Evaluation and performance of high yielding Tomato hybrids in Tamil Nadu

Abstract

Tomato (*Solanum lycopersicum L.*) is an economically important vegetable crop in the globe and is affected by various biotic and abiotic stresses to which the plants were exposed during growth. In this study was investigated to evaluate the tomato hybrids resistant to pest and diseases, biochemical analysis and yield assessment. The result of the experiment revealed that, totally three hybrids were evaluated among them highest average yield was in Arka Abeth (712.7 q/ha) followed by Tomato hybrid CoTH4 4 (650.01 q/ha) and lowest in Sivam hybrid (574.58 q/ha). An infestation of Pin worm was recorded 21.8 % to 41.6% and leaf miner damage was recorded 8.25% to 12.80%. For diseases incidence, Leaf cur virus disease incidence was 0.40 % to 0.61% and wilt incidence was 7.30% to 13.65%. The total soluble solids, fruit pH, ascorbic acid, lycopene and beta carotene content also were recorded.

Keywords: *Tomato hybrids, yield assessment, pest, disease, biochemical analysis*

Introduction

Tomato (*Solanum lycopersicum* L.,) is one of the most important vegetable crops grown both under tropical and sub-tropical conditions in India. It belongs to the family solanaceae and ranks second in vegetables production after potato (Ashok *et al*., 2020). At the regional level, Asia accounted for almost 62% of production share, followed by the Americas (13.2%), Europe (12.6%) and Africa (12%). The top five tomato producers are China (mainland) with 62.8 million tons, followed by India (19 million tons), Turkey (12.8 million tons), USA (10.9 million tons) and Egypt (6.8 million tons) (FAO, 2021). In Tamil Nadu, tomato is cultivated in an area of 29,000 ha with annual production of around one million tonnes and productivity of 30.51 t/ha. Tomato is considered as protective food crop have rich source of mineral, vitamins and organic acids. It is an important source of lycopene, ascorbic acid and carotene valued for their colour, flavour and antioxidant properties (Malathi and Kohila, 2021). The nutritional values of tomato fruits content are carotenoids, polyphenols, soluble sugars, organic acids, minerals and vitamins, especially vitamin C and E. Bioactive compounds of tomato fruits have a wide range of physiological properties, including anti-inflammatory, antiallergenic, antimicrobial, vasodilating, antithrombotic, cardioprotective and antioxidant effects (Kurina et al., 2021). The increasing consumption of tomato makes it, a high value crop for generating income to the farmers. It is an important crop both for production and industry point of view, there is a necessity to improve the

productivity per unit area to achieve the increased production from a limited land. In Dharmapuri district, tomato is cultivated in around 2,460 hectares and an average yield is over 58,400 tonnes a year. The major areas for tomato production are Karimangalam and Palacode blocks. Nowadays Private hybrids are ruling in the market. Cost of the seeds of private hybrids is too high but the farmers are forced to get it for cultivation due to the easy availability. Most of the farmers are cultivating private tomato hybrids with lesser productivity. In this situation, tomato is affected by a number of pest and diseases which hamper the yield of the crop. The major key insect pests *viz*., whitefly (*Trialeurodes vaporariorum*), leaf miner (*Liriomyza trifolii*) and tomato pin worm (*Tuta absoluta*) are the most dangerous pests in many crops including vegetables, tubers, fiber crops and ornamentals from tropics and sub-tropics to temperate climates in crops grown under open and protected environment (Anu et al., 2020). Yield and fruit quality are both significantly reduced by direct feeding of the pest (Michaelides *et al.,* 2019). Constraints, including fungal, bacterial, and viral infections, induce considerable economic losses. Tomato yellowing and/or leaf curl diseases are among the most important viral constraints on tomato crops in the tropics and subtropics (Ouattara *et al*., 2023). Keeping in view the importance of tomato crop, it was imperative to carry out an experiment on different hybrids and varieties of tomatoes under field conditions and to evaluate its performance in terms of pest and disease resistance, nutritional values, high yielding and fruit quality.

Materials and Methods

The present study was conducted at Krishi Vigyan Kendra, Tamil Nadu Agricultural University, Dharmapuri, Tamil Nadu during 2021 - 2022 under open field condition in the farmers holdings of Dharmapuri District. Total five farmers were selected from Dharmapuri district for conducting the experiment. The experimental trial evaluated with three different tomato hybrids viz. CoTH4, Arka Abeth and private hybrid Sivam were selected for the on–farm trial in farmers holdings. COTH 4 is released from Tamil Nadu Agricultural University, Coimbatore, India and Arka Abeth was from Indian Institute of horticultural Research, Bangalore, India and one (Sivam) was from local variety. The experimental trail was laid out in randomized block design (RBD) with three treatments and seven replications in famers sick field. Tomato seeds were sown in seedling trays containing an equal mixture of growth medium namely coco peat, vermiculite and perlite mixture in the ratio of 3:1:1, respectively. The raising of seedling was done with standard procedure of raising seedlings for transplanted vegetables and transplanted on farmers field with a spacing of 60 cm x 45 cm. Size of the experimental plot is 40 m^2 (8.0 m x 5.0 m). The main field was prepared to a fine

tilth and FYM @ 12.5 t ha^{-1} was applied at the time of last ploughing. All other cultural practices are followed as per the recommendations of crop production guide of Horticultural Crops, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India (Crop Production guide, 2020). Insect pests were attracted by placing pheromone traps @ 5 numbers/ha and yellow sticky traps @ 25 numbers/ha. The white flies affected plants were uprooted and one spray of Thiamethoxam 25 % WG @ 0.5ml/litre of water was given to control whiteflies. Application of *Trichoderma viride* @ 4 gram per kg of seeds as seed treatment and 2.5 kg of *Trichoderma viride* mixed with 50 kg of Farm yard Manure (FYM) for the management of wilt disease in tomato. Monitoring and field visits were conducted regularly to collect feedback and provide instant solution to the problems reported by the participating farmers.

A morphological characters on plant height, flower per cluster, number of fruit per plant, fruit weight (g), yield per plant (g) etc. were recorded and the economics of cultivation was also calculated. All the observations were recorded on randomly selected twenty-five plants, except the yield (q/ha), which was computed based on the net plot yield. In order to evaluate the most profitable treatment combination, economics of different treatments were worked out in terms of net returns and net returns per rupee investment. For screening of sucking pest, pest population were recorded in five randomly selected plants from each experimental trial at fortnightly intervals. The observation of leaf miner and tomato pin worm per leaf were counted on randomly selected three leaves. Per cent of leaf miner and pin worm infestation was observed as per the standard protocol (Table 1).

Table 1: Standard scoring procedure for whitefly adult, leaf miner and tomato pin worm infestation on tomato cultivars

Score (0-4)	Per cent infestation (leaf miner)	Per cent infestation (pin worm/ blotch miner)	Remarks
0	No symptoms	No symptoms	Immune
1	1-10 per cent infestation	1-10 per cent infestation	Resistant
2	11-20 per cent infestation	11-20 per cent infestation	Moderately resistant
3	21-30 per cent infestation	21-30 per cent infestation	Susceptible
4	>31 per cent infestation	>31 per cent infestation	Highly susceptible

An appearance of disease symptom was recorded from each of the replication. Assessment on the reaction in the tomato cultivars to tomato leaf curl virus and *Fusarium* wilt disease were observed as per the standard protocol. The selected tomato fruits for

biochemical analysis were categorized by size, shape, weight, colour and maturity stage to maintain uniformity for the experiment purpose. The observations of biochemical parameters in tomato fruits content was quantified by pH, total soluble solids (TSS), Ascorbic acid (mg per 100 g), Lycopene (mg per 100 g) and beta carotene (mg per 100g). The statistical analyses were carried out by using SPSS software.

Results

The performance of tomato hybrids *viz*., COTH4, Arka Abeth and private hybrid Sivam were evaluated in the farmer's field of Dharmapuri district during kharif season 2021-2022. The results of the experiments revealed that the quantitative characters of three hybrids such as plant height (cm), flower cluster/plant, flowers/cluster, fruits/plant, fruit weight (g) and yield/plant (kg) showed highly significant to each other. The plant height is found to be maximum in Arka Abeth (114.73 cm) followed by COTH4 (109.63 cm) when compared to farmers choice variety Sivam (109.63). Number of flower clusters per plant recorded its highest value in Arka Abeth (18.41) followed by COTH4 (17.25). On observing number of flowers per cluster, Arka Abeth (6.78) and COTH4 (6.39) are recorded maximum number of flowers and on par with each other. Highest yield among all three hybrids was 712.97q/ha obtained in Arka Abeth followed by COTH 4 (650.01 q/ha) and Sivam hybrid (574.58q/ha). Fruit weight was more in Arka Abeth (60.8 gm) followed by COTH 4 (59.2 gm) and Sivam hybrid (55.36 gm). No of fruits per plant was highest in Arka Abeth (61.20 nos.) followed by COTH 4 (58.4 nos.) and Sivam hybrid (54.0 nos.) (Table 2).

Regarding pest infestation of tomato revealed that the pin worm was recorded low in COTH 4 (21.8%) followed by Arka Abeth (25.8%) and Sivam Hybrid (41.6%). Whereas leaf minor damage was recorded high in Sivam hybrid (12.80%) and low in Arka Abeth (8.25%). Swathi. Dibbad *et.al*. (2022) reported that tomato cultivars of Omnia, Emerald, Arka Raksham, Arka Samrat and Arka abhedh were categorized moderately resistant to leaf minor. The cultivars Omnia, Emerald, and Arka Rakshak were also categorized as moderately resistant to tomato pinworm. The finding was confirmation with Bitew (2018) report that cultivar LA 1777, LA 1718 and LA 716 were resistant to *Tuta absoluta*.

For diseases incidence, leaf cur virus disease incidence was higher in Sivam hybrid (0.61%) and lowest in Arka Abeth (0.40%), while wilt incidence was higher in Sivam hybrid (13.65%) and lowest in COTH4 (7.30%) (Table 3). The similar studies were reported by

Ashok *et al.,* (2020), Malathi and Kohila (2021), Mohan Singh *et al.,* (2019) and Pugalendhi *et al.,* (2020) in tomato crop.

Table 2: Studies on different parameters of tomato hybrids under open field conditions

Technology Option	**Plant height (cm),**	**Flower cluster/ plant,**	**Flowers/ cluster,**	**fruits/ plant,**	**Fruit weight (g)**	**Yield (q/ha)**	**Net Returns (Rs./ha)**	**B:C ratio**
TO1 (Sivam)	104.81	16.93	5.78	54.0	55.36	574.58	0.74974	1.60
TO 2 – Arka Abeth	114.73	18.41	6.78	61.2	60.8	712.97	1.23587	1.98
TO 3 – COTH4	109.63	17.25	6.39	58.4	59.2	650.01	1.01554	1.81

Table 3: Studies on pest and disease problems in tomato hybrids under open field conditions

Technology Option	Pin worm damage (%)	Leaf miner damage (%)	ToCLV incidence (%)	Wilt incidence (%)
TO1 (Sivam)	41.60	12.80	0.61	13.65
TO 2 – Arka Abeth	25.80	8.25	0.40	9.80
TO 3 – COTH4	21.80	9.45	0.49	7.30

Table 4. Effect of fertilisers on the growth parameters at different growth stages of tomato crop

Treatments	Fruit pH	Total Soluble Solids (° Brix)	Ascorbic Acid (mg per 100 g)	Lycopene (mg per 100 g)	Beta Carotene (mg per 100 g)
TO1 (Sivam)	3.01	3.65	35.1	2.71	0.53
TO 2 – Arka Abeth	3.51	4.45	38.2	3.01	1.02

TO 3 – COTH4	3.87	5.12	34.5	2.65	1.10
SED	0.07	0.06	0.78	0.07	0.02
CD (p = 0.05)	0.15	0.12	1.7	0.16	0.04

The total soluble solids ranged from 3.65 (Sivam) to 5.12 º Brix (COTH4) among the three cultivars. Highest total soluble solids were recorded in COTH4 (5.12 º Brix) followed by Arka Abeth (4.45º Brix) and Sivam private hybrid (3.65º Brix). High TSS and low acidity are the major factors considered for fruit processing products. High TSS due to the improved deposition of solids and more adaptation of organic acids to sugars. Among three hybrids, highest ascorbic acid content was showed in Arka Abeth of 38.2 mg/100g followed by COTH4 (34.5 mg/100g) when compare to check Sivam hybrid (35.1 mg/100g). The highest lycopene content in Arka Abeth of 3.01 mg/100g when compare to check Sivam hybrid (2.71 mg/100g). Among the cultivars, highest β-carotene content was recorded in COTH4 (1.10 mg/100g) followed by Arka Abeth (1.02 mg/100g) when compare to check Sivam hybrid (0.53 mg/100g) (Table 4). This study is agreed with the results obtained by Prakash *et al.,* (2019).

Discussion

A study of different tomato hybrids were evaluated for high yielding, pest and disease resistance and biochemical studies. The results of the experiments revealed that the quantitative characters of three hybrids viz., Arka Abeth, Tomato hybrid COTH4 and private sivam hybrid were observed the following character such as plant height (cm), flower cluster/plant, flowers/cluster, fruits/plant, fruit weight (g) and yield/plant (kg) showed highly significant to each other. With this finding was confirmed by Qasid Ali *et al.* (2017) reported that tomato hybrid variation was showed in the all the morphological parameters. Yield was maximum was found in accession 17863 while maximum fruit size was observed in accessions LA-3346, Dny-evf-Riograndea and LA-0146 and also fruit length, fruit width, pedicel length, total number of inflorescence, and yield per plant. The results of the pin worm infestation were recorded low in COTH 4 followed by Arka Abeth and Sivam. Whereas leaf minor damage was recorded high in Sivam (12.80%) and low in Arka Abeth (8.25%). Similar study was reported by Swathi *et.al.* (2022) tomato cultivars of Omnia, Emerald, Arka Raksham, Arka Samrat and Arka abhedh were categorized moderately resistant to leaf minor. The cultivars Omnia, Emerald, and Arka Rakshak were also

categorized as moderately resistant to tomato pinworm. The findings confirmation with Bitew (2018) report that cultivar LA 1777, LA 1718 and LA 716 were resistant to *Tuta absoluta*. For diseases incidence, leaf cur virus disease incidence was higher in Sivam and lowest in Arka Abeth, while wilt incidence was higher in Sivam and lowest in COTH4. The similar studies were reported by Ashok *et al.,* (2020), Malathi and Kohila (2021), Mohan *et al.,* (2019) and Pugalendhi *et al.,* (2020) in tomato crop.

The total soluble solids, ascorbic acid content, lycopene content and β-carotene content were studied in tomato cultivars. Kurina *et al.,* (2021) reported the screening of 70 accessions of cultivated and wild tomato and studied the various biochemical characteristics *viz.,* dry matter content, ascorbic acid, sugars, carotenoids, chlorophylls and anthocyanins. Prakash *et al.,* (2019) described the similar results reported that the hybrids Punjab Sartaj X EC163605 and Punjab Sartaj X IIVR BT-10 were recorded the highest values for fruit quality and biochemical traits *viz.,* pericarp thickness (5.69 and 5.76 mm), fruit firmness (3.00 and 3.04 kgf/cm2), shelf life (45 and 40.8 days), ascorbic acid (14.75 and 13.90 mg/100g), titrable acidity (0.46 and 0.38 %), lycopene (0.32 and 0.36 mg/100g) and β carotene (0.44 and 0.46 mg/100g) compared to the check hybrids.

Conclusion

The tomato hybrid Arka Abeth was attributed to the higher number of flowers per cluster, fruits per plant, less infestation by pest and diseases over TNAU Tomato hybrid COTH4 and private hybrid Sivam. Market preference was good for Arka Abeth as Dharmapuri market gets more such fruits from Bangalore markets.

References

Ouattara, A., Kabore. I, Zombre. C, Sogoba. K. H, Badiel. B, Traore. E. V, Nana. T. A, Koita., K, and Traoré, O. 2023. Screening of widely used accessions of tomato for resistance/tolerance to the Pepper yellow vein Mali virus in the central region of Burkina Faso. Ital. J. Agron. 18(3): 2202. Doi:https://doi.org/10.4081/ija.2023.2202.

Anu. B.C., T. Saha, and S. A. K. Kumari. 2020. Screening of tomato genotypes for tolerance or susceptibility against sucking pests under field condition. J. Entomol. Zool. Stud. 8(2), 742-745. DOI: https://doi.org/10.22271/j.ento.2020.v8.i2m.6517.

Ashok, A.D., K.Kayalvizhi, and J. Ravivarman. 2020. Functional performances of tomato hybrids under polyhouse conditions at Tiruchirappalli, Tamil Nadu. Int. J. Chem. Stud. 8(4): 1664-1666. DOI: 10.22271/chemi.2020.v8.i4q.9849.

Bitew. M.K. 2018. Significant Role of Wild Genotypes of Tomato Trichomes for *Tuta Absoluta* Resistance. J. Plant. Genet. Breed. 2: 104.

FAO. 2021. Crops and Livestock Products. Available online: http://www.fao.org /faostat /en /#data / QCL.

Kurina. A.B., A.E. Solovieva, I.A. Khrapalova, and A.M. Artemyeva. 2021. Biochemical composition of tomato fruits of various colors. Vavilovskij ž. genet. Sel. 25:5. https://doi.org/10.18699/VJ21.058

Malathi. G., and P. Kohila. 2021. Evaluation of Tomato Hybrids in Salem District of Tamil Nadu. Journal of Krishi Vigyan. 10 (1) : 328-331 DOI:10.5958/23494433. 2021.00115.X.

Mandloi. R., R. Pachori, A.K.Sharma, M.Thomas, and A.S.Thakur. 2015. Impact of weather factors on the incidence of major insect pests of tomato (*Solanum lycopersicon* l.) cv. H-86 (Kashi Vishesh). Ecoscan. 8(1):7-12.

Michaelides. G., N. Seraphides, M. Pitsillou, and S. Sfenthourakis. 2019. Susceptibility of cypriot *Tuta absoluta* populations to four targeted insecticides and control failure likelihood. J. Appl. Entomol.143 (5):508-517. https://doi.org/10.1111/jen.12627.

Mohan Singh, K., D. Ameta, R. A. Kaushik, Rajkumar Jat, and Kuldeep Singh Rajawat. 2019. Performance of Tomato (*Solanum lycopersicum* L.) Hybrids under Polyhouse Condition. Int. J. Curr. Microbiol. Appl. Sci. 8(5): 597-603. https://doi.org/10.20546/ijcmas.2019.805.069

Prakash. E., V. Premalakshmi, T. Arumugam, and V.Thiruvengadam. 2019. Evaluation of indeterminate tomato hybrids (*Solanum lycopersicum*. L) for fruit quality and biochemical traits under polyhouse condition. J. Pharmacogn. Phytochem. 8(3): 4443-4446.

Pugalendhi, L., V. Rajashree, and M. Prabhu. 2020. Tomato Hybrid CTH1: A High Yielding Hybrid with Better Shelf Life. I Int. J. Curr. Microbiol. Appl. Sci. *9*(9): 2574-2582. https://doi.org/10.20546/ijcmas.2020.909.322.

Qasid Ali., Mustafa Erkan, and Ibadullah Jan. 2017. Morphological and agronomic characterization of tomato under field conditions, Pure. Appl. Biol. 6(3): 1021-1029. http://dx.doi.org/10.19045/bspab.2017.600108.

Sotelo-Cardona, P., M. Y. Lin, and R. Srinivasan. 2021. Growing Tomato under Protected Cultivation Conditions: Overall Effects on Productivity, Nutritional Yield, and Pest Incidences. Crops. 1, 97–110. https://doi.org/10.3390/crops1020010.

Swathi Dibbad., L. Hanumatharaya, M. Hanumanthappa, and M. H. Suchithra Kumari. 2022. Screening of tomato cultivars against major insect pests. J. Appl. Entomol. 2(3):05-10.