 cm) plant height was observed in VRT-007. At 60 DAT the maximum (68.40 cm) plant height was recorded from BARI tomato-03 and while the minimum (47.37 cm) plant height observed in VRT-007. At 75 DAT the maximum (86.80 cm) plant height was recorded in BARI tomato-3 while the minimum (55.10 cm) plant height observed in VRT-007. But at last harvest the maximum (120.9 cm) plant height was recorded from BARI tomato-3 and the minimum (69.17 cm) was found from BARI tomato-8. The results indicates that all the genotypes was significantly influenced at different days after transplanting which might be due to the genetic variation and also the variation of regional adaptability. Present results are in agreement with earlier reports of genotypic variations with regard to plant height by Zahedi and Ansari (2012). Similar results were also obtained by Ezin*et al*. (2010); Ahmad *et al*. (2007).

Number of flower clusterplant^{-1}: Number of flower cluster plant^{-1} varied significantly for different genotypes (Table 1). The maximum (19.47) flower cluster plant^{-1}was recorded from BARI tomato-14followed by TLB-130 (18.53) while the minimum was obtained from VRT-005.The results are in line with that of Zahedi and Ansari (2012), who also found the variations are due to the differences in genetic makeup of the cultivars.

Number of flowers cluster^{-1}: A significant variation was found on number of flowers cluster^{-1} in this experiment (Table 1). The maximum (6.62) number of flowers cluster^{-1} was recorded from BARI tomato-14 followed by TLB- 130 (6.36), while the minimum (3.53) was obtained from VRT-007. Similarly, Regassa*et al*. (2012) reported that the genotypic variation for the number of flower clusters^{-1} was significant. The variation in number of flower clusters per plant was possibly due to different genetic makeup of the tomato genotypes.

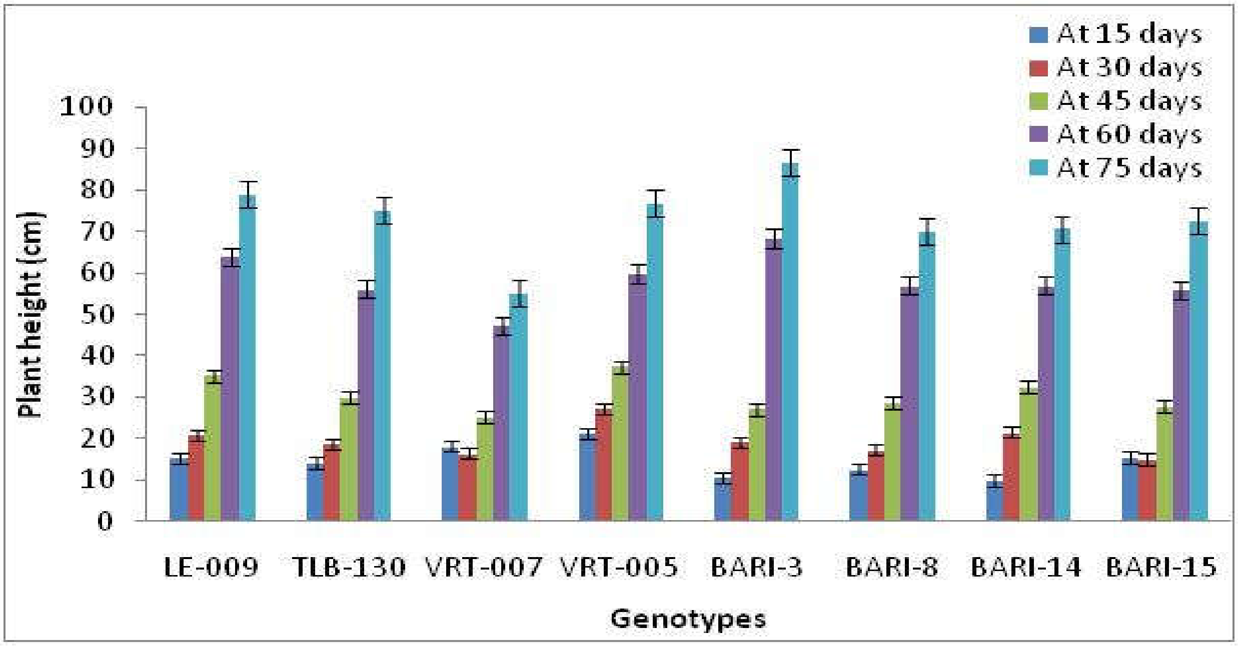

Figure 1. Effects of tomato genotypes on the plant height at different days after transplanting

***Number of fruit per cluster*:** A significant variation was found due to different genotypes on the number of fruit cluster^{-1} (Table 1).

Table 1. Effect of genotypes on number of cluster plant^{-1}, flower cluster^{-1}, and fruit cluster^{-1}

Genotype	No. of cluster plant^{-1}	No. of flower cluster^{-1}	No. of fruit cluster^{-1}
LE-009	18.80^{a}	5.43^{bcd}	4.04^{abc}
TLB-130	18.53^{a}	6.36^{ab}	3.45^{bcd}
VRT-007	13.33^{ab}	3.53^{e}	1.64^{f}
VRT-005	11.00^{b}	4.71^{cd}	1.80^{ef}
BARI-3	16.67^{ab}	5.77^{abc}	4.38^{ab}
BARI-8	17.00^{ab}	4.38^{de}	2.77^{de}
BARI-14	19.47^{a}	6.62^{a}	4.84^{a}
BARI-15	17.00^{ab}	6.34^{ab}	2.95^{cd}
$LSD_{0.05}$	6.42	1.15	1.11
CV %	22.27	12.17	19.58

The maximum number (4.84) of fruit per cluster was found in BARI tomato-14 which was statistically identical (4.38) to BARI tomato-3. The result of the present study varied significantly due to the variation of the studied cultivars which are in consistent with the results of Zahedi and Ansari (2012), Kayum *et al*. (2008), Regassa *et al*. (2012).

Number of flowers plant^{-1}: Number of flowers plant^{-1} varied significantly for different genotypes (Table 2). The maximum (126.3) number of flowers plant^{-1} was recorded from BARI tomato-14 which was statistically identical to TLB-130 (116.0), while the minimum (46.67) was obtained from VRT-007 genotype. Flower production plant^{-1} of the present study was significant among the cultivars which might be due to the variation in their characteristics and the regional adaptability. The present agreement is also confirmed by the findings of Phookan *et al.,* (1998) who also found similar result.

Number of fruits plant^{-1}: Number of fruits per plant differed significantly due to different genotypes (Table 2). The maximum (88.0) number of fruits per plant was recorded from BARI tomato-14, while the minimum (19.50) was recorded from VRT-005. The result revealed that the fruits production plant^{-1} varied significantly among the cultivars which might be due to the variation in their characteristics and also the variation in adaptability. Present results are in agreement with earlier reports of genotypic variations with regard to fruits production plant^{-1} by Regassa *et al*. (2012); Veershetty (2004); and Phookan *et al.,* (1998).

***Days to 50% flowering*:** Days to 50% flowering was differed significantly due to different genotypes (Table 3). The minimum date 53.33 required for 50% flowering was found in BARI tomato-14 whereas the maximum date 68.00 for 50% flowering was recorded in BARI tomato-3. Present results are in agreement with Alam *et al.* (2010) who found that the variation in production of 50% flowering was due to the variation in genetic makeup of the cultivars.

Table 2. Effect of different tomato genotypes on the number of flower and fruit plant^{-1}

Genotype	No. of fruit plant^{-1}	No. of flower plant^{-1}
LE-009	75.67^{a}	102.0^{ab}
TLB-130	66.33^{abc}	116.0^{a}
VRT-007	21.27^{d}	46.67^{c}
VRT-005	19.50^{d}	51.83^{c}
BARI-3	73.33^{ab}	96.67^{ab}
BARI-8	45.33^{c}	75.00^{bc}
BARI-14	88.00^{a}	126.3^{a}
BARI-15	51.33^{bc}	106.7^{a}
$LSD_{0.05}$	23.13	30.05
CV %	23.97	19.04

***Percent fruit setting*:** A significant variation was found in terms of percent fruit setting among different genotypes (Table 3). The highest percentage of fruit setting (76.27) was found in BARI tomato-14 followed by 67.80 which was found in LE-009. The lowest percentage (39.33) was observed in VRT-005. The result revealed that the fruit setting varied significantly among the genotypes which might be due to the variation in their characteristics and also the variation in adaptability. This finding agrees with the results obtained by Regassa *et al*. (2012) and Phookan *et al.,* (1998).

***Days to first harvest*:** Days to first harvest varied significantly due to different genotypes (Table 3). The genotypes showed significant variation in terms of days to first harvest. The minimum days (101.7) was recorded in BARI tomato-14, whereas the maximum (120.3) days was found and TLB-130. The variations in days to first harvest among the studied cultivars were found due to the variation in their characteristics which are also confirmed by the findings of Regassa *et al.* (2012).

Table 3. Effect of genotypes on days to 50% flowering, days to first harvest and % fruit setting

Genotype	Days to 50% flowering	Days to first harvest	% Fruit setting
LE-009	56.33^{bc}	112.3^{abc}	67.80^{ab}
TLB-130	54.67^{c}	120.3^{a}	51.68^{abc}
VRT-007	56.33^{bc}	102.3^{cd}	46.04^{bc}
VRT-005	59.67^{b}	102.3^{cd}	39.33^{c}
BARI-3	68.00^{a}	118.3^{a}	49.37^{bc}
BARI-8	67.00^{a}	104.7^{bcd}	52.45^{abc}
BARI-14	53.33^{c}	101.7^{d}	76.27^{a}
BARI-15	66.33^{a}	114.3^{ab}	43.03^{bc}
$LSD_{0.05}$	4.79	10.59	25.86
CV %	4.55	5.52	27.74

***Fruit length*:** Length of fruit varied significantly for different genotypes of tomato using in this experiment (Table 4). The maximum (6.097) fruit length was found in BARI tomato-15 while fruit length (5.873) was found in LE-009 which was identical. The lowest (4.307) length of fruit was found in TLB-130. This finding agrees with the results obtained by Nahar and Ullah (2011) and Ezin *et al*. (2010).

***Fruit diameter*:** Diameter of individual fruit differed significantly for different genotypes of tomato (Table 4). The maximum (7.59) diameter of individual fruit was recorded from VRT-007 which was statistically identical (6.80) to VRT-005, while the minimum (4.27) was recorded from TLB-130. This finding agrees with the results obtained byEzin *et al*. (2010).

Table 4. Effect of different tomato genotypes on fruit length and fruit diameter

Genotype	Fruit length, cm	Fruit diameter, cm
LE-009	5.87^{ab}	4.85^{bc}
TLB-130	4.31^{f}	4.27^{c}
VRT-007	5.63^{bcd}	7.59^{a}
VRT-005	5.67^{bc}	6.80^{a}
BARI-3	4.64^{e}	5.07^{bc}
BARI-8	5.33^{d}	5.63^{b}
BARI-14	5.53^{cd}	5.30^{b}
BARI-15	6.10^{a}	4.90^{bc}
$LSD_{0.05}$	0.30	0.95
CV %	3.23	9.75

***Pericarp thickness*:** A significant variation was found in pericarp thickness due to different genotypes of tomato (Table 5). The maximum (0.6) pericarp thickness was measured in VRT-007 while the minimum (0.41) was found in TLB-130.The variation in pericarp thickness of different genotypes might be due to their different genotypic characters which are in consistent with the findings of Bhutani and Kalloo (1989) and Patil, 1998.

***Individual fruit weight*:** Weight of individual fruit varied significantly for different genotypes of tomato (Table 5). The maximum (174.1) weight of individual fruit was recorded from VRT-007, while the minimum (45.17) was recorded from TLB-130. The variation in individual fruit weight of different genotypes might be due to their different genotypic characters. Report on genotypic variation in fruit weight by Saidu *et al*. (2012) also supports our findings. Similar findings were also obtained by Mohanty (2002) and Patil (1984).

***Fruit weight plant^{-1}*:** The maximum (3.51) fruit weight per plant was recorded from BARI tomato-14, while the minimum (1.47) was found from VRT-005 (Table 5). The variation in fruit weight was found due to the variation in characteristics. The present result are also confirmed by the earlier reports of Kayum*et al*. (2008) and Ahmad *et al*. (2007) where they reported genotypic variations also varied tomato yield.

Table 5. Effect of genotypes on per plant and individual fruit weight and pericarp thickness

Genotype	Fruit weight plant^{-1}, kg	Individual fruit weight, gm	Pericarp thickness, cm
LE-009	2.39^{bcd}	62.05^{cde}	0.48^{bc}
TLB-130	2.97^{ab}	45.17^{e}	0.41^{c}
VRT-007	2.69^{bc}	174.1^{a}	0.60^{a}
VRT-005	1.47^{e}	102.6^{b}	0.58^{ab}
BARI-3	2.23^{cd}	69.88^{cde}	0.47^{c}
BARI-8	2.62^{bc}	84.86^{bcd}	0.47^{c}
BARI-14	3.51^{a}	91.01^{bc}	0.43^{c}
BARI-15	1.87^{de}	59.27^{de}	0.45^{c}
$LSD_{0.05}$	0.70	30.68	0.11
CV %	16.26	20.34	12.32

***Yield*:** Yield per hectare varied significantly among different genotypes of tomato (Table 6). The maximum (124.8) yield was obtained from BARI tomato-14, while the minimum (66.66) was recorded from BARI tomato-3.The variation in fruit yield of the present study was found due to the variation in characteristics of the studied cultivars and their adaptability in the selected site. The result confirmed the earlier reports of Rahman *et al.* (2011) and Olaoye *et al*. (2010) where they reported genotypic variations in tomato yield.

Table 6. Effect of different genotypes on yield of tomato

Genotype	Yield (t/ha)
LE-009	92.09[ab]
TLB-130	103.7[ab]
VRT-007	113.6[a]
VRT-005	87.13[ab]
BARI-3	66.66[b]
BARI-8	91.99[ab]
BARI-14	124.8[a]
BARI-15	103.3[ab]
$LSD_{0.05}$	46.39
CV %	27.05

Conclusion

Considering the results of the experiments, BARI tomato-14 possessed the features of moderately plant height, number of cluster per plant, flower per cluster, percent fruit setting, fruit per cluster, number of fruit per plant, fruit weight per plant, while it takes lower days for 50 % flowering and providing higher yield. Hence, it could be concluded that, BARI tomato-14 is found suitable and adaptive in coastal condition of Patuakhali region.

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