



Performance of SVATnet tomato varieties and lines under adaptive trial in Rangpur district in Bangladesh

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ABSTRACT

Ten tomato lines collected from SAARC countries were evaluated under adaptive trial at Agricultural Research Station, Burirhat, Rangpur, Bangladesh. The lines are denoted as V1, V2, V3, V4, V5, V6, V7, V8, V9, V10 and BARI Tomato-14 as check were included in the experiment. The experiment was laid out in a completely randomized block design having three replications. The crop were grown in winter season following the unit plot size was 4.0 m × 1.0 m with spacing of 60 cm × 40 cm. Tomato fruit yield was highest in V8, which is statistically similar to the check variety BARI Tomato-14. The order of yield performance among the tested varieties found as V8 > V4 > V2 > V5 > V6 > V7 > V1 > V3 > V9 > V10. Fruit characteristics were varied among the lines and varieties tested. Significantly higher total soluble solids were recorded from V5 and V2 compared to check variety BARI Tomato-14. Greater shelf life (16 days) obtained from V8 compared to other varieties tested. Considering fruit yield, characteristics and quality V8, V4 and V2 can be recommended for cultivation in the greater Rangpur district of Bangladesh.

Key words: SAARC, *Solanum lycopersicum*, tomato fruit qualities, yield performance, shelf life, virus infection.

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INTRODUCTION

Tomato (*Solanum lycopersicum*) is an excellent winter vegetable crop in Bangladesh which is popular among all classes' people. It is nutritious and a good source of carbohydrate, vitamin-A, -C and minerals. Tomato fruits enriched with various flavoring compounds having excellent taste. It also good source of antioxidants, the attractive red color provide lycopene and yellow color provide carotene which prevent cancer and other diseases (Hossain et. al., 2004). In a study it was reported that 100 g fresh tomato fruits contains 3.60 g carbohydrate, 1.10-1.98 g protein, 0.50 mg β-carotene, 1.80-2.30 mg iron and 15-30 mg ascorbic acid (Bose and Sam, 1990). Tomato

generally available in winter as it likes cool and dry weather for better growth and development (Rashid, 1999). It is the most consumed vegetable after potato and sweet potato in Bangladesh (Chowdhury, 1979). It cultivated throughout the country due to its adaptability to wide range of soil and climate (Ahmed, 1976). However, the yield of the crop is lower compared to those obtained from developed countries (Sharfuddin and Siddique, 1985). The national average yield of tomato is 6.6 t ha⁻¹ (BBS, 2011), which is very low compared to other tomato growing countries in the world. This poor yield should be increased through developing new high yielding tomato varieties. Recently farmers of Bangladesh interested to grow high

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yield varieties with disease resistant, better fruit qualities and longer harvesting period.

Farmers cultivated local low yielding tomato varieties in spite of severe disease infection and insect infestation. The existing hybrid and open pollinated varieties has encountered by several yield constraints due to continuous culture in the same land. In Bangladesh tomato farming gained momentum a decade ago when several multinational seed companies brought hybrid seeds to the country. For example, "Sobol" variety marketed by Syngenta has thick skin which is not easily damaged during transportation. Moreover, it takes on a bright red colour quickly and can be transported safely to the distant areas. Farmers also successfully cultivate the Sofol, Shathi, Hightom, Bipul, Surokha, Bangabir and Bijoy varieties while some of the Bangladesh Agricultural Research Institute developed varieties including Manik, Ratan, Chaiti, Apurba, Shila, Lalima and Anupoma are also popular. While local low yielding varieties are generally soft and get damaged easily. It is difficult to transport them to distant districts. Therefore, many tomato varieties are growing in Bangladesh, however, most of them become susceptible to diseases and insect and degradation of genotypic ability. In order to increase the tomato production in Bangladesh, it is essential to identify cultivars capable of year round production with higher yield and resistant to pests (Ashrafuzzaman et al., 2010). There are a few high yield and disease and insect resistant varieties but they do not perform well throughout the year because of their photosensitiveness and less adaptability (Hannan et. al., 2007).

In this regards collection and evaluation of germplasm have wide genetic variation can lead to the development of new varieties having improved specific traits. In practice, it is a continuous process in genetic program for developing new and improved varieties. In this purpose, some open pollinated tomato lines were collected from different SAARC countries. The present experiment was undertaken to evaluate growth, fruit yield and quality performance of the collected tomato lines with a view to develop a new variety(s) having desirable traits.

MATERIALS AND METHODS

Experimental site and climatic condition

The field trials were conducted at Agricultural Research Station, Bangladesh Agricultural Research Institute, Burirhat, Rangpur, Bangladesh during cropping season of 2012-13. The location is situated in the subtropical climatic zone with wet summer and dry winter. The studies were conducted during the winter of 2012-2013. The study area is generally characterized by a moderate weather condition (Figure 1). During the culture period the mean air temperatures were ranges from 15.8-28.5 °C and relative humidity ranges from 72.5-79.5%. Although relative humidity was not fluctuated during the growing period but temperatures were increased after January i.e., fruit development stage. Few rainy days were also evident during the fruit development and harvesting period was found in the experimental site.

Planting materials

Ten tomato lines denoted as V₁, V₂, V₃, V₄, V₅, V₆, V₇, V₈, V₉, and V₁₀ were collected from SAARC countries were used as planting material along with BARI Tomato- 14 as check.

Cultivation procedure

Seeds of the tested lines and variety were sown in the seed bed on 15 November, 2012. Thirty two days old seedlings were transplanted in the main field on December 17, 2012. The experiment was laid out in a completely randomized block design with three replications. The unit plot size was 4.0 m × 1.0 m with maintaining spacing of 60 cm × 40 cm. The crop was fertilized with 10 t, 550 kg, 450 kg, and 250 kg of cow dung, urea, triple super phosphate and muriate of potash per ha, respectively. Half of the quantity cow dung, entire amount of triple super phosphate and half of the muriate potash were applied during land preparation. The remaining half of cow dung was applied during pit preparation. The rest of muriate of potash and entire amount of urea were applied in three equal splits at 15, 30 and 45 days after transplanting. Irrigation, pruning, mulching,

weeding, plant protection measures and other intercultural operations were done as and when necessary. Tomato leaf curl virus and tomato mosaic virus was found on few plants and these are controlled by spraying Dithane M45 and finally by uprooting. Insects were controlled by using Malathion 57 EC (2 times at 25 and 32 days after transplanting). Application of plant growth regulator such as GA3 was sprayed @ 20 ppm at 30 days after transplanting for better plant growth.

Data collection

Data were recorded on different parameters. Data were collected in this study were on plant types, days to 50% flowering (days from the date of sowing to flowering 50% plant), plant height (when the plants attained the maximum height after which the plant ceased to grow for measurement the plant were selected randomly), number of fruits per pant (fruits harvested from ten plants of each treatment were counted and converted number of fruits per plant), weight of fruits per plant, average fruit weight (measured with the help of balance and their average was taken), fruit length (when the fruit attained certain maturity then the length was measured with the help of measuring tape), fruit yield, days to 1st harvest, fruit length (when the fruit attained certain maturity then the length was measured with the help of measuring tape), fruit diameter (fruit diameter was measured with the help of vernier caliper, when the fruit reached up to certain maturity), number of locule per fruit (matured fruits were cut by a sharp knife and locules number were counted), thickness of pericarp (Thickness of pericarp was measured with the help of vernier caliper, when the fruit reached up to certain maturity), total soluble solids (It was measured with the help of refractometer), shelf life (marketable shape, size and colour containing fruits were collected from each treatment then they are kept in a room with room temperature and days were counted just before rotten), and virus infection was calculated by the following formula.

Virus infection (%) =

$$\frac{\text{Number of virus infected plants}}{\text{Number of total plants}} \times 100$$

Fruit yield per plant was tomatoes were got maturity and at harvesting stage per picking. The yield per hectare was calculated following the formula as:

$$\text{Yield (Kg ha}^{-1}\text{)} = \frac{\text{Yield (kg per ha)} \times 100}{\text{Plot size (m}^2\text{)}}$$

Statistical analysis

Collected data were statistically analyzed using MSTAT-C computer package program and mean was calculated. Means were separated following Duncan's Multiple Range Test at 5% level of significance (Gomez and Gomez, 1983).

RESULTS AND DISCUSSION

Growth and yield performance of 11 tomato lines and variety

All the growth and yield parameters of the tested tomato lines and BARI Tomato-14 showed significant differences (Table 1). It was found that all three types of tomato plants such as determinate (D), indeterminate (I) and semi-indeterminate (SI) were exist in the collection. BARI Tomato-14 is semi indeterminate type plant and among collected lines fives were indeterminate (V₃, V₅, V₆, V₈ and V₉), three were determinate (V₄, V₇ and V₁₀) and only two (V₁ and V₂) were semi indeterminate type. The results revealed that V₂ required the greater number of days to 50% flowering (94.0) followed by V₈ (91.0 days) while the fewer days (77.0) were required for V₉ and BARI Tomato-14. Most of the collected lines require three more days to 50% flower compared to the check variety. The semi indeterminate type tomato plants were found taller and the highest plant height at last harvest was observed in V₂ (181.0 cm) followed by V₁ and BARI Tomato-14, while the other lines produced comparatively shorter stature plants and the lowest plant height was observed in V₇ (64.8 cm). The line V₇ gave the highest number of fruits per cluster (4.0) and the variety V₅ gave the lowest number of fruits per cluster (2.6) whilst other lines produced around three fruits per cluster.

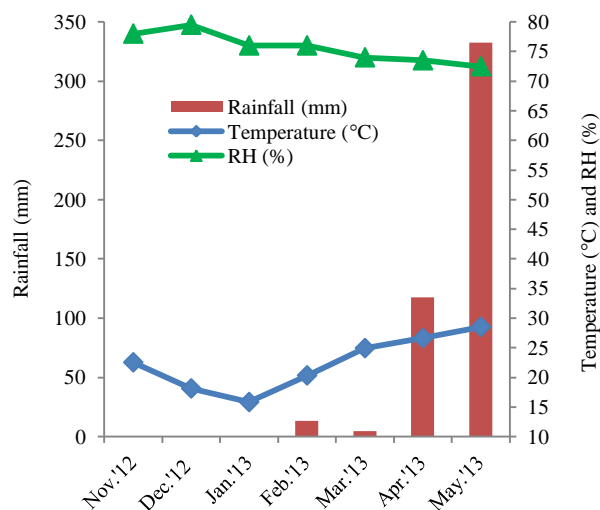


Figure 1
Monthly mean air temperature, rainfall and relative humidity during winter season of 2012-13 at Agricultural Research Station, Bangladesh Agricultural Research Institute, Burirhat, Rangpur, Bangladesh.

Maximum number of fruits per plant were recorded from V₄ (50.9) which is identical with V₇ (46.5) whereas minimum number of fruits per plant were recorded from V₁₀ (22.8). The line V₈ gave maximum weight of fruits per plant (1.93 kg) which is identical with BARI Tomato-14 (1.90 kg) while the line V₁₀ gave minimum weight of fruits per plant (1.11 kg). The highest average fruit weight was found in V₈ (70.6 g) and the lowest average fruit weight was found in V₇ (17.6 g). The fruit length was maximum in V₈ and BARI Tomato-14 (6.0 cm) and the minimum was in V₄ and V₇ (3.5 cm). Maximum tomato fruit yield was recorded from V₈ (76.70 t ha⁻¹) which is identical with BARI Tomato-14 (75.10 t ha⁻¹) and minimum yield was recorded from V₁₀ (44.53 t ha⁻¹) which is identical with V₉ (46.60 t ha⁻¹). The higher fruit yield in V₈ followed by BARI Tomato-14 and V₄ was attributed by higher average fruit weight or fruit weight per plant and also fruit length.

Fruit characteristics, quality and virus infection of 11 tomato lines and variety

Tomato fruit characteristics, qualities and also virus infection were varied significantly among the lines (Table 2). Maximum days required to 1st

harvest in V₈ and V₉ (143.7) followed by BARI Tomato-14 while minimum days required in V₅ (132.6). The longer tomato fruit of about 6.0 cm was harvested from V₈ and BARI Tomato-14 while other lines produce fruits ranging 3.5-5.1 cm long. The highest fruit diameter was obtained from V₁ (5.4 cm) and the lowest fruit diameter was obtained from V₉ (3.5 cm). It was found that except V₅, V₇, and V₉ other lines produce tomato fruits with greater diameter.

In case of locule per fruit, the line V₁ gave the highest number of locule per fruit (3.5) and V₈ gave the lowest number of locule per fruit (2.0). The maximum thickness of pericarp was found in V₁₀ (1.43 cm) and the minimum thickness of pericarp was found in V₉ (0.31 cm). The higher total soluble solids were obtained from V₅ (5.6%) which is identical with V₂ (5.5%) and V₁ (5.3%) and lower was obtained from V₁₀ (4.0%). Shelf life varied from 8.0 to 16.0 days. The highest shelf life was observed in V₈ (16.0 days) and the lowest shelf life was observed in V₁₀ (8.0 days). The line V₄ gave maximum virus infected plants (30.0%) which are identical with V₁, V₅ and V₇ (25.00%) and the variety V₉ gave minimum virus infected plants (10.0%).

It is mentionable that the performance of the collected lines has great variation in genetic potentiality of growth habit and fruit yield. Moreover, seasonal variation and also location or climate of the crop grown has also great influence on the performance of the evaluated lines (Ashrafuzzaman et al. 2010). Several studies showed genotypic and seasonal variation in tomato plant growth, fruit characters and yield attributes such as plant height (Mehta and Asati, 2008; Singh et. al., 2002a,b), number of primary branch (Dutta et. al., 1995; Ghosh et. al., 1995), number of fruit cluster (Singh et. al., 2002a,b; Saeed et. al., 1999), number of fruits (Bhuani et. al., 1989; Islam and Khan, 1991), individual fruit weight (Ajlouni et. al., 1996; Hussain et. al., 2001) and the final fruit yield (Rehman et. al., 2000; Wagh et. al., 2004). In this connection, the results of the present study can be useful information to the breeder to undertake target specific breeding programs. It can also helpful to create wide genetic resources of tomato in Bangladesh.

Table 1
Growth and yield performance of 11 tomato lines and variety under adaptive trial in Rangpur district, Bangladesh.

Tomato line and variety	Plant type	Days to 50% flowering	Plant height (cm)	No. of fruits/cluster	No. of fruits/plant	Wt. of fruits/plant (kg)	Av. fruit wt. (g)	Fruit length (cm)	Yield (t/ha)
BARI Tomato-14	SI ^y	77.0 g ^x	130.3 b	3.2 bc	33.5 b	1.90 a	60.5 b	6.0 a	75.10 a
V ₁ ^z	SI	80.7 d	133.3 b	3.2 bc	24.2 d	1.30 cd	60.3 b	5.1 bc	52.26 cd
V ₂	SI	94.0 a	181.0 a	3.4 b	26.4 cd	1.41 bc	50.4 c	4.7 d	56.53 c
V ₃	I	80.7 d	91.0 c	3.0 c	32.7 b	1.28 c-e	38.1 ef	5.0 c	51.50 cd
V ₄	D	80.0 de	83.3 cd	3.3 bc	50.9 a	1.58 b	33.2 f	3.5 g	63.53 b
V ₅	I	79.0 ef	75.0 de	2.6 d	30.8 bc	1.35 c	42.0 de	4.1 e	54.53 c
V ₆	I	78.0 fg	87.6 c	3.0 c	25.0 d	1.33 cd	42.3 de	5.1 bc	53.33 cd
V ₇	D	79.3 e	64.8 f	4.0 a	46.5 a	1.33 cd	17.6 g	3.5 g	53.06 cd
V ₈	I	91.0 b	83.3 cd	3.2 bc	25.1 d	1.93 a	70.6 a	6.0 a	76.70 a
V ₉	I	77.3 g	69.6 ef	3.1 bc	26.6 cd	1.16 de	43.1 d	3.7 f	46.60 de
V ₁₀	D	87.0 c	77.0 de	3.1 bc	22.8 e	1.11 e	43.1 d	5.1 b	44.53 e
Level of significance		**	*	**	**	*	**	**	**
CV (%)		2.48	3.64	5.78	4.51	2.51	3.33	4.98	5.93

^zTen tomato lines denoted as V₁, V₂, V₃, V₄, V₅, V₆, V₇, V₈, V₉, and V₁₀ were collected from SAARC countries.

^ySI = Semi indeterminate, I = Indeterminate, D = Determinate.

^xMeans followed by different letter(s) differ significantly following Duncan's Multiple Range Test at 5% level.

Table 2
Fruit characteristics, quality and virus infection of 11 tomato lines and variety under adaptive trial in Rangpur district, Bangladesh.

Variety	Days to 1 st harvest	Fruit length (cm)	Fruit diameter (cm)	No. of locule /fruit	Thickness of pericarp (cm)	TSS (%)	Shelf life (Days)	Virus infection (%)
BARI Tomato-14	140.0 a-c ^y	6.0 a	4.5 b	2.6 bc	0.43 ab	4.5 d	13.0 bc	15.0 cd
V ₁ ^z	137.0 b-d	5.1 bc	5.4 a	3.5 a	0.34 c	5.3 ab	10.0 d	25.0 ab
V ₂	140.6 a-c	4.7 d	4.2 d	2.1 e	0.42 ab	5.5 a	12.0 c	15.0 cd
V ₃	137.6 a-d	5.0 c	4.5 b	2.6 bc	0.36 bc	4.5 cd	12.0 c	20.0 bc
V ₄	134.3 cd	3.5 g	4.5 b	2.5 b-d	0.34 bc	4.7 bc	14.0 b	30.0 a
V ₅	132.6 d	4.1 e	3.9 e	2.2 de	0.43 ab	5.6 a	12.0 c	25.0 ab
V ₆	138.0 a-d	5.1 bc	4.4 bc	2.9 b	0.41 ab	4.0 d	10.0 d	20.0 bc
V ₇	136.6 b-d	3.5 g	3.6 f	2.3 c-e	0.34 c	4.1 cd	13.0 bc	25.0 ab
V ₈	143.7 a	6.0 a	4.5 bc	2.0 e	0.35 bc	4.5 cd	16.0 a	15.0 cd
V ₉	143.7 a	3.7 f	3.5 f	2.4 c-e	0.31 c	4.1 cd	10.0 d	10.0 d
V ₁₀	139.3 a-c	5.1 b	4.3 cd	2.1 e	1.43 a	4.0 d	8.0 e	15.0 cd
Level of significance	**	**	**	*	**	*	**	NS
CV (%)	1.12	2.10	1.02	3.11	4.75	4.72	3.33	29.86

^zTen tomato lines denoted as V₁, V₂, V₃, V₄, V₅, V₆, V₇, V₈, V₉, and V₁₀ were collected from SAARC countries.

^yMeans followed by different letter(s) differ significantly following Duncan's Multiple Range Test at 5% level.

CONCLUSION

The aforesaid results indicate the lines collected from different SAARC countries showed good variation in growth, fruit characteristics, fruit yield and also disease infection. The evaluation of growth parameters, yield attributes and final yield indicated that lines V₈, V₄ and V₂ can be recommend for new improved variety development program under climatic condition of Rangpur region of Bangladesh.

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