J. Sylhet Agril. Univ. 4(1):77-85, 2017 **ISSN: 2308-1597**

GROWTH AND YIELD PERFORMANCES OF TOMATO GENOTYPES DURING WINTER SEASON AT EASTERN SURMA KUSHIYARA FLOODPLAIN OF BANGLADESH

A Biswas[*1], Y Arafat[1], M S Islam[1], S Dey[2], S Sarker[3]

[1]*Department of Horticulture, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh*
[2]*Department of Plant Pathology and Seed Science, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh*
[3]*Department of Agronomy and Haor Agriculture, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh*

(Available online at: www.jsau.com.bd)

Abstract

An experiment was carried out at the field laboratory of Horticulture Department, Sylhet Agricultural University during the winter season from October 2013 to March 2014 with a view to evaluate fruit and seed production potentiality of tomato genotypes. Eight tomato genotypes namely C-11, C-21, C-41, C-51, C-71, FP-5,WP-10 and HT-025 were used for this study. The experiment was laid out in a Randomized Complete Block (RCB) Design with three replications. A remarkable variation was observed among the tomato genotypes at the seedling stage of hypocotyls color, stem length, root length and number of leaves at 1st inflorescences of seedlings etc. The genotype C-41 produced the highest number of fruits (48.00 plant^{-1}) but its corresponding individual fruit weight was the lowest (34.33 g). The lowest number of fruits plant^{-1} was harvested from the line WP-10 (22.33 plant^{-1}), and it had the highest individual fruit weight (66.67 g). Significant variation was observed in weight of fruit plant^{-1}. The highest fruit yield plant^{-1} was recorded from the genotype HT-025 (2.02 kgplant^{-1}) and the lowest was recorded from the line FP-5 (1.17 kgplant^{-1}). Corresponding hectare^{-1} fruit yield was the highest in HT-025 (68.68 tones) followed by the line C11 (68.0 tones). The highest number of seedsfruit^{-1} was counted from the genotype C-51 (85.42) very closely followed by C-11 (81.67). The genotype C-41 produced the lowest number of seeds (49.28 fruit^{-1}) identical to that of C-21 (51.72). The genotype HT-025 had the highest 1000-seed weight (2.90 g) which was identical to that of C-41 (2.80 g). The lowest 1000-seed weight was recorded from WP-10 (2.20 g). Seed yield plant^{-1} was varied from 3.64 g to 9.41 g. Among the genotypes, C-11 produced the maximum amount of seeds (319.94 kg ha^{-1}) and lowest seed production recorded from WP-10 (123.76 kg ha^{-1}).

Keywords*:* Genotype, tomato, winter, *solanum lycopersicon* L.

Introduction

Tomato (*Solanum lycopersicum* L.) belongs to the family Solanaceae. It is one of the most popular and nutritious vegetable crop all over the world including Bangladesh. It ranks next to potato and sweet potato in respect of vegetable production in the world (FAO, 2010). But in Bangladesh, it ranks 2nd which is next to potato (BBS, 2009) and top the list of canned vegetables. It is a self-fertilized annual crop. Now, tomato is a universally known vegetable and is one of the highest grown vegetables in the world which leads all other vegetables in total volume of production (Ahmad *et al.*, 2012). Its food value is very rich because of higher contents of vitamin A, B and C including calcium, minerals, carotene and iron (Bose and Som, 1990). It is a nutritious and delicious vegetable used in salad, soups and processes into stable products like ketchup, sauce, pickles paste, chutney and juice. Lycopene in tomato is a powerful antioxidant and reduces the risk of prostate cancer (Hossain, 2001). In Bangladesh, tomato has great demand throughout the year especially in early winter and summer, but its

***Corresponding author: A Biswas,** Department of Horticulture, Faculty of Agriculture, Sylhet Agricultural University, Sylhet-3100, Bangladesh, Email: ashok.aglsau@gmail.com*

production is mainly concentrated during the winter season. Recent statistics showed that tomato was grown in 30756 ha of land and the total production was approximately 414 thousand metric tons in 2015. Thus the average yield of tomato in Bangladesh was 5.47 t ha^{-1} (BBS, 2015), while it was 87.96 t ha^{-1} in USA, 49.87 t ha^{-1} in China and 20.12 t ha^{-1} in India (FAOSTAT, 2012). Cultivation of hybrid tomato varieties has increased considerably throughout the world and have many advantages compared to open pollinated ones. Production of hybrid tomato seed production is not so easy. Maintenance and seed production potentiality of inbred lines is very important in the hybrid seed production (Rashid *et al*., 2010). Therefore, production of seeds from the single plant of the inbred line is also important. 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, quality of seed, awareness about improved production technologies and even conventional breeding methods may improve production level and quality under the existing environmental conditions. Considering the above situation the tomato genotypes C-11, C-21, C-41, C-51, C-71, FP-5, WP-10 and HT-025 were used to evaluate fruit and seed yield performances of different tomato genotypes during winter season under Eastern Surma Kushiyara Floodplain.

Materials and method

Description of the study area

The experiment was conducted at the experimental field of Horticulture Department, Sylhet Agricultural University, Bangladesh during October 2013 to March 2014. The study area is located on latitude 24°54′ to 33°67″ N and longitude 91°54′ to 95°88″ E. The soil of experimental site belongs to the AEZ-20: Eastern Surma Kushiyara Floodplain. Soil is brown hill soil in texture and highly acidic (p^H 4.83) in nature. The climate of the experimental site was subtropical characterized by heavy rainfall during May to October and scanty during rest of the year. The mean monthly relative humidity ranged from 46% to 80% with the peak occurring between July and August.

Experimental Design and Planting

Seeds of eight tomato inbred C-11, C-21, C-41, C-51, C-71, FP-5, WP-10 and HT-025 were sown in three different raised seedbed on October 10, 2013. After seed sowing the seedbed was given partial shade with black net. The seedbed was also covered by a fine white net (60 × 60 mesh) to protect seedlings from insect attack. Eight days old seedlings were transplanted in second seedbed at the spacing of 5 cm x 5 cm distance for hardening of the seedlings. Thirty days old seedlings were transplanted in the experimental field on 29 November, 2013. The experiment was laid out in a Randomized Complete Block (RCB) design with three replications. The unit plot size was 1.0 m × 4.8 m having double row bed^{-1}, 12 plants row^{-1} and 24 plants $plot^{-1}$. Plants were spaced at 60 cm × 40 cm between plant to plant and row to row, respectively. The unit plot and blocks were separated by 50 cm and 75 cm drains, respectively. The land was fertilized with 15 t well-decomposed cowdung, 300 kg Urea, 200 kg Triple super phosphate (TSP) and 150 kg Muriate of Potash (MoP) $hectare^{-1}$, respectively. Half of the cow dung and the entire amount of Triple super phosphate (TSP) were applied during land preparation. The remaining cowdung and half of MoP were applied before five 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. Stacking was provided to keep the plant erect. Weeding, irrigation, pruning, mulching, gap filling and other intercultural operations were done as and when necessary.

Collection of data and statistical analysis

Observations of different characters were recorded from each genotype. Data on the following parameters, in eight tomato genotypes were recorded on the basis of AVRDC-GRSU characterization record sheet. 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

Seedling characteristics at planting

Hypocotyls of eight tomato genotypes exhibited only two types of color viz. purple and green (Table 1). Among eight genotypes, only three (C-51, HT-025 and WP-10) exhibited purple color hypocotyls while remaining lines (C-11, C-21, C-41, C-71 and FP-5) exhibited green color hypocotyls. Primary leaf length among the lines ranged from 1.67 cm to 2.43 cm. The highest leaf length was recorded in the inbred genotype FP-5 (2.43 cm) which was closely followed by C-51 (2.15 cm) while lowest leaf length was recorded from the genotype WP-10 (1.55 cm). The highest width of primary leaf was 1.93 cm found in C-11 which was followed by WP-10 (1.80 cm). The lowest width was recorded from the inbred FP-5 which was 1.38 cm. Yesmin (2011) observed primary leaf width ranging from 1.9 cm to 0.12 cm from 11 inbreed genotypes. Stem length among the genotypes ranged from 10.56 cm to 6.13 cm. The highest stem length was recorded in the inbred genotype C-71 (10.56 cm) which was significantly different from all other genotypes. The genotype FP-5 produced lowest stem length (6.13 cm). Significant variation was found in root length among the tomato genotypes (Table 1). Maximum root length 10.23 cm was recorded in the genotype C-71 closely followed by WP-10 (9.22 cm). The lowest root length was 5.86 cm recorded in the line FP-5. Two types of leaf attitude viz. dropping and horizontal were observed among the genotypes (Table 1). Among eight genotypes, three genotypes (C-41, WP-10 and FP-5) exhibited horizontal leaf attitude while rest five exhibited dropping type leaf attitude. A narrow variation was observed in case of number of leaves under 1st inflorescence among different genotypes (Table 1). The genotype WP-10 showed the highest number (7.16) of leaves under 1st inflorescence and C-11 showed the lowest (5.64) number of leaves under 1st inflorescence. Among eight genotypes, three genotypes (C51, HT-025 and WP-10) exhibited high leaf serration while three genotypes (C-11, C-21 and FP-5) exhibited medium leaf serration and others showed less serration.

Table 1. Seedling and foliage characteristics of eight tomato genotypes

Genotypes	Hypocotyl color	Primary leaf		Stem length (cm)	Root length (cm)	Leaf attitude	Leaf serration	Leaves under 1st inflorescences
		Length (cm)	Width (cm)					
C-11	Green	2.0bc	1.93a	8.6bc	8.46bc	Dropping	Medium	5.64
C-21	Green	1.95cd	1.62cd	8.20bc	6.52cd	Dropping	Medium	6.3
C-41	Green	1.82d	1.38de	7.15de	7.74cd	Horizontal	Less	6.28
C-51	Purple	2.15bc	1.61cd	7.44cd	8.52bc	Dropping	High	6.55
C-71	Green	1.67e	1.57de	10.56a	10.23a	Dropping	Less	5.84
FP-5	Green	2.43a	1.48e	6.13e	5.86d	Horizontal	High	5.83
WP-10	Purple	1.55e	1.8b	9.50ab	9.22ab	Horizontal	Medium	7.16
HT-025	Purple	2.2c	1.75bc	10.25a	7.45cd	Dropping	High	6.90
Significance l level	-	**	**	**	*	-	-	ns
CV%		5.60	4.98	3.40	8.58			12.90

** indicates significant at 1% level of probability; Means bearing the same letter(s) in a column do not differ significantly by DMRT

Characteristics at flowering

Days to 1st flower were significantly different among the genotypes (Table 2). The earliest flowering was observed in the genotype C-41 (45.66 days) while it was late in HT-025 (49.66 days). Ahmed (1993) observed that some tomato varieties bloomed within 57-67 days after seed sowing during early winter. The genotype WP-10 produced the maximum number of flowers cluster^{-1} (11.69) and C-21 produced lowest number of flowers cluster^{-1} (5.23). Patwary (2009) reported that flower cluster^{-1} ranged from 4.18 to 9.92. Petal length among the genotypes ranged from 7.47 mm to 14.34 mm (Table 2). The highest petal length was recorded in the genotype C-21 (14.34 mm) while C-41 produced the lowest petal length (7.47 mm) which was significantly different from other genotypes. Sepal length among the genotypes ranged from 5.33 mm to 11.67 mm (Table 2). The highest sepal length was recorded in the genotype C-11 (11.67 mm) closely followed by C-21 (10.78) and genotype WP-10 produced the lowest sepal length (5.33 mm). The length of stigma ranged between 2.50 to 6.41 mm. The genotype C-71 showed the largest stigma 6.41 mm which was followed by the genotype C-21 (6.16 mm). On the other hand, the genotype C-11 has the shortest genotype (2.50 mm). Style type inserted and same as stamen level

were observed from inbred genotypes (Table 2). Five inbred genotypes (C-11, C-41, C-51, C-71 and WP-10) showed inserted style type while the rest were same as stamen level.

Table 2. Inflorescence characteristics of tomato inbred genotypes

Genotypes	Days to 1st flowering	Flower cluster^{-1}	Petal length (mm)	Sepal length (mm)	Length of stigma (mm)	Style type
C-11	46.66	8.29c	13.66a	11.67a	2.50d	Inserted
C-21	48.00	5.23f	14.34a	10.78ab	6.16a	Same as stamen level
C-41	45.66	9.62b	7.47d	7.61c	4.62c	Inserted
C-51	49.00	8.20c	12.97a	8.55c	5.37b	Inserted
C-71	48.33	9.50b	13.39a	9.16bc	6.41a	Inserted
FP-5	49.00	7.13d	11.44b	7.61c	5.20bc	Same as stamen level
WP-10	48.33	11.69a	10.33bc	5.33d	5.33bc	Same as stamen level
HT-025	49.66	6.13e	10.00c	8.83bc	5.44b	Inserted
Significance level	**	**	**	**	**	
CV%	3.18	1.47	4.63	8.92	5.62	

** indicates significant at 1% level of probability; Means bearing the same letter(s) in a column do not differ significantly by DMRT

Fruit characteristics at the time of harvesting

Among the genotypes, C-11, C-41, FP-5 and WP-10 had round shape fruit while flattened (C-51 and HT-025) and lengthened (C-71) fruit shape were also recorded among the inbred genotypes. Three types of shapes were observed at the blossom end like flat, pointed and intended. Among the eight genotypes blossom end shape of four genotypes (C-11, C-21, FP-5 and WP-10) was flat, two genotypes (C-41 and C-71) were pointed and two genotypes (C-51 and HT-025) were indented. Among the eight genotypes, three genotypes (C-11, C-71 and HT-025) were light red color, two genotypes (C-21 and C-51) were red and three genotypes (C-41, WP-10 and FP-5) were dark red in color in terms of fruit color. Rest of the genotypes was light red in color. Yamaguchi (1983) reported colors of tomato may be red, orange or yellow depending on the genetic makeup of the cultivar. Among the eight genotypes only C-71, FP-5 and HT-025 had red, flesh color while rest of the genotypes were light red in color (Table 3). Firmness of fruit of two genotypes (C-71 and HT-025) was high, four genotypes (C-11, C-21, C-51 and WP-10) were medium while two (C-41 and FP-5) were less.

Table 3. Fruit characteristics of tomato inbred lines

Inbred	Fruit shape	Blossom end shape	Fruit color	Flesh color	Firmness
C-11	Round	Flat	Light red	Light red	Medium
C-21	Oval	Flat	Red	Light red	Medium
C-41	Round	Pointed	Dark red	Light red	Less
C-51	Flattened	Intended	Red	Light red	Medium
C-71	Lengthened	Pointed	Light red	Red	High
FP-5	Round	Flat	Dark red	Red	Less
WP-10	Round	Flat	Dark red	Light red	Medium
HT-025	Flattened	Intended	Light red	Red	High

Fruit yield and yield attributes

The genotypes C-11 and C-41 simultaneously (93.33 days) had earliest harvest and late harvest was observed in the genotype WP-10 (101.70 days). Ahmed (1993) reported 111 to 123 days were required after seed sowing to maturity or first harvest. From the observation it was found that the genotype C-41 had maximum fruits (48.00) plant^{-1} followed by C-11 and FP-5 (46.00 and 40.33 respectively) and WP-10 produced the minimum fruits plant^{-1}

(22.33). Roy (2009) mentioned the number of fruits plant^{-1} ranged from 35 to 76.39. The variation was observed between the reported and present findings regarding the fruits plant^{-1} of tomato might be due to difference of cultivars used. The highest fruit weight was recorded in the genotype WP-10 (66.67 g) and lowest fruit weight was 29 g obtained from the genotype FP-5 (Table 4). Roy (2009) mentioned that the individual fruit weight ranged from 32.87 g to 46.35 g. Significant differences were found in fruit length and fruit width among the genotypes (Table 4). The highest fruit length (5.07 cm) was found from the C-71 which was very similar to C-11 (5.0) and genotype C-41 produced the minimum fruit length (4.05cm). Patwary (2009) reported that the fruit length and width varied from 3.24 cm to 6.09 cm and 2.99 cm to 6.80 cm, respectively. The highest TSS (5.91%) was recorded in C-41and C-21 produced the lowest TSS% which was (4.43%). Locule number of different genotypes ranged from 2.03 to 6.70 (Table 4). The genotype WP-10 produced the maximum locule number (6.70) which was statistically similar to the genotype HT-025. The genotype C-41, C-71 and FP-5 produced lowest locule number (2.03). Rahman *et al,* (2003) mentioned that the locule number ranged from 11.70 to 4.40. The lowest mean value (4.40) for locule number per fruit was also similar to the findings of Stamova (1989). The maximum pericarp thickness 6.73 mm was recorded in the genotype C-11 and lowest pericarp thickness was 4.80 mm recorded in the genotype HT-025. It was found that the genotype HT-025 yielded the highest amount of fruit (2.02 kg plant^{-1}) which is statistically similar to the genotype C-11 (2.00 kg) and FP-5 genotype yielded the minimum (1.17 kg plant^{-1}). Ahmed (1993) reported that yield range of 1.47 to 6.50 kg during early planting.

Table 4. Fruit characteristics of tomato genotypes

Genotypes	Days to 1st harvest	Fruits Plant^{-1}	Fruit weight plant^{-1} (g)	Fruit length (cm)	Fruit width (cm)	TSS (%)	Locule	Pericarp thickness (mm)	Yield (kg plant^{-1})
C-11	93.33c	46.00a	45.00d	5.00a	4.60c	4.64cd	2.10d	6.73a	2.00ab
C-21	94.00c	37.67bc	46.33cd	4.10c	4.16cd	4.43d	2.56d	5.43bc	1.74ab
C-41	93.33c	48.00a	34.33e	4.05c	3.87d	5.91a	2.03d	4.90c	1.64abc
C-51	96.67bc	29.67d	56.33b	4.06c	4.59c	5.26b	3.34c	5.30bc	1.67abc
C-71	98.33ab	37.67bc	47.33cd	5.07a	4.06cd	5.18b	2.03d	5.30bc	1.78ab
FP-5	95.00bc	40.33b	29.00e	4.39abc	3.93d	4.43d	2.03d	5.50bc	1.17c
WP-10	101.7a	22.33e	66.67a	4.84ab	5.76a	4.93bc	6.70a	5.90ab	1.48bc
HT-025	95.67bc	35.00c	52.67bc	4.23bc	5.23b	4.53d	5.86b	4.80c	2.02a
Significance level	**	**	**	**	**	**	**	**	**
CV%	1.66	5.48	5.96	5.95	4.58	2.76	6.96	2.39	11.48

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

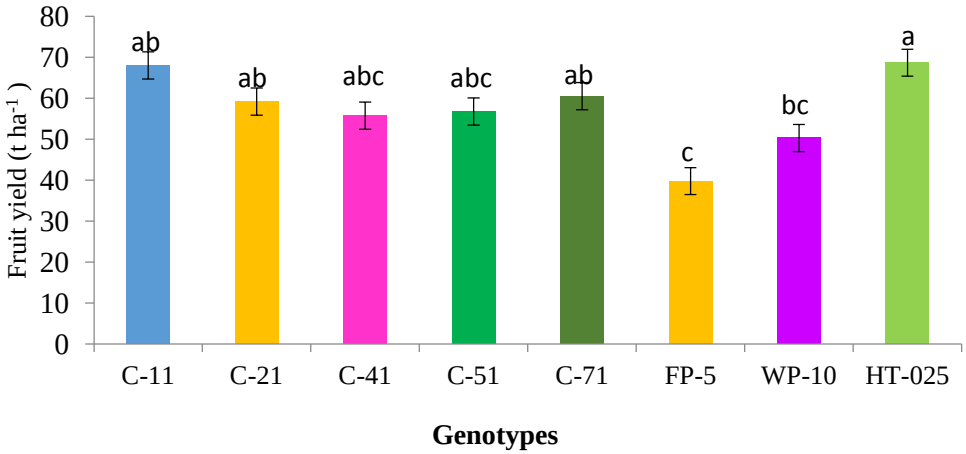

Fig. 1. Fruit yield of tomato genotypes during winter

Seed yield and yield attributes

Number of seeds fruit^{-1} of different genotypes ranged from 49.28 to 85.42. The highest number of seeds fruit^{-1} was (85.42) recorded in C-51 and lowest was (49.28) obtained from the genotype C-41. Patwary (2009) reported that number of seeds fruit^{-1} ranges from 26.0 to 107.70 during winter and 4.02 to 49.39 during summer. Seed yield fruit^{-1} of different genotypes ranged from 125.16 mg to 221.24 mg. The genotype C-51 produced the maximum amount of seeds fruit^{-1} (221.24 mg) followed by HT-025 (206.86 mg) and genotype C-21 produced the minimum amount of seeds fruit^{-1} (125.16 mg). Significant variation was found in terms of seed yield plant^{-1} among the eight genotypes (Table 5). Seed yield plant^{-1} of different genotypes ranged from 3.64 g to 9.41 g. The maximum seed yield plant^{-1} was recorded in the genotype C-11 (9.41 g) followed by the genotype HT-025 (7.24 g) and lowest seed yield plant^{-1} was 3.64 g recorded in the genotype WP10. The genotype HT-025 produced the highest 1000-seed weight (2.90 g) whereas WP-10 produced the lowest (2.20g) 1000-seed weight. Patwary (2009) reported that the ranges of 1000-seed weight varied from 2.29 g to 3.28 g during winter and 1.53 g to 3.02 g during summer. The reported result supports the present findings.

Table 5. Seed yield and yield attributes of eight tomato genotypes

Genotypes	No. of Seeds fruit^{-1}	Seed yield (mg fruit^{-1})	1000 seed Weight(g)	Seed yield (g plant^{-1})
C-11	81.67a	204.99	2.51abc	9.41a
C-21	51.72d	125.16	2.42abc	4.70c
C-41	49.28d	137.98	2.80ab	6.79b
C-51	85.42a	221.24	2.59abc	6.56b
C-71	54.22d	126.87	2.34bc	4.78c
FP-5	65.67c	170.74	2.60abc	6.89b
WP-10	74.67b	164.27	2.20c	3.64c
HT-025	71.33bc	206.86	2.90a	7.24b
Significance Level	**	NS	**	**
CV%	3.99		7.44	8.59

** indicates significant at 1% level of probability; Means bearing the same letter(s) in a column do not differ significantly at 1% level of probability

Seed yield

Among the tomato genotypes seed yield ranged from 123.76 kg ha^{-1} to 319.94 kg ha^{-1} (Fig. 2). The genotype C-11 produced the highest seed yield of 319.94 kg and the genotype WP-10 produced lowest yield 123.76 kg. C-21 and C-71 genotype produced 159.8 kg ha^{-1} and 162.52 kg ha^{-1} respectively.

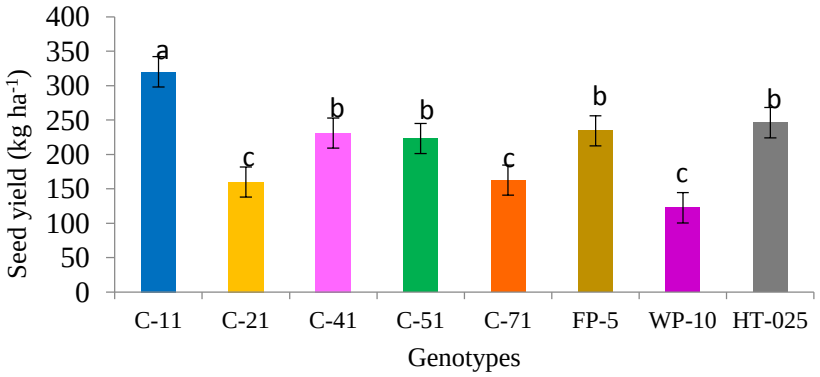

Fig.2. Seed yield of eight tomato genotypes during winter

Conclusion

Based upon the above results and discussion it was concluded that as highest fruit yield plant^{-1} was found from HT-025 (2.02 kg plant^{-1}), corresponding hectare^{-1} fruit yield was 68.68 ton. The highest number of seeds fruit^{-1} was counted from the genotype C-51 (85.42). The genotype C-41 produced the lowest number of seeds fruit (49.28). The genotype HT-025 had the highest 1000-seed weight (2.90 g) and C-11 (319.94 kg) produced the maximum amount of seed hectare^{-1}. The genotype HT-025 will be taken in further research to obtain the high yielding genotype.

References

Ahmed S. 1993. Comparative performance of tomatoes during summer and winter.M S Thesis.Dept. of Horticulture.BSMRAU, Salna, Gazipur. Bangladesh. 25-45p.

Ahmad S. 2012. Genetics of fruit set and related traits in tomato under humid conditions. PhD Thesis.BSMRAU, Salna, Gazipur, Bangladesh.1-236p.

BBS. 2009. Hand book of Agricultural Statistics, December. Bangladesh Bureau of Statistics (BBS).Ministry of Planning, Govt. People's Repub. Bangladesh.14p.

BBS. 2015. Bangladesh Bureau of Statistics.

Bose T K, Som M G. 1990. Vegetables Crops in India. B. Mitra Naya Prokash, Bidhan Sarani, Calcutta, India.

FAO.Production Year Book of 2006.No. 67. 2009. Food and Agriculture Organization (FAO). Rome, Italy. 54p.

FAOSTAT (Food and Agriculture Organization of the United Nations). 2012. Production. Countries and commodity.Tomatoes. http://faostat.fao.org/site/339/default.aspx.

Hossain M M. 2001. Influence of planting time on the extension of picking period of four tomato varieties. M S Thesis, Dept. Crop Bot. Bangladesh Agric. Univ., Mymensingh, Bangladesh.37-39p.

Patwary M M A. 2009. Genetic diversity and heterosis in heat tolerant tomato.PhD Thesis. Dept. Hort. BSMRAU, Salna, Gazipur, Bangladesh. 01-190p.

Rahman M A, Ahmad M S, Khan Q N, M A I and Abdullah-Al-Mahbub. 2003. Genetic Analysis on Yield and its Component Traits of Tomato (*Lycopersicon esculentum* Mill.). A Scientific Journal of Krishi Foundation. The Agriculturists.1(1):21-26.

Rashid M A and Singh D P. 2010. A Manual on Vegetable Seed Production in Bangladesh.AVRDC-USAID-Bangladesh Project.HRC.21-86p.

Roy S K. 2009. Comparative yield and storage quality of commercial tomato varieties of Bangladesh. MS Thesis. Dept. Hort. BSMRAU, Salna, Gazipur, Bangladesh.19-22p.

Stamova L. 1989. New Varieties, Tomato Volgogradets. Kartofeliovoshchi no. (3): 17.

Yamaguchi M. 1983. World Vegetables. Principles, Production and Nutritive Values. AVI Publishing Company, USA. 291-293p.

Yesmin L. 2011. Characterization and evaluation of tomato genotypes for inbred and hybrid seed production potentiality. M S Thesis. Dept. Hort. BSMRAU, Salna, Gazipur, Bangladesh.