

PERFORMANCES OF HEAT TOLERANT TOMATO HYBRIDS UNDER SYLHET CONDITIONS

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Abstract

An investigation was carried out at the experimental field of Horticulture Department, Sylhet Agricultural University during May to August 2013 with a view to evaluate the yield and yield attributing characters of ten tomato cross lines along with five parental lines under high temperature condition. Variations in relation to hypocotyl color, stem pubescence, seedling height and fresh weight of seedling at planting stage were observed among the hybrids and parental lines. Hypocotyl color of parental lines and hybrids exhibited purple and green color. Days to first flowering ranged from 45.67 to 51.00 days of the hybrids and parental lines. Yield and yield attributes of ten hybrids were much higher compared to their parental lines. The highest number of fruits plant⁻¹ was recorded from the hybrid C41 × FP5 (35.50) followed by C41 × C11 (27.07). The hybrid C11 × C71 had the highest individual fruit weight (46.27 g) closely followed by FP5 × C71 (44.37 g). Among the 15 genotypes, the highest soluble solid (5.10%) was recorded in the hybrid C41 × C5. Fruit yield plant⁻¹ of hybrid and parental lines ranged from 0.27 kg to 1.11 kg. The hybrid C41 × C11 produced the highest fruit yield plant⁻¹ (1.11 kg) followed by C41 × FP5 (0.94 kg) which resulted in the highest hectare⁻¹ yield from C41 × C11 (37.74 t ha⁻¹) followed by C41 × FP5 (31.96 t ha⁻¹).

Keywords: Tomato genotype, cross combination, hybrid

Introduction

Tomato (*Solanum lycopersicon* L.) is one of the most popular and nutritious vegetable crop all over the world including Bangladesh which ranks top among other vegetables in total volume of production (Ahmed, 2002). Tomato is mainly grown during winter season in Bangladesh due to presence of congenial atmospheric conditions. Therefore, production and supply of tomato during winter in Bangladesh is very high. Cultivation of tomato during summer in Bangladesh is very limited due to excessive rainfall, temperature, wind storm, etc. Fruit setting in tomato is reportedly interrupted at temperature above 26/20° C day/night, and is often completely arrested above 38/27° C day/night (Kuo *et al*, 1979). Tomato can be grown during rainy summer in Bangladesh using heat tolerant tomato varieties under poly tunnel production system (Ahmed *et al*, 2008). Bangladesh Agricultural Research Institute (BARI) has developed two summer tomato hybrids, which are getting popularity in many districts like Jessore, Pabna, Dinajpur, Comilla, Chittagong, Netrokona etc (Islam, 2011). In Sylhet region of Bangladesh, vast area remained fallow round the year (BARC, 2011). The fallow high land in Sylhet region can be brought under vegetable production especially tomato production during summer season through adapting heat tolerant tomato variety(s) and improved production technology. As Sylhet region the highest experienced rainfall in Bangladesh, therefore, before going to commercial cultivation of tomato during summer season in the farmers field, it is important to select heat tolerant tomato varieties suitable for Sylhet region. Therefore, the present investigation comprising of ten newly developed tomato hybrids along with their parental lines was chosen to characterize and select some suitable heat tolerant tomato hybrids for cultivation during summer season in Sylhet region.

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Materials and Methods

The experiment was conducted at the experimental field of Horticulture Department of Sylhet Agricultural University, Bangladesh during May to August 2013. The seeds of ten cross combinations of tomato and five parent lines were sown in raised seed bed on 15 May 2013. Eight day-old seedlings were transplanted in polythene bag for hardening. Thereafter, twenty five day old seedlings were transplanted in the experimental field on 10 June 2013. The experiment was laid out in Randomized Complete Block (RCB) Design with three replications. The parental lines were C41, C51, C11, FP5 and C71. The cross combinations were C41 × C51, C41 × C11, C41 × FP5, C41 × C71, C51 × C11, C51 × FP5, C51 × C71, C11 × FP5, C11 × C71 and FP5 × C71. About 15 cm raised unit bed was made with a view to prevent the crop from moist condition during heavy rain. The land was previously cultivated with country bean. The unit plot size was 2.3 m × 4.8 m which was again divided into two beds and in each bed there were 12 plants row⁻¹ and 24 plants plot⁻¹. Plants were spaced at 60 cm × 40 cm between row to row and plant to plant distance, respectively. The unit plot and blocks were separated by 50 cm and 75 cm drain, respectively. The land was fertilized with 15 t well decomposed cowdung, 300 kg urea, 200 kg TSP and 150 kg MoP hectare⁻¹, respectively. Half of the quantity of cow dung and the entire amount of TSP were applied during land preparation. The remaining cowdung and half of MoP were applied before 5 days of planting. The whole of urea and half of MoP were applied in 3 equal splits as top dressing at 15, 30 and 50 days after transplanting. Light irrigation of each seedling was given just after transplanting for better establishment of the plants. The crop was protected from rain providing polythene tunnel over the bed. The height of the polytunnel at the middle of the bed was 6.0 feet while it was 4.5 feet at both sides. The structure of the polytunnel was made of bamboo where transparent polythene used over the structure. Staking was provided to keep the plant erect. Weeding, pruning, mulching and intercultural operations were done as and when necessary. Data were recorded for yield and yield contributing characters and statistically analyzed using MSTAT software and the means were separated according to Duncan's Multiple Range Test (DMRT).

Results and Discussion

Mean performance on seedling, floral, plant, fruit and yield related characteristics were estimated and presented in (Table 1). Hypocotyl color of five parental lines and ten cross combinations of tomato exhibited two types of color viz: purple and green. Among 15 genotypes, 6 lines exhibited purple color hypocotyl while 9 lines exhibited green color hypocotyl. Five genotypes had high stem pubescence. Five genotypes had medium stem pubescence while remaining five genotypes had low stem pubescence. The variation of leaves seedling⁻¹ among the genotypes. The highest leaves seedling⁻¹ (5.67) was recorded in the cross combination C41 × C11. The hybrids C51 × C11 produced the lowest leaves seedling⁻¹ which was 3.33. The highest seedling height (39.67 cm) was recorded in the cross combination C41 × C71, which was closely followed by C41 × FP5 and C51 × FP5 (37.67 cm). The parental line C41 produced the lowest seedling height (13.67 cm) which was significantly different from all other genotypes. Among the 10 cross combinations and five parental lines vein anthocyanin were present in three parental lines while vein anthocyanin colouration was absent in 10 cross combinations. In the parental lines, vein anthocyanin was present in three lines. Among 10 cross combinations and five parental lines, eight genotypes exhibited less leaf serration while six genotypes exhibited medium leaf serration and one showed high serration. Seedling weight of different genotypes ranged from 1.57 to 5.30 g. The highest seedling weight (5.30 g) was recorded in the hybrid C41 × FP5 which was followed by C41 × C51 (4.0 g). The lowest seedling weight (1.57 g) was recorded in the parental line C71. The seedling characteristics in relation to the above mentioned parameters showed variations among the cross combinations and also in parental lines (Table 1). Sumia (2012) reported the fresh weight of seedling ranged from 2.77 to 10.70 g.

Growth and yield of tomato hybrids and parental lines are presented in Table 2.

Days to 1st flowering was varied significantly among the 15 tomato genotypes. It ranged from 45.67 to 51.0 days. The earliest flowering (45.67 days) was observed in the parental line C41 and FP5. The hybrid C41 × C71 took the highest number of days (51.0 days) for first flowering which was statistically different from the rest of the genotypes. Variations were observed among different genotypes in respect of fruit yield plant⁻¹. It was observed that the parental line C41 (82.33 days) was the earliest to first harvest. The late harvest was observed in the cross combination C41 × C71 (88.67 days) which was statistically identical to C11 × C71 (88.33 days). Yesmin (2014) reported 82 to 88 days were required after seed sowing to first harvest. Fruit length of different genotypes ranged

from 3.23 to 5.50 cm. It was found that the parental line C71 had the highest fruit length (5.50 cm). The lowest fruit length (3.23 cm) was recorded from the parental line C51. Patwary (2009) reported that the fruit length of tomato varied from 3.24 to 6.09 cm during winter. Fruit width was the highest for the genotype C51 × C11 (4.66 cm) which was followed by the genotype C41 × C11 (4.56 cm). The lowest fruit width was recorded from the parental line FP5 × C71 (3.10 cm) which was statistically similar to the hybrids C11 × C71 (3.20 cm) and C11 × FP5 (3.20 cm). Patwary (2009) also reported that the fruit width of tomato varied from 4.08 to 4.14 cm during summer. The highest TSS (5.10%) was recorded in the cross combination C41 × C51 which was higher than both of its parents C41 (5.03%) and C71 (4.96%). The cross combination C41 × FP5 produced the lowest TSS (3.23%). Among the parental lines, the highest TSS (5.03) recorded in C41 and lowest was recorded from the FP5 (4.26). Locule number of different genotypes ranged from 2.0 to 4.67. The cross combination C51 × C11 produced the maximum (4.67) locules fruit⁻¹. The cross combination C41 × FP5 produced the lowest (2.0) locules fruit⁻¹ which was similar to cross combination C41 × C71. Rahman *et al.* (2013) mentioned that the locule number of tomato ranged from 4.40 to 11.70. The maximum pericarp thickness of 0.83 cm was recorded in the hybrid C11 × C71. The lowest pericarp thickness was 0.33 cm recorded in the parental line C71.

Table 1. Seedling characteristics of 10 cross combinations and 5 parental lines of tomato

| Hybrids/ parents | Seedling characteristics | | | | | | |
|---------------------|--------------------------|--------------------|----------------------------------|-------------------------|---------------------|-------------------|------------------------|
| | Hypocotyl color | Stem pubescence | Leaves seedling ⁻¹ | Seedling height (cm) | Vein anthocyanin | Leaf serration | Seedling weight (g) |
| C41 × C51 | Purple | High | 5.33ab | 36.67ab | Absent | Less | 4.0b |
| C41 × C11 | Green | Medium | 5.67a | 35.0a-d | Absent | Less | 2.53cd |
| C41 × FP5 | Green | High | 5.33ab | 37.67ab | Absent | Medium | 5.30a |
| C41 × C71 | Green | High | 5.0ab | 39.67a | Absent | Less | 2.33c-e |
| C51 × C11 | Purple | Low | 3.33c | 35.33a-c | Absent | Medium | 2.33c-f |
| C51 × FP5 | Purple | Medium | 4.33a-c | 37.67ab | Absent | Medium | 1.87c-f |
| C51 × C71 | Purple | High | 4.67a-c | 37.33ab | Absent | Less | 2.30c-f |
| C11 × FP5 | Green | Medium | 4.33a-c | 31.67b-d | Absent | Less | 2.17c-f |
| C11 × C71 | Green | Low | 4.33a-c | 30.0cd | Absent | Less | 1.90c-f |
| FP5 × C71 | Green | Low | 4.67a-c | 32.0b-d | Absent | Medium | 1.87d-f |
| C41 | Green | Medium | 4.67a-c | 13.67f | Present | Less | 2.60c |
| C51 | Purple | High | 5.0ab | 22.33e | Absent | High | 2.20c-f |
| C11 | Green | Medium | 5.33ab | 21.67e | Absent | Medium | 1.77ef |
| C71 | Green | Low | 4.0bc | 19.33ef | Present | Less | 1.57f |
| FP5 | Purple | Low | 5.33ab | 28.67d | Present | Medium | 1.83d-f |
| F-test | - | - | ** | ** | - | - | ** |
| CV (%) | - | - | 11.5 | 8.68 | - | - | 11.77 |

** indicates significant at 1% level of probability, Means followed by common letter(s) in a coloum do not differ significantly by DMRT.

It was found that the cross combination C41 × FP5 had the highest fruits plant⁻¹ (35.50) which was higher than both of its parents C41 (12.37) and FP5 (13.37). The parental line C51 produced the minimum fruits plant⁻¹ (10.40) which was statistically similar to the parent C71 (12.03). Ahmed (1993) reported that the fruits plant⁻¹ of tomato ranged from 17.80 to 179.59. The highest individual fruit weight was recorded in the cross combination C11 × C71 (46.27 g) which was statistically identical to FP5 × C71 (44.37 g). The lowest fruit weight was (20.40 g) obtained from the parental line C41. Ahmed (2002) found the range of individual fruit weight from 5.25 to 43.38 g among 23 heat tolerant tomato genotypes. Roy (2009) mentioned that the individual fruit weight of tomato ranged from 32.87 to 46.35 g. Fruit yield plant⁻¹ of different genotypes ranged from 0.27 to 1.11 kg. From the results of experiment it was found that the cross combination C41 × C11 had the highest fruit yield (1.11 kg plant⁻¹) which was statistically identical to C41 × FP5 (0.94 kg plant⁻¹). The cross combination C41 × C11 produced higher amount of fruit yield than both of its parents C41 (0.27 kg plant⁻¹) and C11 (0.46 kg plant⁻¹). The yield genotype C41 was the minimum (0.27 kg plant⁻¹). Phookan *et al.* (1990) in an experiment under plastic house condition in summer season with 29

genotypes of tomato reported a yield range plant⁻¹ from 0.21 to 1.60 kg. Fruit yield (t ha⁻¹) of different genotypes ranged from 9.18 to 37.74 t ha⁻¹. From the present investigation it was found that the cross combination C41 × C11 produced the highest yield (37.74 t ha⁻¹). On the other hand, the lowest yield obtained in the genotype C41 which was 9.18 t ha⁻¹. Deljit et al. (1990) mentioned that the fruit yield of tomato was ranged from 27.41 to 84.47 t ha⁻¹.

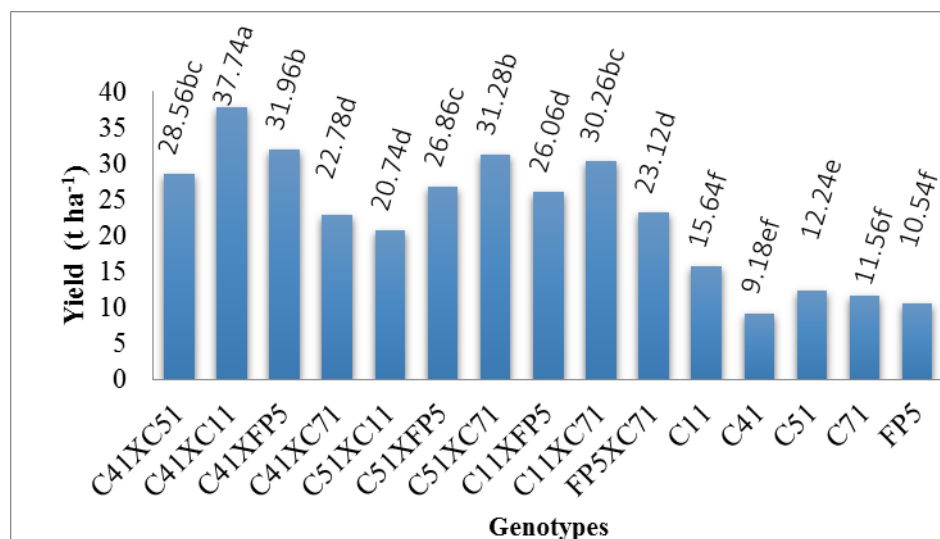


Fig. 1. Fruit yield of tomato genotypes during summer

Table 2. Growth duration and yield and yield attributes of tomato genotypes planted in summer season.

| Hybrid/ Parents | Days to flower | Days to harvest | Fruit length (cm) | Fruit breadth (cm) | TSS (%) | No. of fruits plant ⁻¹ | Individual fruit weight (g) | Fruit yield (kg plant ⁻¹) |
|--------------------|-------------------|--------------------|-------------------------|-----------------------|---------|--------------------------------------|-----------------------------------|--|
| C41 × C51 | 46.0c | 85.33b-e | 4.17de | 4.37bc | 5.10a | 18.07de | 44.03abc | 0.84bc |
| C41 × C11 | 47.67a-c | 86.0a-d | 4.23cde | 4.56ab | 4.97ab | 27.07b | 40.77c-e | 1.11a |
| C41 × FP5 | 49.67ab | 86.67a-d | 3.76fg | 3.40fg | 3.23d | 35.50a | 28.67g | 0.94b |
| C41 × C71 | 51.0a | 88.67a | 4.53c | 3.60ef | 5.03a | 17.17ef | 38.33ef | 0.67d |
| C51 × C11 | 46.67bc | 88.0a-c | 4.30c-e | 4.30cd | 5.03a | 16.27fg | 36.30f | 0.61d |
| C51 × FP5 | 46.33bc | 85.0c-e | 4.20c-e | 4.66a | 4.90ab | 19.20d | 42.07b-d | 0.79c |
| C51 × C71 | 48.67a-c | 84.67de | 4.33c-e | 4.66a | 5.06a | 22.27c | 40.67de | 0.92b |
| C11 × FP5 | 49.67ab | 84.0de | 4.13de | 3.20gh | 5.0ab | 16.20fg | 35.30f | 0.59d |
| C11 × C71 | 51.0a | 88.33ab | 4.33cde | 3.20gh | 5.03a | 19.00d | 46.27a | 0.89bc |
| FP5 × C71 | 50.67a | 84.0de | 3.50gh | 3.10h | 5.06a | 15.17g | 44.37ab | 0.68d |
| C41 | 45.67c | 82.33e | 5.06b | 3.66e | 5.03a | 12.37hi | 20.40h | 0.27f |
| C51 | 46.67bc | 88.0a-c | 3.23h | 4.48abc | 4.93ab | 10.40j | 35.50f | 0.36ef |
| C11 | 46.33bc | 87.0a-d | 4.03ef | 4.33bcd | 4.60bc | 16.20fg | 28.07g | 0.46e |
| FP5 | 45.67c | 85.33b-e | 4.40cd | 4.10d | 4.26c | 13.37h | 22.10h | 0.31f |
| C71 | 48.67a-c | 85.33b-e | 5.50a | 3.46ef | 4.96ab | 12.03i | 26.20g | 0.34f |
| F-Test | ** | ** | ** | ** | ** | ** | ** | ** |
| CV% | 2.8 | 4.47 | 3.21 | 2.57 | 3.37 | 3.72 | 3.94 | 6.40 |

** indicates significant at 1% level of probability. Means followed by common letter(s) in a column do not differ significantly by DMRT.

Among the 10 crossed genotypes, ripened fruit color of seven genotypes was light red color and other three genotypes were red in color. Among the 10 cross combinations, five cross combinations had round shape, three had flattened, one had flattened round and one had long fruit. Flattened shape fruit was observed in the cross

combinations of C51 × C71, C11 × FP5 and C11 × C71. Flattened round fruit was observed in C51 × FP5 and the rest five cross combinations had round shape fruit. Among the 10 cross combinations, blossom end shape of seven genotypes were flat, three cross combinations had pointed blossom end shape. Among the 10 cross combinations, flesh color of three cross combinations were red, four were orange and three were light red. Firmness of 10 cross combinations was categorized as high, medium and low. Firmness of fruit of three cross combinations was high; six cross combinations were medium while one was low. Variation in juiciness of the ripened fruit was also observed among the 10 cross combinations. Juiciness of fruit of three cross combinations was high and three cross combinations for medium while it was low for four cross combinations.

Table 4. Fruit qualitative characteristics of 10 cross combinations of tomato genotypes

| Cross combinations | Ripened fruit color | Fruit shape | Blossom end shape | Flesh color | Firmness | Juiciness |
|--------------------|---------------------|-------------|-------------------|-------------|----------|-----------|
| C41 × C51 | Red | Round | Pointed | Orange | High | Medium |
| C41 × C11 | Light red | Round | Flat | Orange | Medium | Medium |
| C41 × FP5 | Red | Round | Pointed | Red | Medium | High |
| C41 × C71 | Red | Round | Pointed | Red | Medium | High |
| C51 × C11 | Light red | Round | Flat | Orange | Low | High |
| C51 × FP5 | Red | Flattened | Flat | Light red | Medium | Low |
| C51 × C71 | Red | Flattened | Flat | Red | High | Low |
| C11 × FP5 | Light red | Flattened | Flat | Orange | Medium | Medium |
| C11 × C71 | Red | Flattened | Flat | Light red | High | Low |
| FP5 × C71 | Red | Lengthened | Flat | Light red | Medium | Low |

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