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Development of ovoid shaped and high yielding novel variety 'Anand Roma' in tomato (*Solanum lycopersicum* L.)

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Abstract

Self-life is the prime objective of marketing in tomato. With the aim of breeding an extended shelf-life tomato variety, a novel genotype was developed through the pedigree method, originating from the cross ATL 97-26 x GP 11. The tomato variety 'Anand Roma', gave yields of 469.34 q/ha, 401.70 q/ha, 367.88 q/ha, 417.34 q/ha, 417.34 q/ha, 417.34 q/ha, and 404.98 q/ha across multiple trials in middle Gujarat surpassing seven check varieties viz., GT 2 (46.43%), AT 3 (35.34%), JT 3 (38.39%), GAT 5 (13.25%), GT 6 (26.57%), GT 7 (20.31%), and DVRT 2 (26.03%), respectively. Characterized by a determinate growth pattern, this variety exhibits optimal light absorption, resulting in vibrant green foliage. The fruit morphology of ATL 16-06 is typified by an ovoid shape with a tapered blossom end, ranging from flat to pointed. Noteworthy is its extended shelf life, with fruits retaining quality for approximately 8.80 days, surpassing GAT 5 and DVRT 2. With its nutritional richness and biochemical equilibrium, ATL 16-06 demonstrates antioxidant potential and resilience to biotic and abiotic stresses. DNA fingerprinting analysis of ATL 16-06, GAT 5(C), and DVRT 2 (NC) revealed significant genetic differences, highlighting ATL 16-06's distinctiveness from both GAT 5 and DVRT 2. This variety presents a promising option for middle Gujarat, offering improved yields and enhanced resilience to agricultural challenges.

Keywords: Ovoid shaped, yielding, Anand Roma, tomato, *Solanum lycopersicum* L.

Introduction

Tomato (*Solanum lycopersicum* L., $2n=2x=24$) stands as a pivotal vegetable crop, dominating both tropical and subtropical regions globally and holding a significant position within the *Solanaceae* family (Banerjee *et al.*, 2018) [4]. Tomato comprising a genome size of 950 Mb, housing approximately 35,000 genes primarily clustered within contiguous euchromatic regions (Chiusano and Colantuono, 2016) [5]. The crop traces its primary center of diversity along the Andean region of Ecuador and Peru (Landis *et al.*, 2021) [8]. The cultivation of tomatoes underscores its paramount importance, with China leading the ranks of major tomato-growing nations, followed closely by India, Turkey, Egypt, Iran, USA, Mexico, Italy, Brazil, and Spain (Ansari *et al.*, 2019) [3]. The global expanse of tomato cultivation spans approximately 4.76 million hectares, yielding a substantial 182.03 million tonnes, with an average productivity of 37.01 tonnes per hectare (Anony., 2021) [10]. In India, tomato claims the second position among vegetable crops, following potato, yet securing a prominent second place globally (Nguyen *et al.*, 2024) [9]. The Indian terrain boasts an extensive tomato cultivation area of 8.49 lakh hectares, yielding an annual production of 204.02 lakh tonnes in 2022-23 (Anon. 2024) [2]. Noteworthy tomato-growing states include Andhra Pradesh, Madhya Pradesh, Karnataka, Odisha, Gujarat, Chhattisgarh, Maharashtra, Telangana, and West Bengal, with Gujarat particularly prominent, contributing significantly to the national yield. Gujarat, with its 67, 874 hectares of tomato cultivation, records an annual production of 19,22,220 MT, attaining a productivity of 28.32 MT tonnes per hectare (Anon., 2022) [6]. Notable tomato-growing districts within Gujarat include Anand, Kheda, Banaskatha, Ahmedabad, Gandhinagar, Mehsana, Chhotaudepur, Narmada, Panchmahals, Vadodara, Valsad, Sabarkatha, and Kachcha. Beyond its agricultural significance, tomato transcends as one of the most esteemed horticultural commodities globally.

As consumer demands escalate for diverse varieties of superior quality, the focus extends beyond mere yield increment to encompass aspects of fruit quality enhancement. Rich in essential nutrients like beta-carotene, lycopene, and total sugars, tomatoes contribute significantly to human health and nutrition (Ali *et al.*, 2021) [1]. Tomatoes, with their rich nutritional profile, coupled with desirable fruit attributes such as extended self-life, enjoy popularity not only in processing but also in fresh-market contexts. The introduction of distinct tomato varieties such as Junagadh Ruby (1981), Gujarat Tomato 1 (2002), Gujarat Tomato 2 (2005), and subsequent varieties developed by agricultural universities across Gujarat reflect ongoing efforts to meet consumer preferences and agricultural demands. With the aim of breeding an extended shelf-life tomato variety, a novel genotype was developed through the pedigree method, originating from the cross ATL 97-26 x GP 11. Beginning with preliminary evaluation trials (PET) in 2016, subsequent evaluations were conducted across diverse locations within the state from 2017 to 2020, encompassing both *kharif* and *rabi* seasons. This genotype also underwent evaluation in the All India Coordinated Research Project (Vegetable Crops) during 2017-18 under the Integrated Evaluation Trial (IET-DT) and progressed to the Advanced Varietal Trial (AVT-II DT) in 2019-20 for national-level testing. Based on its performance, genotype ATL 16-06 is recommended for further consideration and endorsement under the agro-climatic conditions prevalent in middle Gujarat.

Materials and Methods

Experimental materials and design

The variety GAT 8, alternatively known as Anand Roma or tomato entry ATL 16-06, emerged from the controlled crossbreeding program involving ATL 97-26 x GP 11 utilizing the pedigree method of plant breeding at the Main Vegetable Research Station of Anand Agricultural University, Anand, spanning the years 2016 to 2020. The field experiment was executed following a randomized complete block design, comprising three replications, while GT 2, AT 3, JT 3, GAT 5, GT 6, GT 7 and DVRT 2 were deployed as check varieties. Each experimental plot adhering to a spacing pattern of 75 x 45 cm across various years and locations. Seedlings were transplanted after 30-35 days after nursery preparation.

Phenotyping and Statistical analysis

Data were systematically collected encompassing a range of phenology traits, including the Days to flower initiation and Days to first picking, alongside growth and yield-related parameters such as Leaf: Length (cm), Leaflet: Length (cm), Leaf: Width (cm), Leaflet: Width (cm), Flower: Calyx size (cm), Plant height (cm), Branches per plant, Number of fruits/plant, Fruit weight (g), Fruit length (cm), Fruit width (cm), Fruit girth (cm), Fruit: Size of core in cross section (in relation to total diameter) (cm), Number of seeds per fruit, Pulp to Juice ratio, Pericarp thickness (cm), Fruit: Number of locules, Fruit Firmness (N) and Shelf life (days). Subsequent statistical analyses were conducted utilizing the INDOSTATE software (IndoStat Inc., Hyderabad, India) within the Statistical Department at A.A.U., Anand.

Genotypic Diversity Analysis

CTAB protocol of Doyle and Doyle (1990) [7] was used to extract the genomic DNA. PCR reaction was performed using RAPD OPB6 and OPB8 marker and result observe using 3% agarose gel electrophoresis at department of Plant Biotechnology, A.A.U., Anand.

Results and Discussion

Fruit Yield Performance

The tomato entry ATL 16-06, derived from the cross ATL 97-26 x GP 11 through the Pedigree method initiated in 2008-09, exhibited commendable characteristics with an average yield of 355.91 q/ha across the state during PET and LSVT trials during 2016-21 (Table 2). Notably, tomato entry ATL 16-06 demonstrated exceptional performance, yielding an average of 412.13 q/ha of fruits in middle Gujarat (Table 3). Remarkably, in comparative trials, tomato entry ATL 16-06 surpassed several checks, yielding 469.34 q/ha, 401.70 q/ha, 367.88 q/ha, 417.34 q/ha, 417.34 q/ha, 417.34 q/ha, and 404.98 q/ha in middle Gujarat over GT 2 (46.43%), AT 3 (35.34%), JT 3 (38.39%), GAT 5 (13.25%), GT 6 (26.57%), GT 7 (20.31%), and DVRT 2 (26.03%), respectively, across different trials (Table 3). Impressively, across nine trials conducted in middle Gujarat, tomato entry ATL 16-06 consistently emerged within the top non-significant group, underscoring its robust performance and stability across diverse environments. Furthermore, tomato entry ATL 16-06 was actively involved in the All India Coordinated Research Project (Vegetable Crops) during the 2017-18 period in the Initial Evaluation Trial (IET-DT), and subsequently advanced to the Advanced Varietal Trial-II (AVT-II DT) in 2019-20. The comprehensive performance evaluation of tomato entry ATL 16-06 across various agro-climatic zones of Gujarat is meticulously detailed in Tables 4, 5, and 6, reaffirming its suitability and adaptability to diverse growing conditions.

Morphological characters

The proposed variety exhibits a determinate growth habit, characterized by an optimal light intensity that imparts a vivid green hue to its leaves (Table 4). Distinguished by its ovoid shape, the fruits of this variety feature a tapering blossom end, ranging from flat to pointed. Notably, the proposed variety demonstrates an extended shelf life, with fruits maintaining quality for approximately 8.80 days, surpassing the longevity of both GAT 5 and DVRT 2. This cultivar represents a pioneering advancement in tomato breeding within Gujarat's agricultural landscape, being the first of its kind to feature ovoid-shaped fruits, a significant achievement attributed to the Agricultural Universities of Gujarat. Recognized by the National Bureau of Plant Genetic Resources (NBPGR), this variety has been assigned the prestigious National Identity number IC 638930, signifying its unique genetic profile and potential agricultural impact.

Nutritional Quality

The cultivar exhibits a remarkable composition, showcasing 10.79 mg/100 g of lycopene, 11.30 mg/100 g of ascorbic acid, with acidity levels measuring at 0.10% and an acidity/sugar ratio of 0.04 (Table 5). This profile underscores its nutritional richness and biochemical

equilibrium, positioning it favorably among varieties for its antioxidant potential and physiological attributes (Aouji *et al.*, 2023) ^[11]. Lycopene, a prominent carotenoid pigment abundant in tomatoes, contributes significantly to its vibrant coloration and confers notable health benefits due to its antioxidative properties, particularly in combating oxidative stress and reducing the risk of chronic diseases (Zahari *et al.*, 2023) ^[12]. Ascorbic acid, or vitamin C, is pivotal for immune function, collagen synthesis, and cellular protection against oxidative damage, thus augmenting the variety's nutritional value and health-promoting qualities (Mumtaz *et al.*, 2021) ^[13]. The acidity parameters, comprising total acidity and acidity/sugar ratio, reflect the cultivar's organoleptic attributes and post-harvest storability, influencing its sensory perception, flavor profile, and suitability for processing or culinary applications. The meticulous analysis of these biochemical constituents underscores the cultivar's potential for diverse utilization in both fresh consumption and industrial processing, positioning it as a desirable choice for nutritional enrichment and culinary innovation.

Biotic stress tolerance

The observed variety demonstrates a diminished incidence of tomato leaf curl disease (%) and leaf damage caused by leaf miner (%) in addition to exhibiting a reduced or equivalent number of mines per leaf and fruit damage attributable to fruit borer (%) when juxtaposed against the reference varieties GAT 5, GT 6, GT 7, and DVRT 2, as detailed in Table 6 and Table 7.

Molecular Characterisation

The molecular markers RAPD:OPB6 and RAPD:OPB8 were employed in the analysis. The PCR products were visualized through 3% agarose gel electrophoresis. The DNA fingerprinting profile of ATL 16-06, GAT 5(C), and DVRT 2 (NC) revealed significant dissimilarities at the DNA level, particularly indicating that ATL16-06 differs from both GAT 5 and DVRT 2. The markers OPB6 and OPB8 identified a total of 5 and 6 alleles, respectively. These alleles exhibited band sizes ranging from 377 to 747 and 233 to 817, demonstrating the genetic diversity captured by the markers.

Table 1: Ancillary observations of economic attribute of tomato variety 'Anand Roma' along with checks

Sr. No.	Characters	Anand Roma	GAT 5 (C)	DVRT 2 (NC)
1	Days to flower initiation	45.87 (42-51)	48.20 (42-53)	44.73 (40-51)
2	Days to first picking	84.07 (74-95)	91.60 (85-100)	82.07 (75-90)
3	Leaf: Length (cm)	22.42 (20.5-25.00)	32.27 (28.00-35.60)	22.31 (18.80-25.10)
4	Leaflet: Length (cm)	07.65 (6.30-9.50)	10.18 (7.80-12.20)	07.97 (5.60-9.50)
5	Leaf: Width (cm)	16.85 (14.80-20.20)	22.64 (18.50-28.50)	16.83 (12.80-19.50)
6	Leaflet: Width (cm)	3.64 (3.0-4.20)	4.71 (4.0-5.50)	3.73 (3.0-4.50)
7	Flower: Calyx size (cm)	0.62 (0.30-0.90)	0.73 (0.50-0.90)	0.59(0.20-0.90)
8	Plant height (cm)	70.27 (52.80-90.10)	101.79 (85.90-120.00)	85.43 (63.50-110.60)
9	Branches per plant	8.93 (6.00-13.00)	10.33 (6.00-15.00)	8.33 (6.00-12.00)
10	Number of fruits/plant	29.67 (22-35)	28.27 (19-40)	25.13 (18-34)
11	Fruit weight (g)	97.01 (85.00-115.60)	86.78 (68.50-115.60)	73.22 (65.20-85.20)
12	Fruit length (cm)	8.12 (6.90-10.50)	6.37 (5.20-8.50)	5.99 (4.80-7.00)
13	Fruit width (cm)	5.53 (4.80-6.50)	5.95 (5.00-6.90)	5.41 (4.60-6.30)
14	Fruit girth (cm)	15.84 (12.50-18.50)	14.55 (11.40-17.20)	13.31 (12.20-16.90)
15	Fruit: Size of core in cross section (in relation to total diameter) (cm)	4.67 (3.90-5.60)	4.60 (3.20-5.40)	4.32 (3.50-5.20)
16	Number of seeds per fruit	20.33 (14.00-28.00)	33.13 (27.00-42.00)	31.60 (27.00-39.00)
17	Pulp to Juice ratio	79:21 (70-86: 14-30)	76:24 (70-82: 18-30)	70:30 (62-78: 22-38)
18	Pericarp thickness (cm)	0.74 (0.60-0.90)	0.57 (0.40-0.80)	0.58 (0.40-0.70)
19	Fruit: Number of locules	2.47 (2.00-3.00)	3.33 (3.00-4.00)	4.27 (3.00-5.00)
20	Fruit Firmness (N)	44.12 (40.00-50.09)	41.29 (36.53-46.59)	41.50 (29.98-56.44)
21	Shelf life (days)	8.80 (7.67-9.33)	7.66 (7.33-8.00)	7.00 (6.67-7.33)

Table 2: Yield performance of tomato variety 'Anand Roma' in comparison with check varieties in the Gujarat state

Year/Season	Name of trial	Locations	Fruit yield (q/ha)								S. Em \pm	CD at 5%	CV%
			Anand Roma	Checks									
				GT 2 (a)	AT 3 (b)	JT 3 (c)	GAT 5 (d)	GT 6 (e)	GT 7 (f)	DVRT 2 (g)			
2016-17/ <i>Kharif-rabi</i>	PET	Anand	469.34 ^{ab}	320.52	333.54	-	-	-	-	-	22.84	66.65	11.42
		% Inc. over the checks	46.43	40.71									
2017-18/ <i>Kharif-rabi</i>	LSVT	Anand	371.04 ^{bcg}	-	296.09	291.41	-	-	-	313.94	18.67	54.75	9.91
		Junagadh [#]	250.12	-	184.69	190.62	-	-	-	175.80	16.81	49.31	13.20
		Navsari	326.30 ^{bg}	-	257.39	290.99	-	-	-	240.25	14.50	42.17	7.89
		Ladol	330.55	-	474.43	394.18	-	-	-	496.60	47.94	140.59	20.75
		Thasra	364.71 ^{bcg}	-	260.80	240.23	-	-	-	303.50	19.90	58.34	10.68
		Mean (4)	348.15		322.18	304.20				338.57			
		% Inc. over the checks			08.06	14.45				02.83			
2018-19/ <i>Kharif-rabi</i>	LSVT	Anand	422.84	-	-	-	393.36	367.54	363.79	357.46	22.77	65.94	11.13
		Junagadh [#]	187.88	-	-	-	-	215.83	206.42	210.96	16.16	47.01	11.72
		Navsari	276.81	-	-	-	-	265.01	294.86	288.64	17.81	51.80	10.55
		Ladol	296.11	-	-	-	-	239.58	309.77	246.29	29.31	85.19	19.79
		Thasra	398.66 ^g	-	-	-	350.93	344.39	337.91	331.28	21.43	62.07	11.38
		Mean (2)	410.75				372.15						
		Mean (4)	348.61					304.13	326.58	305.92			
% Inc. over the checks					10.37	14.62	06.74	13.95					
2019-20/ <i>Kharif-rabi</i>	LSVT	Anand	394.80 ^{efg}	-	-	-	338.22	298.87	308.13	274.28	24.78	73.10	13.87
		Junagadh	311.45 ^{defg}	-	-	-	247.76	245.68	239.04	222.87	14.10	41.60	9.06
		Navsari	219.60	-	-	-	272.68	326.15	275.93	339.60	19.22	56.69	11.76
		Jagudan [#]	248.59	-	-	-	234.41	219.65	297.76	240.66	29.49	87.01	18.98
		Thasra	423.35 ^{defg}	-	-	-	357.51	351.34	331.28	315.84	19.77	58.31	10.15
		Mean (4)	337.30				304.04	305.51	288.60	288.15			
		% Inc. over the checks					10.94	10.41	16.88	17.06			
2020-21/ <i>Kharif-rabi</i>	LSVT	Anand	427.21 ^{eg}				371.91	295.27	349.28	332.20	30.42	89.71	14.72
		Junagadh	272.87 ^{dg}				226.31	249.23	233.26	216.87	15.26	45.03	10.05
		Navsari [#]	215.02				254.76	283.15	298.43	286.52	13.99	21.27	9.00
		Jagudan	295.82				257.76	284.25	251.49	255.08	25.47	75.14	12.53
		Thasra	437.2 ^{eg}				399.2	321.0	390.9	342.1	29.05	85.70	13.09
		Mean (4)	358.28				313.80	287.44	306.23	286.56			
		% Inc. over the checks					14.17	24.64	16.99	25.03			
Over all mean (17)			355.91										
Over all mean (1)			469.34	320.52									
Over all mean (5)			372.39		324.45								
Over all mean (4)			348.15			304.20							
Over all mean (10)			360.38				321.56						
Over all mean (12)			348.06					299.03					
Over all mean (12)			348.06						307.14				
Over all mean (16)			348.08							304.80			
Overall % increase over checks				46.43	14.78	14.45	12.07	16.40	13.32	14.20			
Frequency in top non-signi. groups				12/17	0/1	1/5	1/4	6/10	4/12	6/12	4/16		

Note:

(1) a, b, c, d, e, f and g indicate the significant superior than respective check

(2) # was not included in the mean due to below average yield (Trial mean of Junagadh-2017-18=211.73q/ha, Junagadh-2018-19=229.42q/ha, Jagudan-2019-20=207.68 q/h and Navsari-2020-21=269.20

Table 3: Yield performance of tomato variety 'Anand Roma' in comparison with checks in the middle Gujarat

Year/Season	Name of trial	Locations	Fruit yield (q/ha)								S.Em ±	CD at 5%	CV%
			Anand Roma	Checks									
				GT 2 (a)	AT 3 (b)	JT 3 (c)	GAT 5 (d)	GT 6 (e)	GT 7 (f)	DVRT 2 (g)			
2016 -17/ Kharif-rabi	PET	Anand	469.34 ^{ab}	320.52	333.54	-	-	-	-	-	22.84	66.65	11.42
		% Inc. over the checks	46.43										
2017-18/ Kharif-rabi	LSVT	Anand	371.04 ^{bcg}	-	296.09	291.41	-	-	-	313.94	18.67	54.75	9.91
		Thasra	364.71 ^{bcg}	-	260.80	240.23	-	-	-	303.50	19.90	58.34	10.68
		Mean(2)	367.88		278.45	265.82				308.72			
		% Inc. over the checks			32.12	38.39				19.16			
2018-19/ Kharif-rabi	LSVT	Anand	422.84	-	-	-	393.36	367.54	363.79	357.46	22.77	65.94	11.13
		Thasra	398.66 ^e	-	-	-	350.93	344.39	337.91	331.28	21.43	62.07	11.38
		Mean(2)	410.75				372.15	355.97	350.85	344.37			
		% Inc. over the checks					10.37	15.39	17.07	19.28			
2019-20/ Kharif-rabi	LSVT	Anand	394.80 ^{efg}	-	-	-	338.22	298.87	308.13	274.28	24.78	73.10	13.87
		Thasra	423.35 ^{defg}	-	-	-	357.51	351.34	331.28	315.84	19.77	58.31	10.15
		Mean(2)	409.08				347.87	325.11	319.71	295.06			
		% Inc. over the checks					17.60	25.83	27.95	38.64			
2020-21/ Kharif-rabi	LSVT	Anand	427.21 ^{eg}				371.91	295.27	349.28	332.20	30.42	89.71	14.72
		Thasra	437.2				399.2	321.0	390.9	342.1	29.05	85.70	13.09
		Mean(2)	432.21				385.56	308.14	370.09	337.15			
		% Inc. over the checks					12.10	40.26	16.78	28.19			
Over all mean (9)			412.13										
Over all mean (1)			469.34	320.52									
Over all mean (3)			401.70		296.81								
Over all mean (2)			367.88			265.82							
Over all mean (6)			417.34				368.52	329.74	346.88				
Over all mean (8)			404.98							321.33			
Over all % increase over checks				46.43	35.34	38.39	13.25	26.57	20.31	26.03			
Frequency in top non-signi. groups			9/9	0/1	0/3	0/2	5/6	2/6	4/6	1/8			

Note: a, b, c, d, e, f and g indicate the significant superior than respective check

Table 4: Morphological characters of tomato variety 'Anand Roma' along with checks (As per DUS Guidelines)

Sr. No	Characters	Anand Roma	GAT 5 (C)	DVRT 2 (NC)
1	Seedling: Anthocyanin colouration of hypocotyls	Absent	Absent	Absent
2	Leaf: Intensity of green colour	Light	Dark	Light
3	Plant: Growth type	Determinate	Determinate	Determinate
4	Stem: Pubescence	Present	Present	Present
5	Stem: Anthocyanin colouration of upper third portion	Absent	Absent	Absent
6	Stem: Length of internode between 1 st and 4 th inflorescence (for determinate varieties)	Medium	Medium	Medium
7	Leaf: Length	Short	Long	Short
8	Leaflet: Length	Medium	Long	Medium
9	Leaflet: Width	Medium	Broad	Medium
10	Leaflet: Width	Narrow	Medium	Narrow
11	Leaflet: Serration	Less Serrated	Less Serrated	Highly Serrated
12	Leaf: Structure	Intermediated	Open	Intermediated
13	Leaf: Attitude in relation to main stem (in middle third of plant)	Semi erect	Semi erect	Semi erect
14	Leaf: Attitude of petioles of leaflets in relation to main axis	Semi Drooping	Semi Drooping	Semi Drooping
15	Inflorescence: Type (2 nd and 3 rd truss)	Multiparous	Multiparous	Multiparous
16	Plant: Number of inflorescence on main stem (side shoots to be ignored) (for determinate varieties only)	Many	Many	Many
17	Flower: Fasciations (1 st flower of inflorescence)	Absent	Absent	Absent
18	Flower: Pubescence of style	Present	Present	Present
19	Flower: Colour	Yellow	Yellow	Yellow
20	Flower: Anther colour	Yellow	Yellow	Yellow
21	Flower: Nature of stigma	Non-Exserted	Non-Exserted	Non-Exserted
22	Flower: Stigma	Bilobe	Bilobe	Multilobe
23	Flower: Calyx size	Short	Short	Short
24	Peduncle: Abscission layer	Present	Present	Present
25	Jointed peduncle: Length (from abscission layer to calyx)	Short	Short	Short
26	Time of flowering (50% of the plants with at least one open flower from seed sowing)	Medium	Medium	Medium
27	Fruit: Intensity of green colour (before maturity)	Light	Light	Light
28	Fruit: Green shoulder (before maturity)	Absent	Present	Absent
29	Fruit: Size	Large	Large	Large
30	Fruit: Length	Large	Medium	Medium
31	Fruit: Width	Medium	Medium	Medium
32	Fruit: Shape in longitudinal section	Ovoid	Circular	Slightly flattened
33	Fruit: Ribbing at peduncle end	Medium	Medium	Medium
34	Fruit: Cross section	Round	Round	Not Round

35	Fruit: Depression at peduncle end	Absent	Shallow	Shallow
36	Fruit: Size of scar around peduncle (diameter)	Medium	Medium	Medium
37	Fruit: Size of blossom scar	Small	Small	Small
38	Fruit: Shape at blossom end	Flat to pointed	Flat	Indented
39	Fruit: Size of core in cross section (in relation to total diameter)	Medium	Medium	Medium
40	Fruit: Thickness of the pericarp	Thick	Medium	Medium
41	Fruit: Colour at maturity	Red	Red	Red
42	Fruit: Colour of flesh at maturity	Red	Red	Red
43	Fruit: Firmness	Medium	Medium	Medium
44	Time of maturity (from seed sowing to first picking)	Medium	Medium	Medium
45	Fruit: Total soluble solids	High	High	High

Table 5: Biochemical parameters of the tomato variety 'Anand Roma' along with checks

Sr. No.	Characters	ATL 16-06	GAT 5 (C)	DVRT 2 (NC)
1	Moisture (%)	93.86	91.10	91.08
2	Total soluble solid ($^{\circ}$ Brix)	4.73	4.87	5.00
3	Total soluble sugar (%)	2.66	2.78	3.05
4	Ascorbic acid (mg/100 g)	11.30	11.21	10.25
5	Lycopene content (mg/100 g)	10.79	11.86	9.66
6	Phenol (mg/100 g)	63.87	73.88	76.26
7	Acidity (%)	0.10	0.10	0.11
8	Acidity/Sugar	0.04	0.04	0.04

Table 6: Rating of incidence of diseases at Anand centre

Disease	Year and season	Name of trial	ATL 16-06	GAT 5 (C)	GT 6 (C)	GT 7 (C)	DVRT 2 (NC)
Tomato leaf curl disease (TLCV) %	2017-18 <i>Kharif-Rabi</i>	LSVT	3.22	-	-	-	7.00
	2018-19 <i>Kharif-Rabi</i>	LSVT	3.21	2.10	7.55	7.45	7.00
	2019-20 <i>Kharif-Rabi</i>	LSVT	1.04	3.13	5.21	4.17	10.42
	2020-21 <i>Kharif-Rabi</i>	LSVT	2.01	3.33	5.33	4.17	10.42
	Range		1.04-3.22	2.10-3.33	5.21-7.55	4.17-7.45	7.00-10.42
Reaction			R	R	R	R	R

Table 7: Rating of incidence of insect-pests at Anand centre

Insect-pests	Year and season	Name of trial	ATL 16-06	GAT 5 (C)	GT 6 (C)	GT 7 (C)	DVRT 2 (NC)
Number of mines/leaf	2017-18 <i>Kharif-Rabi</i>	LSVT	2.56	-	-	-	4.73
	2018-19 <i>Kharif-Rabi</i>	LSVT	2.22	1.89	4.67	2.22	3.78
	2019-20 <i>Kharif-Rabi</i>	LSVT	1.93	2.78	4.02	3.11	5.64
	2020-21 <i>Kharif-Rabi</i>	LSVT	2.39	2.89	4.71	4.67	4.72
	Range		1.93-2.56	1.89-2.89	4.02-4.71	2.22-4.67	3.78-5.64
Leaf damage by leaf miner (%)	2017-18 <i>Kharif-Rabi</i>	LSVT	6.28	-	-	-	9.11
	2018-19 <i>Kharif-Rabi</i>	LSVT	3.67	3.22	10.44	4.15	8.89
	2019-20 <i>Kharif-Rabi</i>	LSVT	2.23	5.41	7.18	6.66	8.45
	2020-21 <i>Kharif-Rabi</i>	LSVT	3.83	3.89	7.98	8.39	7.98
	Range		2.23-6.28	3.22-5.41	7.18-10.44	4.15-8.39	7.98-9.11
Fruit damage by fruit borer (%)	2017-18 <i>Kharif-Rabi</i>	LSVT	5.41	-	-	-	11.80
	2018-19 <i>Kharif-Rabi</i>	LSVT	5.22	3.22	8.56	5.56	7.63
	2019-20 <i>Kharif-Rabi</i>	LSVT	4.00	5.33	8.00	6.00	12.00
	2020-21 <i>Kharif-Rabi</i>	LSVT	4.17	3.56	10.62	11.53	11.11
	Range		4.00-5.41	3.22-5.33	8.00-10.62	5.56-11.53	7.63-12.00

Conclusion

Tomato accession ATL 16-06 outperformed multiple checks, achieving yields of 469.34 q/ha, 401.70 q/ha, 367.88 q/ha, 417.34 q/ha, 417.34 q/ha, 417.34 q/ha, and 404.98 q/ha in middle Gujarat compared to GT 2 (46.43%), AT 3 (35.34%), JT 3 (38.39%), GAT 5 (13.25%), GT 6 (26.57%), GT 7 (20.31%), and DVRT 2 (26.03%) across various trials. This variety displays determinate growth, optimized for light intensity, resulting in vivid green foliage (Table 4). Its fruits, characterized by an ovoid shape with a tapering blossom end, exhibit extended shelf life, lasting approximately 8.80 days, surpassing GAT 5 and DVRT 2. With its nutritional richness and biochemical equilibrium, ATL 16-06 stands out for its antioxidant potential and resilience to both biotic and abiotic stresses. DNA

fingerprinting confirms significant differences between ATL 16-06, GAT 5 (C), and DVRT 2 (NC), underscoring its distinctiveness from both. Positioned as a promising option for middle Gujarat, this variety offers improved yields and enhanced resilience to agricultural challenges.

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