JSTEI ONLINE JOURNAL Journal of Science, Technology & Environment Informatics

Journal BiNET Scientific Publication

Volume 01, Issue 01, Article no. 5, pp. 45-53 Mehraj *et al.*, 2014
http://www.journalbinet.com/current-issue-jstei.html
Original Research Paper

Performance Assessment of Twenty Tomato Cultivar for Summer Cultivation in Bangladesh

H. Mehraj, S. Mutahera, M. Z. K Roni, A. S. M. Nahiyan[1] and A. F. M. Jamal Uddin*

Dept. of Horticulture, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh
Advanced Biotechnology and Seed Research Center, ACI Limited[1]

Article Info

Key Words:

Tomato cultivars
Summer season
Growth parameters
Yield attributes

Received: 05.10.2014
Accepted: 20.10.2014
Published: 30.11.2014

Contact author:
jamal4@yahoo.com

ABSTRACT

An experiment was conducted at Horticultural farm of Sher-e-Bangla Agricultural University, Bangladesh for performance evaluation of twenty tomato cultivar coded from V_1-V_{20} cultivated in summer. Maximum plant height (116 cm) and number of leaves (147) were found from cultivar Mini Anindyo Red (V_8) and Hybrid Tomato US440 (V_{18}) respectively. Maximum chlorophyll content, days to flower bud appearance and days to flowering were observed from cultivar BARI Tomato 6 (V_{19}); 53.0% chlorophyll, 40.3 days to bud appearance and 46.7 days for flowering. Maximum number of flower bud/bunch (6.0) and fruit/bunch (1.2) were observed from cultivar BARI Tomato 11(V_{20}) and Aran Chan Mini (V_{12}) respectively. Maximum number of branch/plant (5.7), number of bunch/plant (15.3), number of flower bud/plant (129.7), number of flower/plant (108.3), number of flower/bunch (6.7), number of fruit/plant (6.7), fruit length (22.8 cm), fruit diameter (61.3 mm), fruit weight (100 gm), yield/plant (667.1 gm), yield/plot (6.7 kg) and calculated yield/ha (22.3) were found from cultivar Mini Chika (V_{10}). Thus, cultivar Mini Chika (V_{10}) was found to be suitable for cultivation in summer.

Citation (APA): Mehraj, H., Mutahera, S., Roni, M. Z. K., Nahiyan, A. S. M. & Jamal Uddin, A. F. M. (2014). Performance assessment of twenty tomato cultivar for summer cultivation. *Journal of Science, Technology & Environment Informatics,* 01(01), 45–53.

I. Introduction

Tomato *(Lycopersicon esculentum* Mill.) belonging to *Solanaceae* family, is one of the popular vegetable crops of the world including Bangladesh. In Bangladesh, tomato is grown in winter as normally prevailing temperature is congenial for its optimum growth and yield. But it has potentiality to grow in summer also. The production of tomato in summer is limited due to the type of weather prevails in the summer season of Bangladesh (Ahmad, 2002). During this period, the temperature (both day and night), humidity, rainfall and light intensity, which are actually the basic limiting factors of tomato production in the tropics, remain very high (Abdulla and Verkert, 1968). So, year round tomato production in Bangladesh is constrained. Attempts have been made to develop heat-tolerant varieties in some countries. There are two major problems in raising summer tomatoes in Bangladesh: first, the lack of technique to grow tomatoes under hot and rainy conditions; and second, the lack of suitable varieties which can set fruit under higher temperature. Maximum day and minimum night temperature above 32^{0}C and 21^{0}C respectively are known to limit fruit set due to an impaired physiological process in flowering and fruiting or abscission (Bhattarai and Subedi, 1996). Fruit setting in tomato is reportedly interrupted at temperature above 26^{0}C and 20^{0}C in day and night respectively and often completely arrested above the temperature 38^{0}C and 27^{0}C in day and night respectively (Stevens and Rudich, 1978). So, by producing tomato in summer season of Bangladesh, it is possible to produce tomato throughout the year and thereby to meet our demand. Considering the above facts, the present study was undertaken to evaluate the performance of some exotic and indigenous tomato varieties for cultivation in summer with a view to identify the potential variety of summer tomato for Bangladesh.

II. Materials and Method

Location: Experiment was conducted at Horticultural Farm, Sher-e-Bangla Agricultural University, Dhaka, Bangladesh during April to July 2013. Site is situated in the subtropical climatic zone with wet summer and dry winter.

Seed sowing: Seeds were sown on the seedbed in early March and seedlings were transplanted into the main field on early April.

Varieties and experimental design: Twenty (20) cultivar of tomato, namely, V_1: SAU Red 1; V_2: MoMo Gold; V_3: MoMo Red; V_4: Purnima Regular Size; V_5: Fuji Regular Size; V_6: Urmila Regular Orange; V_7: Mini Amai; V_8: Mini Anindyo Red; V_9: Mini Anindyo gold; V_{10}: Mini Chika; V_{11}: Calory Passion Mini; V_{12}: Aran Chan Mini; V_{13}: Sunshine mini; V_{14}: Red Lantern; V_{15}: Bipul, V_{16}: Jholok, V_{17}: Nidhi, V_{18}: Hybrid Tomato US440, V_{19}: BARI Tomato 6 and V_{20}: BARI Tomato 11 were used in this experiment following a Completely Randomized Block Design (RCBD) with three (3) replication.

Spacing, plot size and others: 40 cm x 60 cm spacing was maintained. Each of the plot size was 3.0 m ×1.0 m and 30 cm was left for irrigation and drainage between two beds. Thirty days old seedlings were transplanted in plots under transparent polyethylene shed tunnel.

Fertilization: Manures and fertilizers were applied as recommended by Bangladesh Agricultural Research Institute (Mondal *et al.*, 2011). The entire amount of organic manure, TSP, Gypsum, Borax and half of the MP were applied during final land preparation. The remaining half of MP and entire urea applied in two equal installments, 1st at 15 days after planting and 2nd at flowering.

Disease and insect control: 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 (DAT).

Application of plant growth regulator: GA_3 was sprayed @ 20-ppm at 30 DAT for better plant growth.

Data collection: Data were collected on number of leaves, plant height, chlorophyll content, number of branch/plant, days to flower bud appearance, days to flowering, number of bunch/plant, number of flower bud/plant, number of flower bud/bunch, number of flower/plant, number of flower/bunch, number of fruit/plant, number of fruit/bunch, fruit length, fruit diameter, fruit weight, yield/plant, yield/plot and calculated yield/ha. SPAD-502 Chlorophyll Meter was used for measuring chlorophyll content. Collected data were statistically analyzed using MSTAT-C computer package program and mean was calculated.

Statistical analysis: Differences between treatments were evaluated by Least Significance Difference (LSD) test at 5% level of significance. To determine the genetic affinity of studied varieties and to group them, cluster analysis was performed using the squared Euclidean and Nearest Neighbour Method (Hoque and Rahman, 2006) using SPSS (Statistical Package for the Social Sciences).

III. Results

Plant height and number of leaves

Significant variation was observed in case of plant height. Tallest plant was found from V_8 (116.0 cm) followed by V_{13} (107.0 cm) whereas the smallest from V_{19} (42.3 cm) at 80 DAT. Maximum number of leaves was observed from V_{18} (147.0) that were statistically similar to the V_{20} (127.7) while minimum from V_{14} (24.0) at 80 DAT (Figure 1).

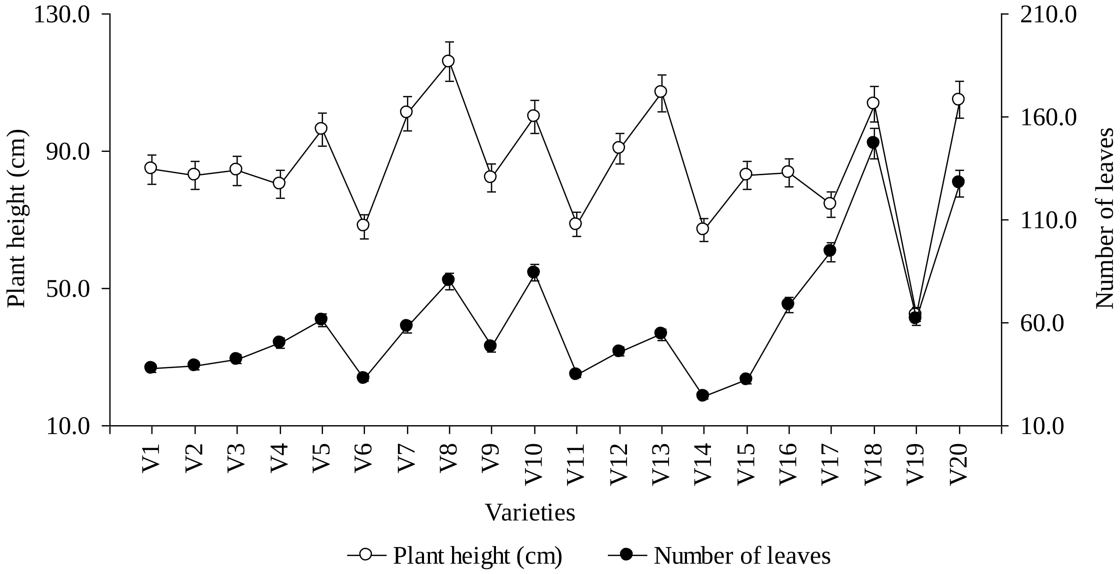

Figure 1. Cultivar response of tomato on plant height and number of leaves at 80 DAT.

Chlorophyll content and growth characteristics

Maximum chlorophyll content on leaves was in V_{19} (53.0%) whereas minimum from V_6 (30.4%). Maximum number of branch/plant was found from V_{10} (5.7) while minimum from V_{19} (0.0). Number of bunch/plant varied significantly among the tomato varieties cultivated in summer season. Maximum number of bunch/plant was found from V_{10} (15.3) that were statistically similar with V_8 (13.0) while minimum from V_1, V_3, and V_{19} (2.3) (Table 1). Tomato varieties cultivated in summer season showed significant variation by their days required for flower bud appearance and flowering. Maximum days required by V_{19} (40.3) whereas minimum from V_8 (18.3). V_{19} (46.7) showed late flowering while V_8 (24.3) was early flowering (Table 1).

Yield contributing attributes

The number of flower bud/plant, flower bud/bunch, number of flower/plant, flower/bunch, fruit/plant and fruit/bunch were varied significantly. Maximum number of flower bud/plant was found from V_{10} (129.7) whereas minimum from V_{19} (6.7). Consequently, V_{20} (6.0) provided maximum number of flower bud/bunch while minimum in V_{19} (0.8). Maximum number of flower/plant (108.3) and flower/bunch (6.7) were found from V_{10} while minimum flower/plant in V_{19} (4.7) and flower/bunch in V_5 (2.2). Maximum number of fruit/plant was found from V_{10} (6.7) whereas minimum from V_{14} (0.3). Conversely, maximum number of fruit/bunch was found from V_{12} and V_1 (1.2) while minimum from V_{14}, V_{15} and V_{17} (0.1) (Table 2).

Table 1. Cultivar response of tomato to different growth related attributes[X]

Cultivar	Chlorophyll Content (%)		Number of branch/plant		Number of bunch/plant		Days to flower bud appearance		Days to flowering	
V_1	37.7	Defg	2.0	cdef	2.3	e	21.0	cdef	32.0	bc
V_2	43.1	abcdef	2.0	cdef	3.3	de	22.0	cde	38.7	b
V_3	41.4	bcdef	1.3	ef	2.3	e	22.3	cd	28.0	cd
V_4	40.7	bcdef	3.0	bcde	8.7	b	19.3	def	25.0	d
V_5	42.8	bcdef	4.0	abc	7.0	bcd	18.7	ef	24.7	d
V_6	30.4	g	2.0	cdef	5.0	bcde	21.0	cdef	26.7	cd
V_7	48.9	ab	2.3	cde	7.7	bc	19.3	def	25.3	cd
V_8	33.8	fg	5.0	ab	13.0	a	18.3	f	24.3	d
V_9	37.9	cdefg	2.7	cde	5.0	bcde	20.0	cdef	25.3	cd
V_{10}	46.5	abcd	5.7	a	15.3	a	19.0	def	25.0	d
V_{11}	48.0	abc	2.0	cdef	4.7	bcde	20.7	cdef	27.7	cd
V_{12}	46.0	abcd	3.0	bcde	4.3	cde	18.7	ef	25.7	cd
V_{13}	35.3	efg	3.7	abcd	6.0	bcde	21.3	cdef	28.3	cd
V_{14}	45.8	abcd	2.0	cdef	2.7	e	28.0	b	36.3	b
V15	45.1	abcde	2.0	cdef	4.0	cde	23.3	c	32.0	bc
V_{16}	44.1	abcde	1.3	ef	4.0	cde	20.3	cdef	26.7	cd
V_{17}	42.3	bcdef	2.3	cde	3.0	de	22.3	cd	28.7	cd
V_{18}	38.1	cdefg	2.0	cdef	7.0	bcd	23.0	c	29.0	cd
V_{19}	53.0	a	0.0	f	2.3	e	40.3	a	46.7	a
V_{20}	38.1	cdefg	1.7	def	5.7	bcde	21.0	cdef	26.7	cd
CV %	14.6		9.9		10.4		9.9		14.4	
LSD 0.05	10.1		2.1		4.1		3.6		6.9	

[x]In a column means having similar letter(s) are statistically identical, dissimilar letter(s) differ significantly (0.05%)

Table 2. Cultivar response of tomato to different yield related attributes[X]

Cultivar	Number of											
	flower bud/plant		flower bud/bunch		flower/ plant		flower/ bunch		fruit/ plant		fruit/ bunch	
V_1	11.3	c	3.9	abcd	7.7	c	3.4	bc	2.9	g	1.2	a
V_2	13.3	c	2.9	bcde	7.7	c	2.3	c	3.0	g	1.0	b
V_3	8.7	c	3.2	abcde	6.0	c	2.7	c	0.8	l	0.3	f
V_4	29.0	bc	2.6	cde	24.3	c	2.4	c	5.9	c	0.8	c
V_5	32.3	bc	3.9	abcd	17.0	c	2.2	c	1.3	j	0.2	g
V_6	18.7	c	3.1	abcde	13.0	c	2.5	c	2.6	h	0.6	d
V_7	89.0	b	5.6	ab	31.3	bc	4.1	bc	5.3	d	0.7	c
V_8	93.3	b	2.0	de	58.0	b	4.3	abc	6.2	b	0.6	d
V_9	35.7	bc	5.0	abc	17.3	c	3.2	bc	2.5	hi	0.5	d
V_{10}	129.7	a	3.2	abcde	108.3	a	6.7	a	6.7	a	0.4	e
V_{11}	30.0	bc	4.6	abcd	19.7	c	4.2	abc	3.4	f	0.7	c
V_{12}	29.7	bc	5.2	abc	22.7	c	5.3	ab	4.9	e	1.2	a
V_{13}	31.3	bc	3.9	abcd	21.0	c	3.5	bc	5.3	d	1.0	b
V_{14}	10.0	c	3.2	abcde	8.3	c	3.6	bc	0.3	o	0.1	h
V15	21.7	c	4.3	abcd	12.3	c	3.6	bc	0.6	m	0.1	h
V_{16}	28.3	bc	5.4	abc	20.7	c	5.4	ab	1.0	k	0.2	g
V_{17}	18.0	c	2.6	cde	14.7	c	4.5	abc	0.4	n	0.1	h
V_{18}	32.0	bc	2.6	cde	26.3	bc	3.7	bc	2.4	i	0.3	f
V_{19}	6.7	c	0.8	e	4.7	c	2.7	c	0.5	n	0.2	g
V_{20}	35.3	bc	6.0	a	19.3	c	3.6	bc	1.1	k	0.2	g
CV %	12.8		17.8		13.2		11.3		2.7		7.1	
LSD 0.05	30.9		2.9		31.8		2.5		0.1		0.1	

[x]In a column means having similar letter(s) are statistically identical, dissimilar letter(s) differ significantly (0.05%)

Fruit characteristics and yields

Fruit length, fruit diameter, fruit weight, yield/plant, yield/plot and yield/ha of the tomato varieties showed significant differentiation. Longest fruit (22.8 cm) and maximum fruit diameter (61.3 mm) was found from V_{10}. Consequently, maximum fruit weight was found from V_{10} (100.0 g) whereas minimum from V_{18} (34.8 g). Maximum yield/plant (667.1 g), yield/plot (6.7 kg) and calculated yield/ha (22.3 ton) was found from V_{10} followed by V_8 (520.3 g/plant, 5.2 kg/plot and 17.3 ton/ha) (Table 3).

Table 3. Cultivar response of tomato to different yield related attributes[x]

Variety	Fruit length (cm)		Fruit Diameter (mm)		Fruit Weight (g)		Yield/plant (gm)		Yield/plot (kg)		Calculated yield/ha (ton)	
V_1	9.0	m	24.0	q	49.4	k	143.4	h	1.4	h	4.7	h
V_2	8.6	n	31.0	o	53.0	i	159.1	gh	1.6	gh	5.3	g
V_3	9.3	l	30.1	p	51.0	j	40.9	j	0.4	j	1.4	j
V_4	11.0	k	46.0	g	57.6	f	338.0	d	3.4	d	11.3	d
V_5	12.1	i	38.8	l	55.8	g	72.6	i	0.7	i	2.4	i
V_6	16.6	e	43.2	ij	63.7	e	163.7	g	1.6	j	5.5	g
V_7	18.3	c	47.9	f	77.8	c	415.1	c	4.1	c	13.8	c
V_8	19.5	b	53.4	b	84.3	b	520.3	b	5.2	b	17.3	b
V_9	17.2	d	43.5	i	67.6	d	169.1	g	1.7	g	5.6	g
V_{10}	22.8	a	61.3	a	100.0	a	667.1	a	6.7	a	22.3	a
V_{11}	11.8	i	43.0	j	51.5	j	175.3	g	1.8	g	5.8	g
V_{12}	12.1	i	44.9	h	54.6	h	265.8	f	2.7	f	8.9	f
V_{13}	14.2	g	46.4	g	57.6	f	305.5	e	3.1	e	10.2	e
V_{14}	16.2	f	41.0	k	49.4	k	13.2	l	0.1	l	0.4	l
V_{15}	13.4	h	36.8	m	38.5	m	23.2	kl	0.2	jkl	0.8	kl
V_{16}	11.9	i	34.3	n	38.9	m	38.9	jk	0.4	jk	1.3	jk
V_{17}	11.4	j	50.8	c	43.2	l	16.7	l	0.2	l	0.6	l
V_{18}	7.8	o	49.2	e	34.8	o	83.5	i	0.8	i	2.8	i
V_{19}	9.2	lm	49.8	d	38.9	m	18.2	l	0.2	kl	0.6	l
V_{20}	9.1	lm	47.9	e	36.8	n	39.3	jk	0.4	j	1.3	j
CV %	1.5		0.7		0.6		5.5		5.9		5.3	
LSD 0.05	0.3		0.5		0.5		16.6		0.2		0.5	

[x]In a column means having similar letter(s) are statistically identical, dissimilar letter(s) differ significantly as per (0.05%)

Hierarchical cluster analysis

Dendrogram graphically present the information concerning which observations are grouped together at various levels of similarity and dissimilarity. Each observation is considered its own cluster. Horizontal lines extend up for each observation and at various similarity and dissimilarity values, these lines are connected to the lines from other observations with a vertical line. The observations continue to combine until. The diagnosis function analysis for determining cut site of Dendogram from cluster analysis based on all traits studied of 20 tomato genotypes. The results of the cluster analysis (Nearest Neighbour Method) based on cultivar characteristics are presented in Figure 2; the cluster diagram (also called cluster trees) revealed two major groups. It was measured 20 tomato varieties on their physical characteristics (growth and yield related) and wanted to cluster these varieties based on these characteristics. In the simple linkage method, we begin with the two most similar cases. Group A comprised of single clusters (Cluster I). Cluster I containing only one variety (V_{10}). Group B consist of two clusters (Cluster II and Cluster III). Cluster II comprised only one variety (V_8) while Cluster III comprised rest 18 varieties (except V_{10} and V_8). 18 cultivar were genetically identical by expressing phenotypic characters while V_{10} and V_8 were differed genetically from the others.

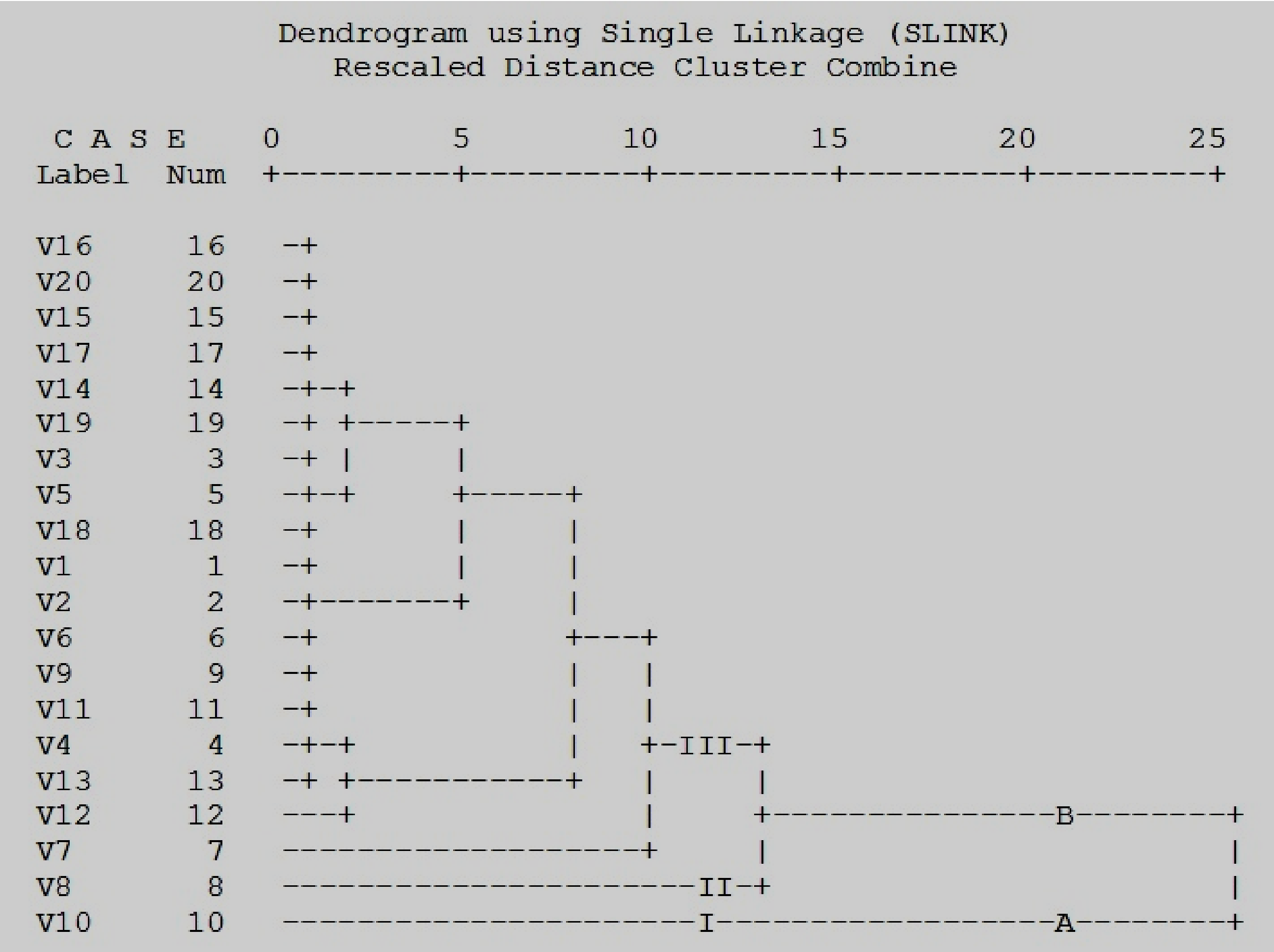

Figure 2. Dendogram of 20 tomato cultivars using single linkage (SLINK Within Groups) rescaled distance cluster combine (Nearest Neighbour Method).

IV. Discussion

Twenty tomato cultivars perform differently under the agro climatic condition during summer season of Bangladesh. Different tomato cultivars showed a significant variation in terms of growth, duration and yield parameters. Variation in growth, duration and yield is genotypic attribution which may even vary from line to line and clone to clone (Hussain *et al.*, 1990; Hussain *et al.*, 2001; Gabal *et al.*, 1985; Khokar *et al.*, 1988 and Chaudhry *et al.*, 1999). It was found that plant height and leaves number (Figure 1) varied among different varieties. Phookan *et al.* (1990) found that plant height of tomato varied in summer under plastic house condition. Similar opinion was put forwarded by Hossain *et al.* (2002) in brinjal. Table 1 indicated that chlorophyll content was varied among these varieties. Leaf chlorophyll content is often highly correlated with leaf N status, photosynthetic capacity, and RuBP carboxylase activity (Evans, 1983; Seemann *et al.*, 1987); a loss in chlorophyll coincides with development of grain filling. Changes in photosynthesis most closely paralleled changes in chlorophyll content. Correlations between loss of Chlorophyll and photosynthesis in both wheat and soybean (Wittenbach, 1979). In addition, Fischer (1983) revealed that radiation use efficiency (RUE) declines during grain filling probably due to sink limitation and/or leaf senescence. In cells, senescence-related changes are first detected in the chloroplast (Dodge, 1970) which is related to chlorophyll content. There were also significant differences in the amount of chlorophyll content of leaves in the four different growths, development stages, the age groups and on different plant species (Blackburn, 1998; Yang and Ko, 1998). The variation in the plant height, number of leaves, chlorophyll content and number of branches/plant is an indication of the differences in the growth habit of the plant varieties as similarly found in cowpeas by Olotuah and Fadare (2012). Significant variation was found in case of days to flowering and fruiting (Table 1). Number of branch/plant, bunch/plant, flower bud/plant, flower bud/bunch, flower/plant, flower/bunch, fruit/plant and fruit/bunch was also found significant variation among the brinjal varieties (Table 2 and Table 3). It was observed that tomato varieties have the ability to produce flower and fruit during the summer season but the number of harvested fruit is very low. It may very high day temperature or heavy rainfall. Plastic tunnel was used to protect the pollen from washed away due to the heavy rainfall, so the temperature might be acted as a vital fact for fruit formation. The production of viable pollen decreased with the increase of day temperature (Bodo, 1991). Smith (1982) reported a big increase in blossom drop resulting from hot and dry wind and low humidity. Phookan *et al.* (1990) evaluated the performance of 29 tomato hybrids on different growth and yield attributing parameters under plastic house condition during the summer season and found fruit number ranging from 2.67 to 70.0. Significant variation was found in individual fruit weight among the tomato varieties (Table 3). Ahmad (2002) also found a significant variation among the 25 heat tolerant hybrids which supports the findings of this study. Fruit size of the twenty tomato cultivars were remarkably dissimilar (Table 3). Dane *et al.* (1991) stated that abundantly flowering genotypes were less affected by heat stress and the present study supports the statement. Yield/plant, yield/plot and calculated yield were also varied significantly among the tomato varieties (Table 3). Yield of tomato varied depending on the level of heat tolerance of the hybrids (Baki, 1991). It was evident that cultivars have different degrees of potentiality in respect of tolerance to heat.

Dendogram shows that cultivar in one cluster are mostly identical and have less diversity. Key point of this method is to close up the two most similar variables and hereinafter they are handled as one (Turcsanyi, 1995). The most similar objects are linked by gradually diminished criteria of similarity (Stanisz, 2007). The segmentation of data has a wide application and is very useful in classification of plants (Sava *et al.*, 2011). Additionally, Cluster analysis is applied to analyze micro array results (Shannon *et al.*, 2003) because it allows one to determine groups of genes with similar patterns of expression or to establish similarity in the genotypes (Eisen *et al.*, 1998). In a breeding program, more the parents are genetically far from each other, more will be the aggressiveness among the offspring. The main objective of cluster analysis for this experiment was to determine the extent of genetic affinity or distance of hybrids from each other so researcher could get an ideal genotype by accident rather append energy and time to a host of hybridization. First cluster studied genotypes based on cluster analysis and then selects limited blocks of hybrid by choosing a hybrid of the best from far cluster considering desirable traits. For example, the genetic dissimilarity in 15 cassava clones was evaluated based on seven morpho-agronomic traits aiming to select the most divergent and best in an approach to future hybridizations, the clones were grouped as related to similarity using nearest neighbor (Nick *et al.*, 2008).

V. Conclusion

Tomato cultivars that were cultivated in summer season during this experiment showed significant variation for different growth and yield attributes. Best cultivar that produced maximum yield having potential growth and yield contributing characters was Mini Chika (V_{10}) followed by Mini Anindyo Red (V_8) and Mini Amai (V_7); these three cultivars may be recommended for multi-location trials of summer tomato production.

VI. References

Abdulla, A. A. & Verkert, K. (1968). Growth flowering and fruit-set of the tomato at higher temperature. Neth. *J. Agric. Sci.* 16: 71-76.

Ahmad, S. (2002). Genetics of fruit set and related traits in tomato under hot -humid conditions. Ph. D. Thesis, Bangabandhu Sheikh Mujibur Rahman Agriculture University. pp. 44-180.

Baki, A. A. (1991). Tolerance of tomato cultivars and selected germplasm to heat stress. *J. Amer. Soc. for Hor. Sci.* USDA-ARS Vegetable. pp. 48-55.

Bhattarai, S. P. & Subedi, P. P. (1996). Heat and bacterial wilt tolerant tomato varietal evaluation during 1992/93-1994/95 season. LARC Working Paper No. 96/56. Lumle Agricultural Research Centre, Kaski, Nepal.

Bodo, R. T. (1991). Comparison of different pollen viability assays to evaluate pollen fertility of potato diploids. *Euphytica* 56: 143-148.

Chaudhry, M. F., Khokhar, K. M., Hussain, S. I., Mahmood, T. and Iqbal, S. M. (1999). Comparative performance of some local and exotic tomato cultivars during spring and autumn seasons. *Pakistan J. Arid Agric.* 2: 7-10.

Dane, F., Hunter, A. G. & Chambliss, O. L. (1991). Fruit set, pollen fertility and combining ability of selected tomato genotypes under high temperature field conditions. *J. Amer. Soc. Hort. Sci.* 116(5)*:* 906-910.

Eisen, M. B., Spellman, P. T., Brown, P. O. & Botstein, D. (1998). Cluster analysis and display of genome-wide expression patterns. Proceedings of the National Academy of Sciences of the United States of America, **9**5(25): 14863–14868.

Gabal, M. R., Abd-Allah, I. M., Abed, T. A., Hassan, F. M. and Hasanen, S. (1985). Evaluation of some American tomato cultivars grown for early summer production in Egypt. *Ann. Agric. Sci. Moshtohor.* 22: 487-899.

Hoque, M. N. & Rahman, L. (2006). Estimation of Euclidean distance for different morpho-physiological characters in some wild and cultivars rice genotypes (*Oryza sativa* L.). *Pakistan Science* 1: 77-79.

Hossain, M. M., Shahjahan, M., Salam, M. A. & Begum, M. A. (2002). Screening of Brinjal Varieties and Lines Against Brinjal Shoot and Fruit Borer, *Leucinodes orbonalis Guenee. Pakistan J. of Biological Sci.* 5(10): 1032-1040.

Hussain, S. I., Khokar, K. M., Qureshi, K. M., Mahmood, T. & Niazi, Z. M. (1990). Studies on production of tomato cultivars in summer season. *Pakistan J. Agric. Res.* 25: 65-69.

Hussain, S. I., Khokar, K. M., Laghari, M. H. & Mahmud, M. M. (2001). Yield potential some exotic and one local tomato cultivars grown for summer production. *Pakistan J. Biol. Sci.* 4: 1215-1216.

Khokar, K. M., Hussain, S. I. & Qureshi, K. M. (1988). Varietal trial on green house tomato grown under unheated plastic tunnel. *Pakistan J. Agric. Res.* 27: 248-251.

Mondal, M. R. I., Islam, M. S., Jalil, M. A. B., Rahman, M. M., Alam, M. S. & Rahman, M. H. H. (2011). KRISHI PROJUKTI HATBOI (Handbook of Agro-technology), 1st part, 5th edition. *Bangladesh Agricultural Research Institute*, Gazipur-1701, Bangladesh, pp: 390.

Nick, C., Carvalho, M., Bambini de Assis, L. H. & Pereira de Carvalho, S. (2008). Genetic dissimilarity in cassava clones determined by multivariate techniques. *Crop Breeding and Applied Biotechnology*, 8: 104-110.

Olotuah, O. F. & Fadare, Z. O. (2012). Growth morphology and seed quality variation among five indigenous varieties of cowpea, V*igna unguiculata* (L.) Walp. *Int. J. of Agri. Sci.* 2(6): 546-549.

Phookan, D. B., Talukdar, P., Shadeque, A. & Chakravarty, B. K. 1990. Genetic variability and heritability in tomato *(Lycopersicon escuiuntum)* genotypes during summer season under plastic-house condition. *Indian J. Agric. Sci.* 68(6): 304-306.

Sava, F. A. & Popa, R. I. (2011). Personality types based on the big five model. A cluster analysis over the Romanian population. Cognition, Brain, Behavior. *An Interdisciplinary J.* 15(3): 359–384.

Shannon, W., Culverhouse, R. & Duncan, J. (2003). Analyzing micro array data using cluster analysis. Future Medicine 4(1): 41–52.

Smith, 0. (1982). Regulation of temperature to anthesis and blossom drop of the tomato, together with a histological study of the pistils. *J. Agric. Res.* 44: 183-190.

Stanisz, A. (2007). Przystępny kurs statystyki z zastosowaniem STATISTICA PL na przykładach z medycyny. T. 3. Analizy wielowymiarowe. Kraków: Stat-Soft.

Stevens, M. A. & Rudich, J. (1978). Genetic potential for overcoming physiological limitations on adaptability, yield and quality in the tomato. Hort. Sci. 13: 673-678.

Turcsanyi, G. (1995). Mezogazdasagi Novenytan. Mezogazdasagi Szaktudas Kiado, Budapest. 408-502.p (edit.).

Evans, J. T. (1983). Nitrogen and photosynthesis in the flag leaf of wheat. Plant Physiology 72: 297–302.

Seemann, J. R., Sharkey, T. D., Wang, J. & Osmond, C. B. (1987). Environmental effects on photosynthesis, nitrogen-use efficiency and metabolite pools in leaves of sun and shade plants. *Plant Physiology* 84: 796–802.

Wittenbach, V. A. (1979). Ribulose bisphosphate carboxylase and proteolytic activity in wheat leaves from anthesis through senescence. *Plant Physiology* 64: 884-887.

Dodge, J. D. (1970). Changes in chloroplast fine stucture during the autumnal senescence of Betula leaves. *Annales Botanici.* 34: 817-824.

Fischer, R. A. (1983). Wheat. In: Proceeding symposium on potential productivity of field crops under different environments. pp.129-154.

Blackburn, G. A. (1998). Spectral estimating photosynthetic pigment concentration: a test using senescent tree leaves. *Int. J. Remote Sensing* 19(4): 657-675.

Yang, C. M. and Ko. C. C. (1998). Seasonal changes in canopy spectra of sweet potato. *J. Photogram. Remote Sensing* 3: 13-28.

Citation for this article (APA Style):

Mehraj, H., Mutahera, S., Roni, M. Z. K., Nahiyan, A. S. M. & Jamal Uddin, A. F. M. (2014). Performance Assessment of Twenty Tomato Cultivar for Summer Cultivation in Bangladesh. *Journal of Science, Technology & Environment Informatics,* 01(01), 45–53.
Retrieved November 30, 2014, from http://www.journalbinet.com/current-issue-jstei.html