Study the performance of high yielding Tomato hybrids in Dharmapuri district, Tamil Nadu, India

ABSTRACT

Tomato (*Solanum lycopersicum L.*) is an economically important vegetable crop in the globe and affected by various biotic and abiotic stresses to which the plants were exposed during growth. In this study, three tomato hybrids *viz*., Arka Abeth, CoTH4 4 and Sivam were evaluated the resistant to pest and diseases including biochemical analysis and yield assessment. The experiment results revealed that highest average yield was recorded in Arka Abeth (712.7 q/ha) followed by CoTH4 4 (650.01 q/ha) and lowest in Sivam (574.58 q/ha). Regarding pest and disease, Pin worm was recorded 21.8 % to 41.6% and leaf miner damage was recorded 8.25 % to 12.80 %, Leaf curl virus disease incidence was 0.40 % to 0.61% and wilt incidence was 7.30% to 13.65%. Among the three tomato cultivars arka abeth was performed higher in the biochemical parameters such as ascorbic acid (38.2 mg/ 100g) and lycopene (3.01 mg/100g).

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

1. 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 [3]. In Tamil Nadu, tomato is cultivated in an area of 29,000 ha with annual production of around one million tonnes with 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 [11]. Bioactive compounds of tomato fruits have a wide range of physiological properties including anti-inflammatory, antiallergenic, antimicrobial, vasodilating, antithrombotic, cardioprotective and antioxidant effects [12]. In Dharmapuri district, tomato is cultivated in around 2,460 hectares and an average yield is over 58,400 tonnes a year. The increasing consumption of tomato makes it, a high value crop for generating income to the farmers. It is an important crop both on 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, but most of the farmers are cultivating tomato hybrids with lesser productivity due to biotic stress. Tomato production is affected by number of pest and diseases which hamper the yield as well as fruit quality [7]. 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 tomato crop grown under open and protected environment [10]. Regarding disease incidence, leaf curl virus and wilt are important constraints on tomato production in tropics and subtropics [6]. Keeping in view of these biotic stresses, an experiment was conducted to study the performance of selected three hybrids in terms of pest and disease resistance including high yielding and fruit quality.

2. 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. Total five farmers were selected in Dharmapuri district for conducting the experiment. The on-farm trials were conducted with three tomato hybrids *viz*., COTH4, Arka Abeth and Sivam. COTH 4 is released from Tamil Nadu Agricultural University, Coimbatore, India and Arka Abeth was from Indian Institute of horticultural Research, Bangalore, India and Sivam was from local hybrid. The trail was laid out in randomized block design (RBD) with three treatments and seven replications in famer's sick field. Tomato seeds were sown in protrays containing a 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 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). All the 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. Monitoring and field visits were conducted regularly to collect data on pest and disease 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 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. Tomato fruit subjected for quality 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.

3. RESULTS AND DISCUSSION

The performance of tomato hybrids *viz*., COTH4, Arka Abeth and 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 hybrid 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 recorded in Arka Abeth followed by COTH 4 and Sivam. Fruit weight and No of fruits per plant was highest in Arka Abeth followed by COTH 4 and Sivam (Table 2). Highest benefit cost ratio recorded in Arka Abeth followed by COTH 4 and Sivam. This results finding was

confirmed [15] that tomato hybrid variation was showed in the all the morphological parameters.

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 (%)	Tomato leaf curl virus incidence (%)	Wilt incidence (%)
TO 1 - 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

Regarding pest infestation revealed that pin worm was recorded low in COTH 4 followed by Arka Abeth and Sivam Hybrid (Table 2). Whereas leaf minor damage was recorded high in Sivam and low in Arka Abeth. Similar study was reported [2,8] 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 was confirmed [1,14] that cultivar LA 1777, LA 1718 and LA 716 were resistant to *Tuta absoluta*.

For diseases incidence, leaf curl virus disease incidence was higher in Sivam and lowest in Arka Abeth, while wilt incidence was higher in Sivam and lowest in COTH4 (Table 3). The similar results were confirmed with different studies [3,4,5,11] conducted in tomato crop.

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)
TO 1 - (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 (TSS) ranged from 3.65 to 5.12 º Brix recorded among the three cultivars. Highest TSS was recorded in COTH4 followed by Arka Abeth and Sivam hybrid. Among three hybrids, highest ascorbic acid content was found in Arka Abeth of followed by COTH4 when compare to Sivam. High TSS and low acidity are the major parameters considered by fruit processing industries. High TSS recorded due to the improved deposition of solids and more adaptation of organic acids to sugars. This results were confirmed with [9] the process of biosynthesis and polysaccharides degradation at the time of maturity. Similarly screening of 70 accessions of cultivated and wild tomato [12] for biochemical characteristics *viz.*, dry matter content, ascorbic acid, sugars, carotenoids, chlorophylls and anthocyanins. The similar results reported [13] 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, fruit firmness, shelf life, ascorbic acid, titrable acidity, lycopene and β carotene compared to the check hybrids. The highest lycopene content recorded in Arka Abeth when compare to Sivam. Among the cultivars, highest β-carotene content was recorded in COTH4 followed by Arka Abeth when compare to Sivam (Table 4). This study is agreed with the results obtained in tomato [13].

4. 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 COTH4 and Sivam. Market preference was good for Arka Abeth at Dharmapuri district.

REFERENCES

1. Sotelo-Cardona, P., M. Y. Lin, and R. Srinivasan. Growing Tomato under Protected Cultivation Conditions: Overall Effects on Productivity, Nutritional Yield, and Pest Incidences. Crops. 2021;97–110. https://doi.org/10.3390/crops1020010.
2. Mandloi. R., R. Pachori, A.K.Sharma, M.Thomas, and A.S.Thakur. Impact of weather factors on the incidence of major insect pests of tomato (*Solanum lycopersicon* l.) cv. H-86 (Kashi Vishesh). Ecoscan.2015;8(1):7-12.
3. Ashok, A.D., K.Kayalvizhi, and J. Ravivarman. Functional performances of tomato hybrids under polyhouse conditions at Tiruchirappalli, Tamil Nadu. International Journal of Chemistry Studies 2020; 8(4): 1664-1666. DOI: 10.22271/chemi.2020.v8.i4q.9849.
4. Mohan Singh, K., D. Ameta, R. A. Kaushik, Rajkumar Jat, and Kuldeep Singh Rajawat. Performance of Tomato (*Solanum lycopersicum* L.) Hybrids under Polyhouse Condition. International Journal of Current Microbiology and Applied Sciences. 2019;8(5):597-603. https://doi.org/10.20546/ijcmas.2019.805.069
5. Pugalendhi, L., V. Rajashree, and M. Prabhu. Tomato Hybrid CTH1: A High Yielding Hybrid with Better Shelf Life. International Journal of Current Microbiology and Applied Sciences.2020;9(9):2574-2582.https://doi.org/10.20546/ijcmas.2020.909.322.
6. Ouattara, A., Kabore. I, Zombre. C, Sogoba. K. H, Badiel. B, Traore. E. V, Nana. T. A, Koita., K, and Traoré, O. Screening of widely used accessions of tomato for resistance/tolerance to the Pepper yellow vein Mali virus in the central region of Burkina Faso. Italian Journal of Agronomy. 2023;18(3): Doi:https://doi.org/10.4081 /ija.2023.2202.
7. Michaelides. G., N. Seraphides, M. Pitsillou, and S. Sfenthourakis. Susceptibility of cypriot *Tuta absoluta* populations to four targeted insecticides and control failure likelihood. Journal of Applied Entomology.2019;143(5):508-517. https://doi.org/10.1111/jen.12627.

8. Swathi Dibbad., L. Hanumatharaya, M. Hanumanthappa, and M. H. Suchithra Kumari. Screening of tomato cultivars against major insect pests. Journal of Applied Entomology.2022;2(3):05-10.
9. Žnidarčič et al., D. Žnidarčič, D. Ban, M. Oplanić, L. Karić, T. Požrl Influence of postharvest temperatures on physicochemical quality of tomatoes (Lycopersicon esculentum Mill) Journal of Food, Agriculture and Environment, 2010;8:(1):21-25
10. Anu. B.C., T. Saha, and S. A. K. Kumari. Screening of tomato genotypes for tolerance or susceptibility against sucking pests under field condition. Journal of Entomology and Zoology Studies. 2020;8(2):742-745. DOI:https://doi.org/10.22271/j.ento. 2020.v8.i2m.6517.
11. Malathi. G., and P. Kohila. Evaluation of Tomato Hybrids in Salem District of Tamil Nadu. Journal of Krishi Vigyan. 2021;10 (1) : 328-331 DOI:10.5958/23494433.2021.00115.X.
12. Kurina. A.B., A.E. Solovieva, I.A. Khrapalova, and A.M. Artemyeva. Biochemical composition of tomato fruits of various colors. Vavilov. Journal of Genetics and Breeding. 2021;25:5. https://doi.org/10.18699/VJ21.058
13. Prakash. E., V. Premalakshmi, T. Arumugam, and V.Thiruvengadam. Evaluation of indeterminate tomato hybrids (*Solanum lycopersicum*. L) for fruit quality and biochemical traits under polyhouse condition. Journal of Pharmacognosy and Phytochemistry. 2019;8(3): 4443-4446.
14. Bitew. M.K. Significant Role of Wild Genotypes of Tomato Trichomes for *Tuta Absoluta* Resistance. Journal of Plant Breeding and Genetics. 2018;2: 104.
15. Qasid Ali., Mustafa Erkan, and Ibadullah Jan. Morphological and agronomic characterization of tomato under field conditions. Pure and Applied Biology.2017;6(3): 1021-1029. http://dx.doi.org/10.19045/bspab.2017.600108.
16. Lone, A. H., Sheikh, T. A., Lone, B. A., Ahngar, T. A., Baba, Z. A., Bashir, M., Sheikh, M. A., Mir, M. S., Rashid, Z., Majid, S., Faisul - Ur- Rasool, ., & Dar, Z. A. (2022). Performance of Sweet Corn Hybrids (Zea mays saccharata) as Influenced by Soil and Foliar Application of Zinc. Journal of Experimental Agriculture International, 44(12), 167–174. https://doi.org/10.9734/jeai/2022/v44i122090
17. V. Ilodibia, C., A. Achebe, U., N. Udeorah, S., Arubalueze, C. U., & E. Okoye, C. (2018). Effect of Breeding on the Growth and Yield of Cucumis sativus (L.). Asian

Journal of Research in Crop Science, 1(1), 1–7. https://doi.org/10.9734/AJRCS/2018/40122

18. Tokatlidis IS, Koutroubas SD. A review of maize hybrids' dependence on high plant populations and its implications for crop yield stability. Field Crops Research. 2004 Aug 10;88(2-3):103-14.
19.