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Performance evaluation of some productive tomato (*Lycopersicon esculentum* Mill.) hybrids

Md. Omar Kayess*, Md. Jalil Uddin, Md. Hasanuzzaman, Md. Imanur Rahman, Md. Rakibul Alam

Department of Genetics and Plant Breeding, Hajee Mohammad Danesh Science & Technology University, Dinajpur, Bangladesh

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Abstract

Performance of ten tomato hybrids were tested in randomized complete block design with three replications at the experimental field under the department of Genetics and Plant Breeding, Hajee Mohammad Danesh Science and Technology University, Dinajpur from October 2015 to April 2016. Different agronomical traits were investigated. Analyses of variance for all the traits were showed significant differences among the hybrids. From the research work it was found that, significant difference was high in case of plant height, canopy width and number of marketable fruits per plant. Single fruit weight, days to 1st flowering, fruit diameter and shelf life were showed moderate significant difference among the hybrids. Hybrid-6 was the highest yielding (2003.15 g plant^{-1}) hybrid possessed highest single fruit weight (45.81g) with medium plant height (84.40 cm) and second highest fruit diameter (59.85 mm) producer. It also requires minimum days to 50% flowering (23.20) with medium canopy width (46.20 cm) and average number of marketable fruits plant^{-1} (41.40) in the same way medium shelf life (12.00 days) and fruit length (8.87 mm) too. The second highest yielding hybrid was Hybrid-10 which showed minimum thousand seed weight but produced lower fruit length (6.82 cm), fruit diameter (14.16 mm) and single fruit weight (29.78 g). The third highest yielding hybrid was Hybrid-4 (1913.32 g plant^{-1}) and minimum thousand seed weight but revealed worsen performance to the other traits. So, it was recommended for further popularization of Hybrid-6 hybrid in Bangladesh especially in northern parts.

* **Corresponding Author:** Md. Omar Kayess ✉ kbdkayess@gmail.com

Introduction

Tomato (*Solanum lycopersicum* L.) is known as poor man's apple or golden apple and also a popular vegetable all over the world because of its high nutritive value and diversified uses (Kamran *et al.,* 2011; Regassa *et al.,* 2012) and also the second largest cultivated vegetable crop in the world after potato (Hanson *et al.,* 2001). It is local to the Andes district of South America (Moraru *et al.,* 2004) and belongs to the family Solanaceae, commonly known as nightshade gang. It is most widely produced, consumed and processed important winter vegetable crops (Tekeoka *et al.,* 2001; Rukshar *et al.,* 2012). The area and production are increasing day by day in Bangladesh due to changing in food habit. The cultivated area in Bangladesh is about 24.7 thousand hectares of land accounting for production of 94,000 metric tons with productivity of 9.38 tons per hectares (BBS, 2012). As raw vegetable tomatoes are eaten directly or added to other food items like various forms of juice, sauces, ketchup, sauce (Takeoka *et al.,* 2001), conserved puree, marmalade, chatney, and soups and a variety of processed products like paste, whole peeled have gained significant acceptance (Ahamd, 1976; Thompson and Kelly 1983; Bose and Som 1990). It is also rich in ascorbic acid, lycopene and different phenolic compounds (Scalff *et al.,* 2000). The potential health benefits of a diet rich in tomatoes and tomato products indicated by Mayeaux *et al.,* 2006. Various micro element like potassium, vitamin C, folic acid and contains a mixture of different carotenoids, including vitamin A, effective β-carotene content as well as lycopene are also very rich in tomato (Wilcox *et al.,* 2003). In edible portion it contains Calcium 50 mg, Protein 4.5 mg, Iron 2.7 mg, Riboflavin 0.15 mg, Niacin 3.2 mg, Phosphorus 123 mg, Calories 97 and Ascorbic acid 102 mg pound^{-1} (Lester 2006). Without provitamin A activity lycopene is a major carotenoid and is considered responsible for their beneficial effects (Gerster, 1997; Rao and Agarwal, 1999). Beside this, for reducing cardiovascular risk associated with type 2 Diabetes tomato consumption might be beneficial.

From production and industry point of view, there is a necessity to improve the productivity of tomato per unit area to achieve the maximum production from a limited land. The traditional plant breeding methods are sustainable, affordable and ecofriendly to improve productivity. In tomato the commercial F1 hybrids are common and for higher heterosis selection of newer parents is a continuous process. To give high hybrid vigour, generally genetically diverse parents are more expected. In case of development of an open pollinated cultivars it is also often possible to combine desired alleles in regular fashion without waiting for longer term. A plant breeding program needs enough genetic variation for selection of better type. Careful selection and hybridization may help to obtain lines higher in yields with better quality. Genetic variability can offer opportunity for the effective selection for high yielding tomato variety rich in fruit quality. The present experiment was carried to find out the performance of different tomato hybrids and to select the outstanding tomato hybrids in terms of growth and yield traits.

Materials and methods

Location

The present research work was conducted at the experimental field of the department of Genetics and Plant Breeding of Hajee Mohammad Danesh Science and Technology University, Dinajpur, Bangladesh, from October 2015 to April 2016 during the Rabi season. The experimental field was located at 25.13°N latitude and 88.23°E longitudes belonging to the agro-ecological region of the AEZ-1 (UNDP and FAO, 1988).

Design and plot size

The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The individual plot size was 12m x 1m where each replication contained 10 plots. Each plot contains 15 plants. The distances between the rows were 1m and plant to plant distances 0.80m. The distance between the block was 1m.

Production techniques

The seeds of 10 tomato hybrids used in the experiment were developed in department of Genetics & Plant Breeding, HSTU, Dinajpur (Table 1). The manures and fertilizers like Cow dung, Urea, TSP, MoP, Gypsum and Boric acid were applied at the rate of 10000, 270, 250, 150, 50 and 5kg ha^{-1}. After final land preparation, full dose of P, K, S, Zn, B and half amount of the Urea was applied.

The rest half of the Urea was applied in two installments at 15 days after transplanting and a week before flowering. The sowing was carried out on 12 October 2015 in the nursery bed and transplanted in the experimental field on 12 November, 2015 at afternoon. Recommended tomato production procedure of Bangladesh Agricultural Research Council was followed (BARC, 2005).

Various intercultural operations like irrigation, gap filling, weeding, mulching, stalking, pruning and plant protection measures were done as per need.

Depending on variable maturity time harvesting continued for about one month because fruits of different hybrids matured progressively at different dates and over long time. The fruits per entry were allowed to ripe and then seeds were separated from them and then the seeds were collected for future use.

Data collection on agronomic traits

Data were recorded on the following traits: plant height (cm), canopy width (cm), days to 50% flowering, fruit diameter (mm), fruit length (cm), single fruit weight (g), number of marketable fruits $plant^{-1}$, thousand seeds weight (g), shelf life (days) and yield per plant (g).

Data analysis

The mean values of all the traits were evaluated and analysis of variance was performed by the 'F' test. To test the differences among the hybrids Duncan's Multiple Range Test (DMRT) was performed by using Statistical Tool for Agricultural Research (STAR) version 2.0.1 2014.

Table 1. Name and sources of the hybrids were used in the experiment.

Name of the hybrids	Source of seed collection
Hybrid -1 Hybrid -2 Hybrid -3 Hybrid -4 Hybrid -5 Hybrid -6 Hybrid -7 Hybrid -8 Hybrid -9 Hybrid -10	Department of Genetics & Plant Breeding, HSTU, Dinajpur

Results and discussion

The analysis of variance and mean performance for the traits plant height (cm), canopy width (cm), days to 50% flowering, fruit diameter (mm), fruit length (cm), single fruit weight (g), number of marketable fruits, thousand seeds weight (g), shelf life (days) and yield per plant (g) are presented in the table 2 and 3 respectively. It was noticed that mean sum of squares of the hybrids for all the traits were significant. Significant variation was observed among the hybrids for all the studied trait. At large there was no significant variation among the blocks for all the trait. Coefficient of variation was low for most of the traits except number of marketable fruits per plant due to several harvesting time as well as variation was also found for yield per plant (g) because of similar reason. The results of analysis of variance (Table-2) showed that the hybrids had significant differences among them for all the traits indicating the existing genetic variance and there is a chance and scope for the selection of better hybrid varieties for cultivation by the farmer. Hybrid-6 was the highest yielding (2003.15g $plant^{-1}$) hybrid possessed highest fruit weight (45.81g) with medium plant height (84.40 cm) and second highest fruit diameter (59.85 mm) producer. Hybrid-6 hybrid requires minimum days 50% flowering (23.20) having medium canopy width (46.20 cm) and average number of marketable fruits $plant^{-1}$ (41.40) with medium shelf life (12.00 days) and fruit length (8.87 mm). Besides this, it showed minimum thousand seed weight (2.53 g). The salient features made this hybrid unique to give better yield compared to remaining hybrids.

In contributing towards fruit yield, the importance of these traits were also stressed by Srivastava *et al.,* 1998; Kulkarni, 1999; Patil, 2003; Sekhar *et al.,* 2008 and Kaushik *et al.,* 2011. The second highest yielding hybrid was Hybrid-10 (1946.11g plant^{-1}), number of marketable fruits plant^{-1} (64.56) and shelf life (14.33 days). Though it has minimum thousand seed weight but showed lower fruit length (6.82 cm), fruit diameter (14.16 mm) and single fruit weight (29.78 g) (Table-3). The contribution of these traits towards yield was also emphasized by Yogananda, 1997 but contradictory to the findings of Patil, 2003. Defining fresh tomato marketability an important trait is fruit shelf life, the Hybrid-10 is better for both yield and shelf life. Siddiqui *et al.,* 1996. Singh *et al.,* 2002; Kabir, 2004; Hossain, 2003 and Karim, 2005 who also stated that the morphological and growth traits of tomato were varied significantly due to hybrids.

The third highest yielding hybrid was Hybrid-4 (1913.32 g plant^{-1}) and minimum thousand seed weight but showed worsen performance to the other traits (Table 3). Sonone *et al.,* 1986; Sing *et al.,* 1997 and Phookan *et al.,* 1998 who also reported that due to varieties the morphological and growth characters of tomato were varied significantly. In the present experiment, Hybrid-6 was found superior in economic yield (marketable yield) and other traits. So, that it was recommended for further popularization in Bangladesh especially in northern parts. For the success of production and productivity of tomato in the area other agronomic and plant protection trials should be done. To increase its shelf life post-harvest management activities also have to be researched. Since the experiment is one site one season experiment, to generate more reliable information on performance of the hybrids across location and year further studies using combination of locations and seasons are required.

Table 2. Analysis of variance for different plant characters in tomato (MS).

Items	df	Plant height (cm)	Canopy width(cm)	Days to flowering	Fruit diameter (mm)	Fruit length(cm)	Single fruit weight (g)	Number of marketable plant^{-1}	1000 seed weight (g)	Shelf life (days)	Yield plant^{-1} (g)
Replication	2	1.03^{NS}	9.03**	2.47*	0.42^{NS}	0.73^{NS}	0.66^{NS}	0.09^{NS}	0.86^{NS}	0.62^{NS}	0.09^{NS}
Genotypes	9	237.48**	123.25**	7.23**	26.82**	86.37**	47.40**	28.38**	144.94**	95.60**	23.221**
Error	18	8.37	3.31	0.74	0.16	0.03	1.69	13.04	0.002	0.12	13943.34
Coefficient of Variation		3.40%	3.59%	3.65%	2.49%	2.09%	3.55%	8.39%	1.85%	3.00%	7.29%

**and* indicates significant at 0.01 and 0.05 level of probability, respectively.

NS means not significant.

Table 3. Mean Performance of ten important **traits** characters of 10 tomato genotypes.

Hybrids	Plant height (cm)	Canopy width (cm)	Days to flowering	Fruit diameter (mm)	Fruit length (cm)	Single fruit weight (g)	Number of marketable fruits plant^{-1}	Thousand seed weight (g)	Shelf life (days)	Yield plant^{-1} (g)
Hybrid-1	73.50cd	45.94cd	27.00a	15.31c	7.44de	31.52de	37.00ef	2.87b	10.20e	1242.12e
Hybrid -2	72.83cd	41.56e	24.29bc	16.33b	8.18c	37.43c	40.67de	2.51f	10.00e	1549.22d
Hybrid -3	72.00d	36.44f	23.71bc	16.66b	7.21e	33.07d	40.54de	2.78c	9.00f	1468.50 d
Hybrid -4	68.50d	43.72de	24.43bc	13.69d	8.12c	36.40c	50.17bc	2.67d	10.14e	1913.32a b
Hybrid -5	82.83b	51.00b	22.17d	17.56a	8.41c	42.07b	22.67g	3.21a	13.00c	1026.02f
Hybrid -6	84.40b	46.20cd	23.20cd	16.62b	8.87b	45.82a	41.40de	2.53ef	12.00d	2003.15a
Hybrid -7	152.43a	80.24a	21.86d	16.01bc	6.65f	31.86de	54.57b	2.60de	8.83f	1762.30b c
Hybrid -8	72.67cd	50.00b	21.86d	17.89a	9.54a	45.83a	33.17f	3.25a	12.50cd	1560.67c d
Hybrid -9	77.67c	48.77bc	23.86bc	15.97bc	7.62d	36.62c	46.50cd	2.3g0	13.67b	1786.52a b
Hybrid -10	86.00b	48.17bc	25.29b	14.16d	6.82f	29.78e	64.56a	2.21h	14.33a	1946.11a

										b
LSD(0.05)	4.963	3.121	1.472	0.67	0.28	2.23	6.19	0.08	0.59	2.02
Min	68.50	36.44	21.86	13.69	6.65	29.78	22.67	2.21	8.83	1026.02
Max	152.43	80.24	27.00	17.89	9.54	45.83	64.56	3.25	14.33	2003.15
Mean	85.11	50.71	23.49	16.08	7.93	36.65	43.07	2.69	11.47	1619.39

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