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Research Article

YIELD AND QUALITY EVALUATION OF TOMATO YELLOW LEAF CURL VIRUS TOLERANT SUMMER TOMATO IN BANGLADESH

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Abstract

Tomato Yellow Leaf Curl Virus is very devastating pathogenic disease of tomato, which affect the yield and quality of tomato production in Bangladesh. Above mentioned experiment was conducted during summer season at Research Centre of Bangladesh Agricultural Research Institute, Joydebpur, Gazipur with a view to evaluating the yield and fruit quality parameters of Tomato Yellow Leaf Curl Virus resistant summer tomato in Gazipur condition. Variations in relation to yield and fruit quality characters were observed among the genotypes. Shelf life of different tomato lines ranged from 15.67 days to 18 days. The inbred line CLN-3862 exhibited longest shelf life (18.33 days) and lowest shelf life (15.67 days) was found in case of inbred line CLN-3735. The inbred line CLN-3791 showed highest yield potential (54.94 tha^{-1}). On the other hand, the lowest yield obtained in the inbred line CLN-3859 which was 14.82 t/ha. In current study, only BARI Hybrid Tomato-8 exhibited highest Tomato yellow leaf curl virus (TYLCV) infection which was about 16.64% at 60 days after transplanting. Heart shape fruit was observed in the inbred line of CLN-3735, round shape fruit was observed in the inbred lines of CLN-3791, CLN-3850, CLN-3864, CLN-3906 and BARI Hybrid Tomato-8. Lengthened round shape fruit was observed in the inbred lines of CLN-3792, CLN-3849, CLN-3859, CLN-3860 and CLN3862. Flattened round shape fruit was observed in the inbred lines of CLN-3916. Among the genotypes, ripe fruit color of five tomato lines were light red color, three were yellowish red color, two were dark red color and two were orange color. Among the genotypes, blossom end shapes of eight were flat, two inbred lines had pointed and two had indented blossom end shape. In obtained results, fruit ridge of eleven were flat and only one was prominent and flesh color of four were light red, four were red, two were dark red and two were orange. Yield capacity and virus resistance of CLN-3792 exhibits the promicing results among all genotypes.

Introduction

Tomato is one of the most popular and nutritious vegetable crops throughout the world including Bangladesh, which is a leading vegetable in total volume of production (Ahmed, 2002). Many wild relatives of the tomato were identified by the plant explorers. At present, tomato is a most cultivated vegetable which surpasses all other vegetables in terms of total production (Ahmed, 2002).

Cite This Articale

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In respect of production t tomato ranks third in the world, next to potato and sweet potato (Rashid, 1993). The land under tomato cultivation in Bangladesh was about 6.81% and per acre average yield was 6046.35 kg, whereas in total production 442299.60 tons (BBS, 2023). In comparison to other countries like India (25.33tha-1), Japan (52.82 tha-1), USA (110.71 tha-1), China (58.35 tha-1), Egypt (39.39 tha-1) and Turkey (72.59 tha-1) it's production scenario is very low (FAO, 2022). In India, tomato covers 8.120 lakh ha land with annual production of 205.73 lakh MT and productivity of - 25.33 t/tha-1 (FAO, 2022). The main reasons of lower yield in Bangladesh are generally for several major factors like, lack of good variety and good quality seeds of improved varieties, inadequate hybrid variety, pest and disease infestation. Due to congenial environment tomato is cultivated in winter months in Bangladesh because winter is optimum for growth and yield. Due to palatability and vitamin content tomato is demandable throughout the year. Due to environmental hindrances tomato production is far less than the requirements especially in summer season. As a result, special thrust is needed for boosting up summer vegetables production and increasing cash flow to the farm family.

However, hybrid tomato seed production is difficult task (Opena *et al*., 1993). Inbreed lines development and maintenance is the prerequisite for hybridization. Tomato yellow leaf curl virus transmitted by whitefly has become a major problem for tomato growers. The TYLCV was first mentioned by Akanda (1991) that can cause up to 100% loss in tomato yield in many countries like Southeast Asia, Middle East, Tropical Africa, Southwest Europe, and the Caribbean Islands (Czosnek and Laterrot, 1997). The management of TYLCV is of profound importance to reduce the loss and quality deterioration. Due to highly perishable in nature; shelf life of freshly harvested tomato is an important factor for the growers as storage life of fresh tomato is about 3-6 weeks at normal temperature. To increase the post-harvest availability, it is important to store them under proper storage facilities. To increase the shelf life of fresh tomato, harvesting at proper stage of maturity is needed. Several summer tomato varieties have been introduced in this country. So evaluation of yield performance and fruit quality of TYLCV resistant summer tomato inbred lines is highly needed that were collected from AVRDC for Bangladesh conditions.

Materials and Methods

The experiment was conducted at the experimental field of Horticulture Research Centre at Bangladesh Agricultural Research Institute (BARI), Joydebpur, Gazipur, Bangladesh. The climatic situations of the experimental site is subtropical with heavy rainfall during June to October and scarcity in the rest of the year. Soil texture is sandy loam and acidic in nature with a pH of around 5.8. Besides this it belongs to the “Shallow red-brown terrace” soil under Madhupur tract (FAO, 1988; Haider *et al*., 1991). Eleven (11) promising tomato inbred lines along with BARI Hybrid Tomato-8 were collected from The Olericulture Division of BARI, Gazipur. Accession numbers of the inbreed lines are CLN-3849, CLN-3850, CLN-3859, CLN-3860, CLN-3862, CLN-3864, CLN-3906, CLN-3916, CLN-3735, CLN-3791, CLN-3792 and BARI Hybrid Tomato-8. The experiment was designed in a Randomized Complete Block Design (RCBD) replicated three times. Three seedbeds, where each seedbed (3.0 m × 1.0 m in size) considered as one replication. Unit plot size was 1.0 m × 4.8 m having double row per plot and 12 plants per row and 24 plants per plot. Maintained plants spacing was 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. Seeds of inbred lines were sown in three different raised seed bed on 6th June, 2013. The previous crop of the field was Bottle gourd. Crop was covered by polytunnel during the entire cropping period to protect the crop from heavy rain. Twenty-five-days old seedlings were transplanted in the field on 29th June, 2013. All intercultural operations were done timely. Data about following parameters of tomato genotypes were collected on the basis of AVRDC characterization record sheet. Collected data on some parameters were subjected to Statistical Tools for Agricultural Research (STAR) Program software for analysis of variance and mean separation respectively. Correlation coefficient analysis was done by MSTAT program software. A box plot is a convenient demonstrating way of graphically depicting groups of numerical data through their quartiles (minimum, first quartile, median, third quartile and maximum). Fruit Yield, Shelf Life (days), Fruit Shape, Blossom End Shape, Fruit Ridge, Ripened Fruit Color, Flesh Fruit Color, Virus Reaction were taken into consideration as the parameters for the experiment.

Figure 1. Field view of the experimental site

Observations recorded from each inbred line. Data about following parameters were collected on the regular basis of AVRDC characterization record sheet. Recorded data were subjected to Statistical Tools for Agricultural Research (STAR) Program software for analysis of variance and mean separation. Correlation coefficient analysis was done by MSTAT program software. Boxplot introduced by an American mathematician John W. Tukey for depicting the distribution of statistical data in 1969. Boxplot is a convenient way of graphical representation of numerical data through their quartiles measurements (minimum, first quartile, median, third quartile and maximum).

Results and Discussion

Yield Component Characteristics

Shelf Life (Days)

There was a negligible variation in the shelf life of the tomato genotypes in normal field condition (Table 1). Shelf life of different tomato lines varied from 15.67 days to 18 days. From the experiment it was found that the inbred line CLN-3862 showed longer shelf life (18.33 days), and closely similar with the inbred line CLN-3860 (18 days) and BARI Hybrid Tomato-8 (18 days). But the lowest shelf life (15.67 days) was found in the inbred line CLN-3735, that was closely similar with the inbred line CLN-3792 (16 days) and CLN-3791 (16.33 days).

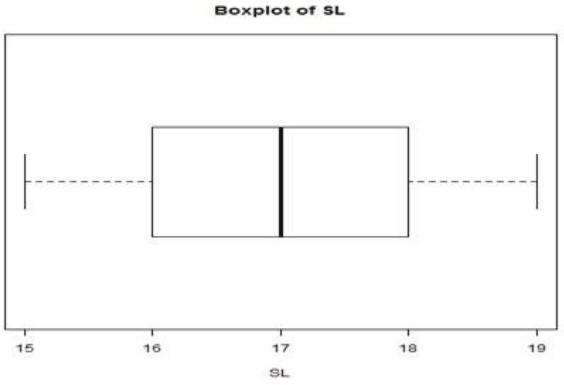

Figure 2. Boxplot representing shelf life of the tomato genotypes

From the rectangle of boxplot, it is clear that, about 50% shelf life of inbred lines varied from 16 to 18 days. The bold black line inside the rectangle indicates the median value (16.84), which was approximately same as mean value (16.86) of the tomato lines.

Table 1. Yield component characteristics of TYLCV resistant summer tomato genotypes

Yield Component Characteristics			
Genotypes	**No. of Fruits Plant^{-1}**	**Yield Plant^{-1} (kg)**	**Shelf Life (Days)**
CLN-3735	17.33ab	1.496a	15.67
CLN-3791	18.33ab	1.616a	16.33
CLN-3792	17.33ab	1.496a	16.00
CLN-3849	11.33bcd	1.039d	17.00
CLN-3850	12.67bcd	1.129cd	16.67
CLN-3859	7.33d	0.436f	15.67
CLN-3860	15.33abc	0.726e	18.00
CLN-3862	9.67cd	0.697e	18.33
CLN-3864	15.33abc	1.241bc	17.33
CLN-3906	7.33d	0.628e	16.33
CLN-3916	11.67bcd	1.128cd	17.00
BARI Hybrid Tomato-8	21.67a	1.346b	18.00
F-test	**	**	NS
CV%	17.73	4.20	7.18

Means bearing the same letter(s) do not differ significantly.

** indicates 1% level of significance.

NS- means not-significant.

Fruit Yield (tonha-1)

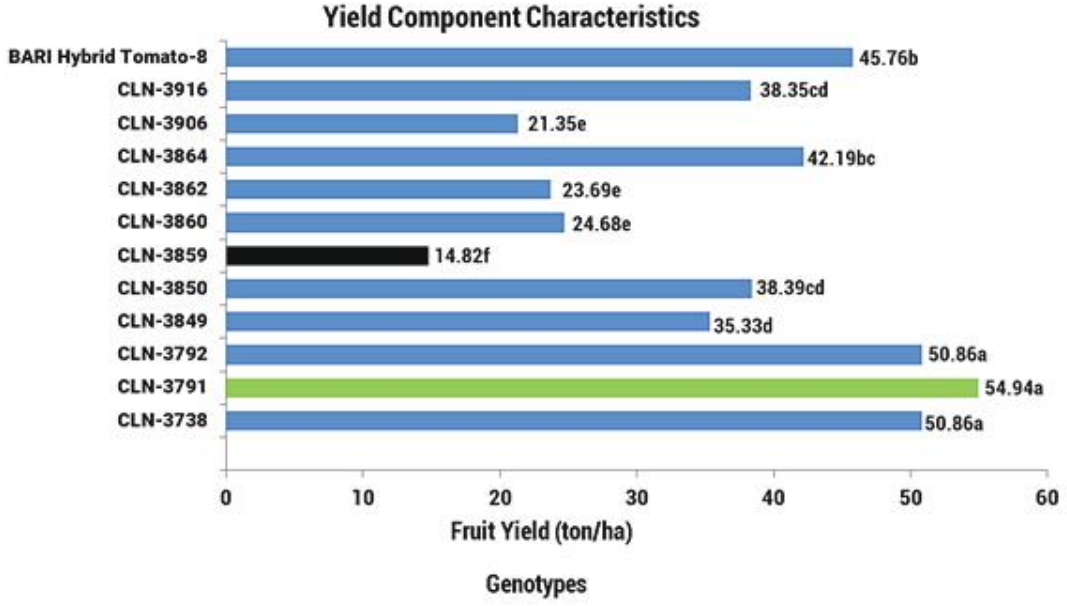

Figure 3. Fruit yield (t/ha) of tomato genotypes during summer

Fruit yield of different tomato genotypes varied from 14.82 tha^{-1} to 54.94 t/ha (Fig. 3). The study depicted that the inbred line CLN-3791 yielded the highest fruit yield (54.94 tha-1). On the other hand, the lowest yield (14.82 tha-1) was found in the inbred line CLN-3859. Deljit *et al.,* (1990) showed that the fruit yield of tomato varied from 27.41 tha^{-1} to 84.47 tha^{-1}. Roy (2009) also revealed that tomato yield variation from 52.02 to 99.85 tha^{-1}. Variation between the reported and present findings in case of fruit yield might happen due to the inherent genetic make-up of the lines used.

Viral Reaction

There was no TYLCV infectious symptoms among the genotypes. Only BARI Hybrid Tomato-8 showed highest Tomato yellow leaf curl virus (TYLCV) infection (16.64%) at 60 days after transplanting (DAT). Polston *et al.* (2005) reported that 90% reduction of yield might happen if infected within 8 weeks after transplantation and 45% if infection occurs after 8-14 weeks of transplanting. Virus effected scenario in BARI Hybrid Tomato-8 is represented in the following table.

Table 2. Viral infection of BARI Hybrid Tomato-8

Viral infection	Plants/replication		
	R_1	R_2	R_3
At planting	0 (0%)	0 (0%)	0 (0%)
15 days after planting	1 (4.16%)	0 (0%)	0 (0%)
30 days after planting	1 (4.16%)	1 (4.16%)	1 (4.16%)
45 days after planting	2 (8.32%)	1 (4.16%)	2 (8.32%)
60 days after planting	2 (8.32%)	3 (12.48%)	4 (16.64%)

Fruit Quality Attributes

The estimated fruit quality attributes of cross combinations and presented in Table 3.

Fruit Shape

Fruit shape was classified into four groups; heart shape, round, lengthened round, flattened round (Table 3). Among the genotypes, five tomato lines attributed round shape, five were lengthened round, one was heart shape and one was flattened round. The inbred line of CLN-3735 showed heart shape fruit and round shape fruit was observed in the inbred lines of CLN-3791, CLN-3850, CLN-3864, CLN-3906 and BARI Hybrid Tomato-8. Lengthened round shape fruit was observed in the inbred lines of CLN-3792, CLN-3849, CLN-3859, CLN-3860 and CLN3862. Flattened round shape fruit was observed in the inbred lines of CLN-3916. Different types of tomato fruit shape were also reported by Morimoto *et al*. (2000).

Ripened Fruit Color

Ripened fruit color was classified into four groups; mild red, deep red, yellowish red and orange. Among the genotypes, ripe fruit color of five tomato line were mild red color, three were yellowish red color, two were deep red color and two were orange color (Table 3). Yamaguchi (1983) reported that colors of tomato may be red, orange or yellow depending on cultivar genetic makeup.

Blossom End Shape

Blossom end shape was classified into three classes; pointed, indented and plained. Among the mentioned genotypes, blossom end shapes of eight were levelled, two inbred lines had pointed and two had indented blossom end shape (Table 3). Vander and Tanksley (2003) also reported Blossom end shape of tomato fruits

Fruit Ridge and Flesh Color

Fruit ridge was classified into two groups; plainer and prominent. Among the genotypes, fruit ridge of eleven were flat but one was prominent (Table 3). Flesh color was classified into four groups; mild red, red, deep red and orange. Among the genotypes, flesh color of four were mild red, four were red colored, two were deep red and two were orange (Table 3).

Table 3. Fruit qualitative characteristics of TYLCV resistant summer tomato genotypes

Genotypes	Fruit Shape	Fruit Color	Blossom End Shape	Fruit Ridge	Flesh Color
CLN-3735	Heart shape	Mild red	Pointed	Levelled	Orange
CLN-3791	Round	Mild red	Indented	Levelled	Mild red
CLN-3792	Lengthened round	Yellowish red	Pointed	Levelled	Deep red
CLN-3849	Lengthened Round	Yellowish red	Levelled	Levelled	Red
CLN-3850	Round	Mild red	Levelled	Levelled	Mild red
CLN-3859	Lengthened round	Deep Red	Levelled	Levelled	Deep red
CLN-3860	Lengthened round	Mild red	Levelled	Levelled	Mild red
CLN-3862	Lengthened round	Orange	Levelled	Levelled	Orange
CLN-3864	Round	Yellowish red	Levelled	Levelled	Red
CLN-3906	Round	Deep red	Levelled	Levelled	Red
CLN-3916	Flattened round	Orange	Indented	Levelled	Mild red
BARI Hybrid Tomato-8	Round	Mild red	Levelled	Prominent	Red

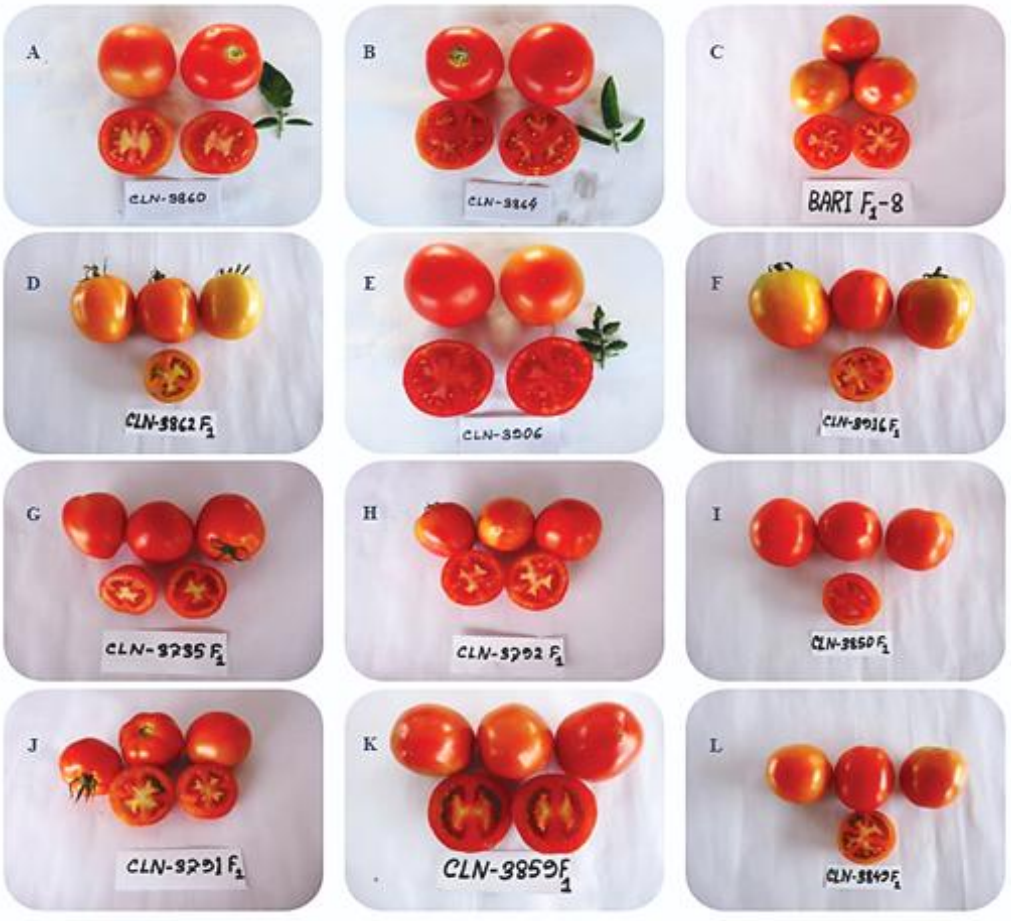

Figure 4. Ripened fruits of TYLCV resistant summer hybrid tomato: (A) CLN-3860; (B) CLN-3864; (C) BARI Hybrid Tomato-8; (D) CLN-3862; (E) CLN-3906; (F) CLN-3916; (G) CLN-3735; (H) CLN-3792; (I) CLN-3850; (J) CLN-3791; (K) CLN-3859; (L) CLN-3849

Conclusion

Wide ranges of yield and morphological variation were recorded among the genotypes. The performance of summer tomato inbred line was satisfactory as they did not exhibit any infectious symptoms of yellow leaf curl virus of tomato in Bangladesh condition. The inbred line CLN-3862 showed highest shelf life in normal condition. Although the virus resistance is little less, however, considering the productivity, it is necessary to consider the CLN-3735 and CLN-3792 Lines for future breeding and commercial cultivation. Sufficient yield was observed in both the plants. All the three lines can be determined region wise for summer cultivation and further steps should be taken in future by more extensive field data validation.

Validation of Research Interest

All the author declare that they have no conflic of interests.

References

Ahmad S. 2002-. Genetics of fruit set in Tomato (*Lycopersicon esculentum* L) under hot-humid condition. PhD. Thesis. Department of Horticulture, Bangabandhu Sheikh Mujibur Rahman Agriculture University, Gazipur. 1-236p.

Akanda A M 1991. Studies on the virus and mycoplasma disease of vegetable crops in Bangladesh. A PhD Thesis submitted to the Plant Pathology Laboratory, Department of Agronomy, Faculty of Agriculture, Kyushu University, Fukuoka, Japan. 181p.

BBS, 2023 Summary crop Statistics. Area, Yield rate and Production of Minor Crops. 2021-22 and 2022-23. Statistics Division, Ministry of Planning, Government of Peoples Republic of Bangladesh.

Czosnek H and Laterrot H .1997. A worldwide survey of Tomato yellow leaf curl viruses. Arch Virol 142, 1391-1406.

Deljit S H, Singh S S, Brar H S, Rewal and Singh D. 1990. Performance of new exotic introductions of tomato. Indian J. Hort. 479(2):256-258.

FAO. 2022 , Food and Agriculture Organization of the united Nations, Tomato breeding for processing in India: Current status and prospects - Scientific Figure on ResearchGate. Available from: https://www.researchgate.net/figure/Major-tomato-producing-countries-in-the-world_tbl1_374394225 [accessed 26 Feb 2025]

FAO. 1988. Production Year book, Food and Agricultural Organization of the United Nation, Rome, Italy. 42: 190-193.

Haider J, Marumoto T and Azad A K 1991. Estimation of microbial biomass, carbon and nitrogen in Bangladesh soils. Sci. Plant Nutr. 37 (4): 591-599.

Morimoto T, Takeuchi T, Miyata H and Hashimoto Y. 2000. Pattern recognition of fruit shape based on the concept of chaos and neural networks. Comp Electron Agric. 26**:** 171–186.

Opena R T and Chen J T 1993. Production of F1 hybrid tomato seeds. In.: Breeding of solanaceous and cole crops. A compilation of lecture materials of training course held in BARI, Gazipur. pp. 56-67.

Polston, J E, McGovern R J, Sherwood T and Kelly R. 2005. New Developments in Tomato yellow leaf curl virus in Florida. Southeast Florida Research and Education Centre.

Rashid M M 1993. Shabji Baggan (In Bengali). Bangla Academy, Dhaka. pp. 192-219.

Roy SK (2009). Comparative Yield and Storage Quality of Commercial Tomato Varieties of Bangladesh.MS Thesis. Bangabandhu Sheikh Mujibur Rahman Agricultural University. Salna, Gazipur, pp.19-29.

Vander K E and Tanksley S D. 2003. The making of a bell pepper-shaped tomato fruit: identification of loci controlling fruit morphology in yellow stuffer tomato. Theor Appl Genet. 107**:** 139–147.

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