

Original Research Article

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Tomato Hybrid CTH1: A High Yielding Hybrid with Better Shelf Life

L. Pugalendhi*, V. Rajashree and M. Prabhu

Horticultural College and Research Institute, Tamil Nadu Agricultural University,
Coimbatore – 641 003, India

*Corresponding author

ABSTRACT

CTH 1 Tomato is a F₁ hybrid of LE 1226 X LE 1249. It was developed by the Department of Vegetable Science, Horticultural College and Research Institute, Tamil Nadu Agricultural University, Coimbatore. Fruits are flat round with green shoulder during ripening and turned into red colour at full ripening with an average fruit weight of 75.40g. The fruits of the hybrid could be harvested for 20-22 times in five months duration. Due to the long harvesting period, the single plant yields 36 fruits with an average yield of 2.94 kg/plant. The hybrid culture CTH 1 proved its superiority with an yield of 92.3 t/ha which was 27.31 per cent increase over the check TNAU tomato hybrid CO 3 and 40.91 per cent over another check Lakshmi (C) respectively. It showed consistent performance in Multi location Trials (14 Nos) and Adaptive Research Trials (107 Nos). The plants can be grown at a spacing of 60 x 45 cm under irrigated condition. The plants should be staked. It can be successfully grown in June -July and Dec - Jan under irrigated conditions. This hybrid is having better shelf life compared with other commercial hybrids. This hybrid can be recommended for cultivation in the districts of Coimbatore, Cuddalore, Dharamapuri, Dindigul, Erode, Kancheepuram, Karur, Krishnagiri, Madurai, Namakkal, Pudukottai, Ramanathapuram, Salem, Thanjavur, Thirunelveli, Thiruvannamalai, Theni, Thoothukudi, Tirupur, Trichy, Vellore and Villupuram of Tamil Nadu.

Keywords

CTH1, F₁ hybrid,
Leaf curl virus,
Moderate resistance
and Tomato

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Introduction

Tomato (*Solanum lycopersicum* L.) is one of the important vegetables grown in the world. Tomato originated in Peru Equador region of Latin America and was introduced by Portuguese in India. It is cultivated worldwide in variety of climatic conditions including sub tropics and tropics. Among the vegetables tomato occupies fourth position in area and second position in production in India. In India, tomato occupies a larger area of 0.79

million hectare with an annual production of 19.76 million tonnes (Anonymous, 2018). It is universally treated as a “protective food” and it is also an excellent vegetable for processing. The fruits are consumed raw, cooked or processed as juice, ketchup, sauce, paste, puree etc. (Rani *et al.*, 2009). Being a good source of minerals, acids, vitamins (A, B and C) and lycopene it has high nutritive value (Sumathi *et al.*, 2006 and Kavitha *et al.*, 2007). The scenario of tomato production in India has tremendously changed with

increasing popularity of hybrids (Pugalendhi, 1986). The growers, consumers and processing industries are with pressing demand to evolve high yielding hybrids with varying qualities as per local demands. Increased vigour in total yield in tomato to the extent of 300 per cent over the commercial varieties has been reported. In India, the extent of the cross over the better parent is 203 per cent (Cheema and Dhaliwal, 2004). Commercial hybrids of tomato are products of mid twentieth century though their valued performance was recognized a century and a quarter ago (Anbukkarasi *et al.*, 2018). Hence, it is imperative to obtain hybrids which have high yielding potential along with good quality and resistance to pests and diseases. With this background a tomato F₁ hybrid CTH1 was developed and evaluated under different environments for commercial exploitation.

Materials and Methods

The present investigation was carried out at the Department of Vegetable Science, Horticultural College and Research Institute, TNAU, Coimbatore Out of 15 tomato hybrid combinations developed through Line X Tester analysis (Kempthorne, 1957) by using 5 lines and 3 testers, two hybrids CTH 1 (LE1226 x LE 1249) and CTH 2 (LE 1251 x LE 1229) were identified with high yield. The parental lines are maintained by continuous selfing and hybrid seeds are produced by hand emasculation and crossing. The hybrids were evaluated for three seasons during 2012-14 at College orchard, Tamil Nadu Agricultural University (TNAU), Coimbatore. Based on the consistent yield and consumer preference, the hybrid CTH 1 was identified as the best and compared with check hybrids *viz.*, TNAU tomato hybrid CO 3 and Lakshmi under multilocation trials (8 Nos.) at TNAU

research stations during 2015-16 and 2016-17, adaptive research trials (107 Nos.) at farmers holdings located in 17 districts of Tamil Nadu during 2017-18, on farm trials (5 Nos.) during 2018-19, demonstration trials (2 Nos.) and all India coordinated trials (6 Nos.). The descriptors for tomato F₁ hybrid CTH1 and its female (LE 1226) and male parents (LE 1249) are described as per descriptors of IPGRI, 1996.

The seed rate followed for tomato hybrids is 150 g/ha and spacing adopted was 60 x 45 cm (37,037 plants/ ha) The nutrients applied @ 50:250:100 NPK kg/ha, as basal and top dressing of N and K each @ 150 kg /ha in 3 equal splits at 30, 45 and 60 days after transplanting. Yellow sticky traps @10 numbers were used to attract adult insects. The affected plants were uprooted and one spray of Thiamethoxam 25 % WG @ 0.5ml/litre of water was given to control whiteflies.

Observations on yield parameters *viz.*, number of fruits per plant, mean fruit weight, yield per plant and pest and disease incidence were recorded. The quality traits *viz.*, TSS (by digital hand refractometer), and ascorbic acid were estimated as per standard procedures (AOAC,1984). The fruits were given for organoleptic evaluation by a panel of ten judges and evaluation was done as per the characteristics in the score card for organoleptic evaluation. Based on one to nine 'Hedonic Scale', the colour and appearance, flavour, texture, taste and overall acceptability were evaluated and marks awarded to the above hybrids. The mean value was reckoned as final score (Prabhu *et al.*, 2010).

Disease scale for tomato leaf curl virus was followed as suggested by Banerjee and Kalloo (1987).

$$\text{Per cent disease incidence (PDI) for Tomato leaf curl virus} = \frac{\text{Total number of plants infected with ToLCV}}{\text{Total number of plants observed}} \times 100$$

Results and Discussion

Morphological characters

Potato leaf type was observed in Tomato F₁ hybrid CTH1 and its female parent LE 1226 and standard leaf type was observed in male parent LE 1249 (Table 1). These leaf types are also reported by Bhattarai *et al.*, (2018). Tomato F₁ hybrid CTH1 plants are semi determinate (100 -110 cm) and training is required at 30 days after planting. The semi-determinate genotypes are equivalent to determinate ones with extended vegetative growth, which in turn impacts shoot height, number of leaves and either stem diameter or internode length. Semi-determinate plants also tend to increase the highly relevant agronomic parameter Brix × ripe yield (BRY). Water-use efficiency (WUE), evaluated either directly as dry mass produced per amount of water transpired or indirectly through C isotope discrimination was higher in semi-determinate genotypes. The previous experimental results shown that the increases in BRY in semi-determinate genotypes are a consequence of an improved balance between vegetative and reproductive growth, a mechanism analogous to the conversion of the overly vegetative tall cereal varieties into well-balanced semi-dwarf ones used in the green revolution (Vicente *et al.*, 2015). The first fruit setting was observed at 65 days after planting, Fruits are flat round with five locules, green shoulder at breaker stage which turns to red colour during ripening (Table 1).

Yield and quality characters

The fruits are borne in clusters of five, with

an average fruit weight of 80-100 g and belongs to medium maturity type. This hybrid has long harvesting period with 20-22 harvests in 160 - 165 days with a yield of 2.35 kg per plant (Table 1). The ascorbic acid content: is 26.13 mg/100 g and TSS is: 6.7⁰ brix and pericarp thickness is 5.84mm. These results clearly indicated that the tomato hybrid CTH1 is highly suitable for processing and value addition as compared with check hybrids. This character is very much useful to control market price fluctuation and losses of tomato (Tripathi *et al.*, 2017). Similarly, the hybrid CTH1 ranked first for consumer preference followed by check hybrids TNAU tomato hybrid CO 3 and Lakshmi (Table 2).

Reaction to insect pests and diseases

The tomato hybrid CTH1 recorded the least (9.7/ three leaves) adult whitefly population followed by Tomato hybrid CO 3 (10.7). While, Lakshmi hybrid was the most preferred with the highest population (28.5/three leaves). CTH1 maintained its superiority over check with significantly the least (8.1) number of adult thrips per three leaves. The other pests *viz.*, tomato leaf miner, *Tuta absoluta* and serpentine leaf miner, *Liriomyza trifolii* was recorded very minimum of 4.3 and 7.8 % compared to check 27.14 and 17.5% respectively. There was no incidence of fruit borer and leaf eating caterpillar damage on CTH1 and Tomato hybrid CO 3.

The tomato leaf curl virus disease transmitted by white fly and caused by begomovirus is a destructive disease of tomato in many parts of India.

Table.1 Morphological descriptors of the Tomato hybrid CTH 1 and parents

Sl.No	Plant characters	CTH 1	Female (LE 1226)	Male (LE 1249)
I	Growth characteristics			
1	Plant height (cm)	100-110 cm	85 cm	65 cm
2	Plant growth habit	Semi determinate	Semi determinate	Determinate
3	Number of primary branches	4	3	2
4	Leaf type	Potato leaf	Potato leaf	Standard
5	Leaf colour	Green	Green	Green
6	Leaf pubescence	Absent	Present	Present
7	Foliage cover	Excellent	Excellent	Sparse
8	Petiole pubescence	Present	Present	Present
9	Stem thickness	Medium	4.8 cm	2.9 cm
10	Stem pubescence	Sparse	Sparse	Sparse
11	Stem pigmentation	No	No	No
II	Flowering characteristics			
1	Flower colour	Deep yellow	Deep yellow	Deep yellow
2	Style position	Same level as stigma	Same level as stigma	Same level as stigma
3	Days to first fruit set	65 DAP	60 -65 DAP	62-65 DAP
4.	Total crop duration	160 -165 days	155-160 days	140-145 days
5	Number of clusters per plant	16	12	6.2
6	Number of flowers per cluster	5	6	4.51
III	Fruiting characteristics			
1	Fruit size	Medium large (< 80 -100 g)	Medium large (80 -100 g)	45-50 g
2	Fruit shape	Flat round	Heart shaped	Flat round
3	Immature fruit skin colour	Green	Light green	Dark green
4	Presence of green shoulder on fruits	Present	No	Yes
5	Fruit colour	Green shoulder during the breaker stage. Green shoulder disappears at fully ripened stages and red colour develops.	Light green during breaker stage and turn red colour during maturity.	Prominent green shoulder even after ripening.
6	Fruit surface	Smooth	Smooth	Smooth
7	Stem end fruit shape	Indented	Indented	Indented
8	Blossom end fruit shape	Flat	Slightly flatted	Slightly flatted

9	Type of fruit cracking	None	None	None
10	Fruit firmness (kg/cm ²)	Semi ripening - 2.76 and full ripened -2.04	3.86	1.86
11	Pulpiness	Pulpy	Highly pulpy	Pulpy
12	Seediness	Medium	Medium	Medium
IV	Yield characteristics			
1	Number of fruits per cluster	4	5	4.1
2	No. of fruits/plant	32.1	31.2	26.7
3	Locule number per fruit	4	4	3.7
4	Fruit length (cm)	5.50	5.20	4.7
5	Fruit girth (cm)	11.0	10.54	7.5
6	Fruit weight (g)	88.4	80	50
7	Fruit yield per plant	2.35	1.89	1.78
8	Fruit yield (t / ha)	90.8	46.9	39.5
V	Quality characteristics			
1	Pericarp thickness (mm)	5.84	4.97	3.87
2	Total soluble solids	6.70	5.67	4.09
3	Ascorbic acid (mg/100g)	26.13	24.1	23.7
4	Seed shape	Ovate	Ovate	Ovate
5	Seed colour	Light yellow	Light yellow	Creamy yellow
VI	Biotic stress susceptibility			
1	Leaf curl incidence (%)	10.5 (moderately resistant)	10.5 (moderately resistant)	11.4(moderately resistant)
2	Pest incidence (borer)	6.0	6.4	7.9

Table.2 Quality parameters and consumer preference of Tomato hybrid CTH 1 and check hybrids

Hybrids	Quality parameters			Consumer preference				Overall acceptability
	Ascorbic acid (mg/100g)	TSS (°Brix)	Pericarp thickness (mm)	Colour and appearance	Flavour	Texture	Taste	
CTH 1	26.13	6.70	5.84	9	9	9	9	9
TNAU Tomato hybrid CO 3 (C)	35.72	5.58	5.21	8	8	9	9	8.5
Lakshmi (C)	28.27	4.52	3.13	7	9	9	8	8.25
Mean	30.04	5.60	4.73	8	8.7	9	8.7	8.6

Table.3 Screening of Tomato hybrid CTH1 and check hybrids for major insect pests and diseases during 2017-18

Hybrids	Fruit borer	Leaf miner	Serpentine leaf miner	Thrips	Whitefly	Damping off	Fusarium wilt	Early blight	Spotted wilt virus	Tomato leaf curl virus
	Pest incidence (%)*			(No./3 leaves/plant)*		Disease incidence / intensity (%)				
CTH 1	-	4.3	7.8	8.1	9.7	5.80	12.00	5.75	10.50	10.00
TNAU Tomato hybrid CO 3	-	4.7	8.2	9.4	10.7	6.25	12.21	6.00	11.55	11.11
Lakshmi	14.98	27.14	17.5	24.7	28.5	8.33	14.33	7.00	15.33	24.33
Mean	-	12.0	11.2	14.1	16.3	6.79	12.85	6.25	12.46	15.15

* Mean of 20 observations

Table.4 Overall performance of Tomato hybrid CTH 1 under station, multi location, adaptive and demonstration trials

Particulars	No. of trials	Number of fruits / plant			Average fruit weight (g)			Mean yield / plant (kg)		
		CTH 1	TNAU Tomato hybrid CO 3 (C)	Lakshmi (C)	CTH 1	TNAU Tomato hybrid CO 3 (C)	Lakshmi (C)	CTH 1	TNAU Tomato hybrid CO 3 (C)	Lakshmi (C)
HC & RI, Coimbatore	3	38.1	29.4	30.8	77.3	61.7	63.9	2.73	2.27	2.18
Large Scale demonstration at HC & RI Coimbatore	1	38.0	31.8	28.9	78.0	61.3	64.8	3.56	1.98	2.0
MLT I	8	31.0	28.1	28.4	67.4	52.8	57.2	2.40	1.50	1.60
MLT II	6	39.8	34.0	36.8	71.1	64.2	62.4	2.51	1.70	1.80
ART	107	35.8	31.9	32.9	81.1	69.2	71.1	2.97	2.36	2.37
Large Scale demonstration at Farmers Field (Sattakalpudur)	1	36.2	31.2	30.4	77.5	65.3	67.8	3.45	1.98	2.10
Mean	126	36.48	31.07	31.37	75.40	62.42	64.53	2.94	1.97	2.01
Yield increase over check		27.31 % over Tomato hybrid CO 3 (C)						40.91 % over Lakshmi (C)		

Table.5 Mean performance of the Tomato hybrid CTH 1 under adaptive research trials (2016-17)

S. No	Name of the District & number of Blocks	Number of fruits per plant			Average fruit weight (g)			Fruit yield/plant (kg)		
		CTH 1	TNAU Tomato hybrid CO 3	Lakshmi	CTH 1	TNAU Tomato hybrid CO 3	Lakshmi	CTH 1	TNAU Tomato hybrid CO 3	Lakshmi
1	Coimbatore (10)	35.7	32.0	33.5	75.9	64.2	67.3	2.4	1.9	2.10
2	Cuddalore (10)	36.7	32.0	32.8	74.8	63.8	64.7	2.31	1.88	1.84
3	Dharmapuri (10)	25.0	26.0	26.0	60.0	65.0	65.0	4.00	3.75	3.00
4	Dindigul (10)	36.8	32.4	32.8	74.7	64.7	64.6	2.30	1.85	1.90
5	Erode (10)	19.0	16.7	21.1	117.2	106.7	87.2	2.20	1.80	1.60
6	Karur (1)	80.0	70.0	75.0	100.0	70.0	80.0	8.0	5.0	6.00
7	Namakkal (6)	36.9	33.7	33.0	75.6	66.3	66.7	2.3	1.80	1.90
8	Pudukottai (5)	21.4	14.6	15.4	162.8	89.0	127.8	4.0	2.76	3.18
9	Ramanad (2)	37.5	33.5	32.0	74.0	66.2	64.5	2.40	2.10	1.80
10	Thanjavur (1)	45.0	42.0	48.0	80.0	75.0	69.0	3.60	3.20	3.30
11	Thoothukudi (2)	27.5	24.0	21.5	41.5	40.0	43.0	1.08	0.96	0.91
12	Krishnagiri (5)	36.0	32.60	33.60	74.6	64.8	66.3	2.40	1.77	2.03
13	Salem (10)	33.6	29.30	30.3	83.1	72.7	68.29	2.26	1.82	1.85
14	Madurai (10)	35.2	30.42	30.95	83.9	66.7	71.7	2.43	1.88	2.10
15	Theni (5)	37.6	32.7	34.16	74.7	64.9	65.8	2.35	1.93	1.90
16	Trichy (5)	28.3	27.83	26.5	67.0	70.3	71.0	4.08	3.62	3.11
17	Vellore (5)	37.3	32.9	32.4	73.8	65.4	65.2	2.31	2.02	1.79
	Mean (107)	35.8	31.9	32.9	81.1	69.2	71.1	2.97	2.36	2.37



Tomato Hybrid CTH 1

The results of the present study revealed that the tomato culture CTH1 recorded less tomato leaf curl virus (10.00 PDI) incidence compared to the check hybrid TNAU Tomato hybrid CO 3 (11.11 PDI) and Lakshmi (24.33 PDI) (Table 3). Similar findings in screening of tomato hybrids against tomato leaf curl virus resistance were reported by Babu *et al.*, (2017).

Performance of tomato hybrids under different field trials

The tomato hybrid CTH1 recorded the highest yield under station trials at Coimbatore for three seasons over check hybrids with a yield of 95.8 t/ ha (Table 4). Similarly, the same recorded the maximum yield of 73.1 t/ha, 78.9 t/ha and 95.6 t/ha in MLT 1, MLT 2 and ART respectively. Whereas, the check hybrid (Lakshmi) recorded minimum yield of 57.5 t/ha, 66.0 t/ha and 65.9 t/ha in MLT 1, MLT 2 and ART respectively. This Tomato hybrid CTH 1 recorded 27.31% increase in yield over Co3 and 40.91% increase over Lakshmi. The large scale demonstration was conducted in farmers field at Sattakal pudur and these results also revealed that Tomato hybrid CTH 1 recorded maximum yield of 94.5 t/ha, however, the check varieties *viz.*, Tomato hybrid CO 3 and Lakshmi recorded the yield of 73.4 t/ha and 69.3 t/ha respectively (Table 4).

In conclusion, the tomato hybrid CTH1 has recorded the yield of 92.3t/ha which is 27.31 per cent higher over TNAU Tomato hybrid CO 3 and 40.91 per cent highest over hybrid Lakshmi. The tomato hybrid CTH 1 has recommended for Coimbatore, Cuddalore, Dharamapuri, Dindigul, Erode, Kancheepuram, Karur, Krishnagiri, Madurai, Namakkal, Pudukottai, Ramanathapuram, Salem, Thanjur, Thirunelveli, Thiruvannamalai, Theni, Thoothukudi, Tirupur, Trichy, Vellore and Villupuram,

districts of Tamil Nadu (Table 5) and under irrigated conditions during June-July and December – January.

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