



# Performance of Tomato Genotypes for Growth and Yield under Eastern Dry Zone of Karnataka, India

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## **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## **ABSTRACT**

The study assessed the growth, reproductive and yield attributes of 200 tomato genotypes assembled from AVRDC, Taiwan, IIVR, Varanasi, NBPGR, New Delhi and SAU of India and some Research centers of Karnataka. Field experiments were conducted in 2015-17 at Dept. of Vegetable Science, College of Horticulture, Bengaluru, Karnataka. The main aim was to assess some of growth and yield attributes of 200 tomato genotypes. These 200 genotypes collected from AVRDC, Taiwan, IIVR, Varanasi, NBPGR, New Delhi and SAU of India and some research centers of Karnataka. The growth parameters like plant height, maximum plant height noticed in genotype (13P3) 202.33 cm. The number of branches per plant maximum was observed in genotype (AR-56) i.e. 11.33 branches per plant. Wide variability was observed for fruit width in tomato. The highest fruit width reported (H-86) 8.15cm. Wide variability was observed for tomato fruit length also, the length of tomato fruit maximum noticed in genotype (EC-321426) 7.45 cm. The highest average fruit weight was observed in H-86 (131.94 g) and the lowest in 73P2 (20.00 g). The total tomato fruit

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yield recorded per plant ranged between 0.39 kg (Roma) and 6.48 kg (4P1). This study gives information on the agronomic variation in the 200 tomato genotypes assessed which can invariably serve as an index to selecting putative parents in breeding for new tomato variety that will combine desirable agronomic characteristics with high yield and its attributing characters.

**Keywords:** Growth; yield; diversity; tomato; genotypes.

## 1. INTRODUCTION

Tomato (*Solanum lycopersicum* L.) belonging to the family Solanaceae was once considered poisonous and inedible, has now become one of the most popular and extensively consumed vegetable [1]. It stands unique among vegetables because of its high nutritive values and uses. Tomato is consumed either fresh, cooked or processed into various products like juice, ketchup, sauce, puree, whole canned fruit and is one of the main ingredient of 'pizzas'. Tomatoes are important source of Vitamin A, Vitamin C and minerals [2]. The genetic improvement of both quantitative and qualitative characters is the main interest of plant breeders. The information on genetics of various quantitative traits particularly of those that contribute to yield and quality would be most useful in planning the breeding programs so as to make effective selections. The purpose of this is to give comprehensive up-to-date information to the various aspects of genetic improvement by hybridization and at the same time elucidate the nature and magnitude of different type of gene action involved. The critical assessment of the nature and magnitude of variability in the available germplasm is the pre-requisite to any breeding programme [3]. The efficiency of selection and development of improved varieties solely depends on the nature and extent of variability expressed for yield and related characters in the gene pool. Since most of the economic plant characters are polygenic in nature and are highly influenced by the environment, it becomes difficult to conclude whether the observed variability is heritable or due to environmental factors. High yield and yield contributing characters with improved processing qualities have been the major objectives of tomato breeding programme [4]. Keeping in view the objectives of the present investigation has been planned with the following objectives to investigate the performance of different tomato genotypes in the Karnataka for its growth and yield attributes.

## 2. MATERIALS AND METHODS

Study on "Genetic variability, heterosis and combining ability studies for yield and quality traits in tomato (*Solanum lycopersicum* L.)" was undertaken during the year 2015-17 at experimental block of Department of Vegetable Science, College of Horticulture, Bangalor, India. The details of the material used for the investigation, evaluation of tomato genotypes, development of F<sub>1</sub>'s and their evaluation, experimental designs adopted and statistical procedures followed are outlined below.

### 2.1 Experimental Site

The experimental field was located at an altitude of 930 m above MSL, 12° 58' North latitude and 77° 35' East-longitude in the Eastern Dry Zone (Zone-5) of Karnataka. The experimental field was a fairly levelled land with red sandy loam soil in texture with slight heterogeneity in fertility status.

### 2.2 Experimental Material

The material for the present study comprised a total of 200 genotypes which were procured from different institutes such as Indian Institute of Vegetable Research (IIVR), Varanasi, Uttara Pradesh, Indian Institute of Horticultural Research (IIHR), Hessarghatta, Bengaluru and University of Agricultural Sciences, GKVK, Bengaluru (Tables 1 and 2). The seeds were sown in pro trays containing 98 holes. Coir pith was used as growing media. The sown trays were stacked and covered with polythene for three days in order to get early as well as uniform germination. Trays were irrigated daily once or twice depending up on the temperature. After fifteen days of sowing the trays were drenched with 19:19:19 (NPK) at the concentration of 1g/l in order to get good rooting as well as growth. The prophylactic sprays were taken against pest and diseases.

**Table 1. List of genotypes used in the present study**

S.N	Name of the institute	Number of genotypes collected
1	NBPGR, New Delhi	10
2	IIHR, Hessarghatta, Bengaluru, Karnataka	06
3	IARI, RS, Katrain	03
4	IARI, New Delhi	06
5	IIPR, Kanpur	02
6	IIVR, Varanasi	08
7	PAU, Ludhiana	09
8	MPKV, Rahuri	03
9	TNAU, Coimbatore	01
10	KAU, Thrissur	01
11	UAS, Bengaluru	01
12	UAS, Raichur	02
13	HRS, Devihosur, Haveri, Karnataka	20
14	COH, Mudigere	05
15	COH, Mysuru	73
16	Dept. of Vegetable Science, COH, Bengaluru	14
17	Dept. of BCI, COH, Bengaluru	27
18	Ahmedabad local	01
19	Alahabad local	03
20	Guntur	01
21	Rajamundri	01
22	Madanapalli	01
23	Sakura Seeds Pvt, Ltd	01
24	Sungro Seeds Pvt, Ltd	01
<b>Total</b>		<b>200</b>

The field was brought to fine tilth by disc ploughing followed by harrowing and cross cultivation. Farm yard manure at the rate of 25 t ha<sup>-1</sup> was also incorporated at the time of land preparation. Ridges and furrows were prepared at 60 cm spacing. The half dose of the nitrogen and full dose of phosphorus and potash at the rate of 150:150:150 kg (NPK) per hectare was applied at the time of planting. Twenty five days old seedlings were transplanted in the main field with a spacing of 60 cm between plants, on one side, half way up the ridges. Light irrigation was given at the time of planting. Subsequent irrigations were provided whenever it was required. Just prior to earthing up i.e. 30 days after transplanting, half of nitrogen was given as top dress. Regular weeding was carried out and staking was provided forty-five days after transplanting [5].

### 2.3 Growth Characteristics

The following observations were recorded on three randomly selected plants from each entry and the average of these three plants was worked out for the purpose of statistical

computation. The details of observations recorded in each experiment and techniques adopted for recording the observations were as follows.

#### 2.3.1 Plant height

Plant height was measured in centimeters from the ground level to the tip of the plant at final harvesting stage.

#### 2.3.2 Number of branches per plant

Number of branches per plant were counted and the average was expressed in numbers.

#### 2.3.3 Yield parameters

From each plant five fruits were taken randomly to measure length and width. The length of fruit was measured from the calyx end to blossom end using vernier caliper and average was expressed in centimeters. With the help of vernier callipers, fruit width was measured in the middle of fruit and recorded in centimetre.

**Table 2. Details of tomato genotypes and checks used in the experiment and their source of collection**

<b>S.N</b>	<b>Original Code</b>	<b>Field Code</b>	<b>Source of Collection</b>
1	ARTD-1	G-1	HRS, Devihosur, Haveri, Karnataka
2	ARTD-2	G-2	HRS, Devihosur, Haveri, Karnataka
3	ARTD-3	G-3	HRS, Devihosur, Haveri, Karnataka
4	ARTD-4	G-4	HRS, Devihosur, Haveri, Karnataka
5	ARTD-5	G-5	HRS, Devihosur, Haveri, Karnataka
6	ARTD-6	G-6	HRS, Devihosur, Haveri, Karnataka
7	ARTD-7	G-7	HRS, Devihosur, Haveri, Karnataka
8	ARTD-8	G-8	HRS, Devihosur, Haveri, Karnataka
9	AOTD-9	G-9	HRS, Devihosur, Haveri, Karnataka
10	AOTD-10	G-10	HRS, Devihosur, Haveri, Karnataka
11	AOTD-11	G-11	HRS, Devihosur, Haveri, Karnataka
12	AOTD-12	G-12	HRS, Devihosur, Haveri, Karnataka
13	AOTD-13	G-13	HRS, Devihosur, Haveri, Karnataka
14	AOTD-14	G-14	HRS, Devihosur, Haveri, Karnataka
15	AOTD-15	G-15	HRS, Devihosur, Haveri, Karnataka
16	AOTD-16	G-16	HRS, Devihosur, Haveri, Karnataka
17	AOTD-17	G-17	HRS, Devihosur, Haveri, Karnataka
18	AOTD-18	G-18	HRS, Devihosur, Haveri, Karnataka
19	AOTD-19	G-19	HRS, Devihosur, Haveri, Karnataka
20	AOTD-20	G-20	HRS, Devihosur, Haveri, Karnataka
21	EC-321426	G-23	NBPGR, New Delhi
22	EC-326146	G-31	NBPGR, New Delhi
23	EC-338714	G-33	NBPGR, New Delhi
24	EC-338717	G-35	NBPGR, New Delhi
25	EC-338725	G-37	NBPGR, New Delhi
26	EC-338735	G-38	NBPGR, New Delhi
27	EC-9057	G-39	NBPGR, New Delhi
28	EC-357839	G-40	NBPGR, New Delhi
29	EC-357846	G-42	NBPGR, New Delhi

S.N	Original Code	Field Code	Source of Collection
30	EC-362940	G-43	NBPGR, New Delhi
31	Punjab Varkha Bahar-1	G-46	PAU, Ludhiana
32	PNR-1	G-47	PAU, Ludhiana
33	S-12	G-48	PAU, Ludhiana
34	Punjab Varkha Bahar-2	G-49	PAU, Ludhiana
35	Hisar Lal	G-50	PAU, Ludhiana
36	Punjab Upama	G-51	PAU, Ludhiana
37	Punjab Chhuhara	G-52	PAU, Ludhiana
38	Punjab Kesari	G-53	PAU, Ludhiana
39	Punjab Ratta	G-54	PAU, Ludhiana
40	52135	G-57	IIPR, Kanpur
41	Azad-T-1	G-61	IIPR, Kanpur
42	Kashi Sharad	G-62	IIVR, Varanasi
43	Kashi Hemanth	G-63	IIVR, Varanasi
44	Kashi Amrith	G-64	IIVR, Varanasi
45	Kashi Anupama	G-65	IIVR, Varanasi
46	H-86	G-66	IIVR, Varanasi
47	Kalyanpur Type	G-68	IIVR, Varanasi
48	Arka Abha	G-69	IIHR, Hessarghatta, Bengaluru, Karnataka
49	Arka Sourabh	G-70	IIHR, Hessarghatta, Bengaluru, Karnataka
50	DT-10	G-72	IIVR, Varanasi
51	H-24	G-73	IIVR, Varanasi
52	PTR-4	G-75	UAS, Raichur
53	PTR-6	G-76	UAS, Raichur
54	Bhagyashree	G-77	MPKV, Rahuri
55	Dhanashree	G-78	MPKV, Rahuri
56	Pule Raja	G-79	MPKV, Rahuri
57	Utkal Kumari	G-80	Dept. of Vegetable Science, COH, Bengaluru
58	Utkal Deepti	G-81	Dept. of Vegetable Science, COH, Bengaluru
59	Utkal Raja	G-82	Dept. of Vegetable Science, COH, Bengaluru
60	Pragnya	G-83	Dept. of Vegetable Science, COH, Bengaluru

<b>S.N</b>	<b>Original Code</b>	<b>Field Code</b>	<b>Source of Collection</b>
61	Roma	G-84	IARI, RS, Katrain
62	Best of All	G-85	IARI, RS, Katrain
63	Sioux	G-86	IARI, RS, Katrain
64	PKM-1	G-87	TNAU, Coimbatore
65	Akshaya	G-88	KAU, Thrissur
66	Rajamundri Local	G-90	Rajamundri
67	Guntur Local	G-91	Gunturu
68	Arka Alok	G-92	IIHR, Hessarghatta, Bengaluru, Karnataka
69	Arka Vikas	G-93	IIHR, Hessarghatta, Bengaluru, Karnataka
70	Arka Meghali	G-95	IIHR, Hessarghatta, Bengaluru, Karnataka
71	Arka Ahuthi	G-96	IIHR, Hessarghatta, Bengaluru, Karnataka
72	Madanapalli Local	G-98	Madanapalli
73	Pusa Sheetal	G-99	IARI, New Delhi
74	Pusa Sadabahar	G-100	IARI, New Delhi
75	Pusa Rohini	G-101	IARI, New Delhi
76	Pusa Gourava	G-102	IARI, New Delhi
77	P-120	G-103	IARI, New Delhi
78	Pusa Ruby	G-104	IARI, New Delhi
79	S-22	G-105	Sakura Seeds PVT, LTD
80	Navodaya	G-106	Sungro Seeds PVT, LTD
81	Selection	G-107	Ahmedabad local
82	C-10-2	G-108	Dept. of BCI, COH, Bengaluru
83	C-11-2	G-109	Dept. of BCI, COH, Bengaluru
84	C-20-1	G-110	Dept. of BCI, COH, Bengaluru
85	CO-3	G-111	Dept. of BCI, COH, Bengaluru
86	CLN-2026	G-112	Dept. of BCI, COH, Bengaluru
87	41	G-113	Dept. of BCI, COH, Bengaluru
88	DVRT-2	G-114	Dept. of BCI, COH, Bengaluru
89	EC-13904	G-116	Dept. of BCI, COH, Bengaluru
90	C-1-4	G-119	Dept. of BCI, COH, Bengaluru
91	C-4-1	G-120	Dept. of BCI, COH, Bengaluru

<b>S.N</b>	<b>Original Code</b>	<b>Field Code</b>	<b>Source of Collection</b>
92	EC-381263	G-121	Dept. of BCI, COH, Bengaluru
93	EC-501574	G-123	Dept. of BCI, COH, Bengaluru
94	EC-501580	G-124	Dept. of BCI, COH, Bengaluru
95	EC-501583	G-126	Dept. of BCI, COH, Bengaluru
96	EC-538404	G-129	Dept. of BCI, COH, Bengaluru
97	EC-538405	G-130	Dept. of BCI, COH, Bengaluru
98	EC-620383	G-133	Dept. of BCI, COH, Bengaluru
99	EC-620398	G-134	Dept. of BCI, COH, Bengaluru
100	EC-620401	G-135	Dept. of BCI, COH, Bengaluru
101	EC-620446	G-136	Dept. of BCI, COH, Bengaluru
102	EC-620464	G-137	Dept. of BCI, COH, Bengaluru
103	EC-620469	G-138	Dept. of BCI, COH, Bengaluru
104	EC-620470	G-139	Dept. of BCI, COH, Bengaluru
105	Monte Fevarate	G-140	Dept. of BCI, COH, Bengaluru
106	Rio Grande	G-141	Dept. of BCI, COH, Bengaluru
107	Angoorlata	G-143	Dept. of BCI, COH, Bengaluru
108	Ageta-2	G-144	Dept. of BCI, COH, Bengaluru
109	85	G-145	COH, Mysuru
110	4	G-148	COH, Mysuru
111	80	G-149	COH, Mysuru
112	200	G-150	COH, Mysuru
113	8	G-151	COH, Mysuru
114	1P2	G-152	COH, Mysuru
115	2P2	G-153	COH, Mysuru
116	3P2	G-154	COH, Mysuru
117	4P1	G-155	COH, Mysuru
118	5T5P6	G-156	COH, Mysuru
119	6T6P8	G-157	COH, Mysuru
120	7	G-158	COH, Mysuru
121	8P3	G-159	COH, Mysuru
122	9P4	G-160	COH, Mysuru

<b>S.N</b>	<b>Original Code</b>	<b>Field Code</b>	<b>Source of Collection</b>
123	10P6	G-161	COH, Mysuru
124	11P4	G-162	COH, Mysuru
125	12P1	G-163	COH, Mysuru
126	13P3	G-164	COH, Mysuru
127	14P6	G-165	COH, Mysuru
128	15P4	G-166	COH, Mysuru
129	16P2	G-167	COH, Mysuru
130	17P5	G-168	COH, Mysuru
131	18P3	G-169	COH, Mysuru
132	19P8	G-170	COH, Mysuru
133	20	G-171	COH, Mysuru
134	21	G-172	COH, Mysuru
135	23P4	G-173	COH, Mysuru
136	25P2	G-175	COH, Mysuru
137	27P2	G-177	COH, Mysuru
138	28P2	G-178	COH, Mysuru
139	29P4	G-179	COH, Mysuru
140	30P2	G-180	COH, Mysuru
141	33P2	G-183	COH, Mysuru
142	34P2	G-184	COH, Mysuru
143	35P2	G-185	COH, Mysuru
144	36	G-186	COH, Mysuru
145	37P2	G-187	COH, Mysuru
146	38P2	G-188	COH, Mysuru
147	40P4	G-190	COH, Mysuru
148	43	G-193	COH, Mysuru
149	44P2	G-194	COH, Mysuru
150	45	G-195	COH, Mysuru
151	46P5	G-196	COH, Mysuru
152	47P2	G-197	COH, Mysuru
153	48P4	G-198	COH, Mysuru



<b>S.N</b>	<b>Original Code</b>	<b>Field Code</b>	<b>Source of Collection</b>
154	51	G-201	COH, Mysuru
155	53	G-202	COH, Mysuru
156	54P3	G-203	COH, Mysuru
157	55P2	G-204	COH, Mysuru
158	56P2	G-205	COH, Mysuru
159	58	G-206	COH, Mysuru
160	59	G-207	COH, Mysuru
161	61P4	G-208	COH, Mysuru
162	62P4	G-209	COH, Mysuru
163	63P3	G-210	COH, Mysuru
164	64	G-211	COH, Mysuru
165	65P5	G-212	COH, Mysuru
166	66P1	G-213	COH, Mysuru
167	70	G-214	COH, Mysuru
168	71P2	G-215	COH, Mysuru
169	72P2	G-216	COH, Mysuru
170	73P2	G-217	COH, Mysuru
171	74P5	G-218	COH, Mysuru
172	75P3	G-219	COH, Mysuru
173	76P1	G-220	COH, Mysuru
174	77P1	G-221	COH, Mysuru
175	78P4	G-222	COH, Mysuru
176	83P1	G-223	COH, Mysuru
177	84P1	G-224	COH, Mysuru
178	86P2	G-225	COH, Mysuru
179	67	G-226	COH, Mysuru
180	68	G-227	COH, Mysuru
181	Nandhi	G-228	UAS, Bengaluru
182	Pant Polyhouse-2	G-229	Alahabad local
183	AR-28	G-230	COH, Mudigere
184	Anaga	G-231	Dept. of Vegetable Science, COH, Bengaluru

<b>S.N</b>	<b>Original Code</b>	<b>Field Code</b>	<b>Source of Collection</b>
185	IIHR -2195	G-233	Dept. of Vegetable Science, COH, Bengaluru
186	AR-21	G-234	COH, Mudigere
187	AR-56	G-235	COH, Mudigere
188	AR-4	G-237	COH, Mudigere
189	IIHR – 2199	G-239	Dept. of Vegetable Science, COH, Bengaluru
190	IIHR – 2198	G-240	Dept. of Vegetable Science, COH, Bengaluru
191	IIHR – 2197	G-242	Dept. of Vegetable Science, COH, Bengaluru
192	AR-29	G-244	COH, Mudigere
193	IIHR – 2196	G-246	Dept. of Vegetable Science, COH, Bengaluru
194	Utkal Local-2	G-247	Dept. of Vegetable Science, COH, Bengaluru
195	Pant Polyhouse	G-248	Alahabad local
196	Pant-3	G-249	Alahabad local
197	IIHR – 2200	G-250	Dept. of Vegetable Science, COH, Bengaluru
198	IIHR - 2201	G-251	Dept. of Vegetable Science, COH, Bengaluru
199	H-24-1	G-252	Dept. of Vegetable Science, COH, Bengaluru
200	Solan-2	G-254	COH, Mysuru
<b>Checks</b>			
1	Arka Samrat	Check-1	IIHR, Hessarghatta, Bengaluru, Karnataka
2	Arka Rakshak	Check-2	IIHR, Hessarghatta, Bengaluru, Karnataka
3	5105	Check-3	IIPR, Kanpur

**Table 3. Analysis of variance (ANOVA) for growth and yield parameters in tomato**

S.N	Source of variation	Mean sum of squares					Error
		Blocks	Entries	(a) Checks	(b) Varieties	(c) Checks Vs Varieties	
	Degrees of freedom	10	200	3	203	1	18
<b>A</b>		<b>Growth parameters</b>					
1	Plant height (cm)	164.87	456.12 **	2502.06 **	487.40 **	2683.26**	51.68
2	Number of branches/plant	1.35	2.74 **	7.34 **	2.78**	2.58*	0.46
<b>B</b>		<b>Yield parameters</b>					
3	Fruit width (cm)	0.46	0.87 **	10.96 **	0.98**	2.89**	0.14
4	Fruit length (cm)	0.59	0.97 **	7.99 **	1.05 **	1.96**	0.20
5	Fruits per plant	313.58	1160.81 **	931.26 **	1155.28**	502.04*	106.79
6	Average fruit weight (g)	172.95	312.47 **	6337.77 **	372.16**	319.86*	62.41
7	Yield per plant (kg)	0.81	1.45 **	13.01 **	1.57**	1.58*	0.31

\*Significant at 5 per cent, \*\* Significant at 1 per cent

**Table 4. Per se performance of 200 tomato genotypes for growth, yield and quality attributes**

S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
1	ARTD-1	G-1	60.33	6.67	4.90	5.95		
2	ARTD-2	G-2	65.67	4.00	4.95	6.50	52.85	2.15
3	ARTD-3	G-3	56.00	5.67	5.10	4.70	69.05	1.49
4	ARTD-4	G-4	53.00	5.67	5.55	5.20	61.25	2.95
5	ARTD-5	G-5	62.67	5.00	4.80	6.45	54.38	2.06
6	ARTD-6	G-6	63.67	3.67	4.50	4.60	56.19	3.22
7	ARTD-7	G-7	51.33	4.33	4.25	4.60	64.71	3.00
8	ARTD-8	G-8	48.33	4.00	5.10	6.45	43.80	1.02
9	AOTD-9	G-9	61.67	4.67	4.70	6.50	63.17	2.65
10	AOTD-10	G-10	58.33	4.33	4.95	6.45	51.97	2.54
11	AOTD-11	G-11	70.33	7.67	4.75	5.80	56.98	3.66
12	AOTD-12	G-12	59.67	6.00	4.50	4.45	49.62	2.43
13	AOTD-13	G-13	52.00	7.33	5.20	4.85	42.50	3.21
14	AOTD-14	G-14	45.67	7.33	4.55	4.55	44.85	4.67

S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
15	AOTD-15	G-15	53.00	6.00	5.05	4.80	43.64	3.44
16	AOTD-16	G-16	84.00	4.67	4.90	4.70	42.45	3.54
17	AOTD-17	G-17	52.00	6.33	5.20	5.05	57.70	4.16
18	AOTD-18	G-18	47.00	5.00	4.80	4.75	75.24	2.44
19	AOTD-19	G-19	58.00	5.67	4.70	5.05	52.84	4.01
20	AOTD-20	G-20	56.33	5.67	4.45	4.60	66.50	1.56
21	EC-321426	G-23	55.00	6.00	7.45	7.45	62.53	2.88
22	EC-326146	G-31	78.67	6.33	4.00	5.05	94.85	1.90
23	EC-338714	G-33	66.33	4.67	4.25	3.75	34.16	1.98
24	EC-338717	G-35	110.00	7.33	3.30	3.15	42.79	1.94
25	EC-338725	G-37	96.00	6.33	3.85	3.55	24.11	4.93
26	EC-338735	G-38	58.33	5.00	4.90	3.90	32.03	1.78
27	EC-339057	G-39	66.67	5.00	3.35	3.25	43.18	3.69
28	EC-357839	G-40	83.67	6.00	4.65	4.50	22.86	1.62
29	EC-357845	G-41	130.00	6.67	4.75	3.95	74.02	3.20
30	EC-362940	G-43	78.33	9.00	4.70	3.00	40.53	4.39
31	Punjab Varkha Bahar-1	G-46	93.33	5.00	5.75	5.80	28.98	2.30
32	PNR-1	G-47	102.67	6.67	5.55	4.90	72.90	2.84
33	S-12	G-48	63.67	4.67	4.10	3.60	61.80	2.74
34	Punjab Varkha Bahar-2	G-49	56.67	5.67	5.70	4.55	34.21	3.05
35	Hisar Lal	G-50	61.00	5.67	4.15	6.50	73.09	4.28
36	Punjab Upama	G-51	73.67	4.67	4.60	5.45	51.06	2.96
37	Punjab Chhuhar	G-52	75.00	6.33	4.20	6.50	58.12	4.40
38	Punjab Kesari	G-53	71.67	3.67	4.90	4.35	51.44	5.03
39	Punjab Ratta	G-54	69.33	6.67	5.35	6.20	40.40	1.71
40	52135	G-57	98.00	6.67	4.45	3.80	79.95	3.38
41	Azad-T-1	G-61	80.33	6.67	4.30	3.80	46.29	2.28
42	Kashi Sharad	G-62	96.00	6.33	5.35	5.45	60.52	3.80
43	Kashi Hemanth	G-63	102.33	7.67	6.35	6.70	95.00	2.63
44	Kashi Amrith	G-64	59.00	8.33	5.50	4.85	102.36	3.43
45	Kashi Anupama	G-65	51.00	6.33	6.60	4.45	67.28	5.00
46	H-86	G-66	62.00	6.00	8.15	5.85	77.77	5.59

S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
47	Kalyanpur Type	G-68	109.33	7.67	7.20	5.05	131.94	6.45
48	A Abha	G-69	72.67	5.67	5.60	4.35	48.87	3.97
49	A Saurabh	G-70	78.67	7.00	3.25	3.10	63.91	2.39
50	DT-10	G-72	94.33	9.00	6.00	4.60	52.30	2.06
51	H-24	G-73	61.00	9.00	3.85	3.75	47.80	3.54
52	PTR-4	G-75	64.33	4.67	4.20	4.15	34.78	3.87
53	PTR-6	G-76	68.00	5.00	5.10	4.75	53.18	3.96
54	Bhagyashree	G-77	58.33	6.00	6.55	5.60	74.66	5.96
55	Dhanashree	G-78	72.33	6.33	4.85	4.25	90.86	5.34
56	Pule Raja	G-79	105.67	8.00	4.95	5.40	52.05	4.47
57	Utkal Kumari	G-80	61.67	5.33	5.20	3.95	76.65	5.02
58	Utkal Deepti	G-81	64.00	6.33	3.45	3.65	56.61	3.12
59	Utkal Raja	G-82	84.00	6.33	5.25	4.30	26.13	3.54
60	Pragnya	G-83	63.67	6.00	4.40	4.05	73.31	2.71
61	Roma	G-84	68.67	5.67	4.10	6.65	35.72	3.13
62	Best of all	G-85	105.67	5.67	3.45	3.60	29.46	0.39
63	Sioux	G-86	108.33	6.33	4.85	4.15	29.69	1.68
64	PKM-1	G-87	45.33	6.33	4.60	3.65	102.22	2.52
65	Akshaya	G-88	49.33	4.00	5.60	3.95	43.85	0.51
66	Rajamundri	G-90	69.67	6.33	4.70	3.75	43.18	2.79
67	Guntur Local	G-91	66.00	5.33	5.10	3.70	56.17	2.22
68	A Alok	G-92	48.33	6.00	5.85	5.35	52.26	2.00
69	A Vikash	G-93	56.33	5.00	5.05	3.85	74.22	2.71
70	A Meghali	G-95	78.67	5.33	4.70	4.10	34.46	2.00
71	A Ahuthi	G-96	68.67	4.67	4.00	6.50	60.64	4.58
72	Madanapalli	G-98	90.00	5.67	6.30	4.70	56.02	2.41
73	Pusa Sheetal	G-99	73.00	4.00	5.05	5.00	48.19	2.50
74	Pusa Sadabahar	G-100	56.67	3.33	3.80	5.00	50.68	2.55
75	Pusa Rohini	G-101	77.00	4.33	5.80	5.25	40.27	1.20
76	Pusa Gourava	G-102	60.33	5.00	4.70	5.55	64.53	2.02
77	P-120	G-103	61.67	3.00	5.00	4.35	57.19	3.83
78	Pusa Ruby	G-104	70.00	5.67	4.50	3.60	57.70	1.38

S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
79	S-22	G-105	59.67	4.33	5.50	4.45	36.97	3.80
80	Navodaya	G-106	57.67	4.67	4.50	3.80	58.04	3.80
81	Selection	G-107	74.00	7.33	4.80	3.85	31.81	1.54
82	C-10-2	G-108	73.00	5.00	4.95	3.60	35.95	3.00
83	C-11-2	G-109	54.00	5.00	3.85	3.20	27.66	2.25
84	C-20-1	G-110	70.67	4.67	5.95	5.35	26.74	2.29
85	CO-3	G-111	49.67	5.00	5.00	4.05	63.10	4.61
86	CLN-2026	G-112	63.67	5.33	3.90	4.80	39.41	3.81
87	41	G-113	75.33	2.67	4.95	5.70	27.61	3.40
88	DVRT-2	G-114	71.67	4.33	4.85	3.75	58.35	0.61
89	EC-13904	G-116	86.67	6.00	4.35	3.65	59.06	3.21
90	C-1-4	G-119	60.33	8.33	4.95	4.00	45.58	2.33
91	C-4-1	G-120	110.67	7.67	3.10	3.40	44.46	2.47
92	EC-381263	G-121	114.33	7.67	3.20	4.00	25.67	2.07
93	EC-501574	G-123	101.67	6.67	5.80	4.30	22.64	3.02
94	EC-501580	G-124	74.67	9.00	5.15	4.40	41.85	1.73
95	EC-501583	G-126	81.67	10.00	3.90	3.10	74.64	4.04
96	EC-538404	G-129	65.00	4.67	6.15	4.80	25.70	2.61
97	EC-538405	G-130	61.67	5.00	5.50	5.35	74.65	2.87
98	EC-620383	G-133	77.67	7.00	3.20	3.50	70.93	4.13
99	EC-620398	G-134	50.67	4.33	4.05	5.35	27.92	2.47
100	EC-620401	G-135	66.33	6.00	5.20	5.20	36.53	1.08
101	EC-620446	G-136	54.00	3.67	5.05	5.80	62.49	3.81
102	EC-620464	G-137	56.67	5.33	4.85	5.00	82.28	4.28
103	EC-620469	G-138	57.00	5.33	4.40	5.80	54.46	1.03
104	EC-620470	G-139	59.33	4.67	4.10	4.25	57.08	2.61
105	Monte Fevarate	G-140	55.33	4.67	4.15	4.90	28.38	0.57
106	Rio Grande	G-141	67.00	7.33	3.30	3.45	43.36	2.13
107	Angoorlata	G-143	76.67	4.33	3.95	3.70	22.76	1.43
108	Ageta-2	G-144	59.33	5.00	5.50	5.35	28.93	0.89
109	85	G-145	96.00	7.00	4.20	4.10	57.65	1.67
110	4	G-148	99.00	8.67	4.15	4.20	42.74	1.96

S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
111	80	G-149	54.67	5.67	4.95	3.25	40.23	3.01
112	200	G-150	69.67	5.33	4.30	5.05	45.31	3.45
113	8	G-151	57.33	7.33	5.05	4.80	52.69	3.73
114	1P2	G-152	76.67	9.67	4.55	3.20	30.45	3.81
115	2P2	G-153	95.67	7.00	4.75	4.40	31.98	3.66
116	3P2	G-154	86.33	9.33	3.45	3.05	31.63	3.15
117	4P1	G-155	85.33	9.00	5.80	4.65	36.83	5.70
118	5T5P6	G-156	71.67	8.67	3.35	2.80	59.79	6.48
119	6T6P8	G-157	69.33	7.00	4.05	4.50	38.88	4.74
120	7	G-158	58.67	10.00	4.40	3.95	54.68	1.82
121	8P3	G-159	49.67	6.33	4.75	3.40	54.13	4.14
122	9P4	G-160	43.67	6.00	5.00	4.85	48.57	2.94
123	10P6	G-161	82.00	7.00	3.60	3.45	40.39	5.77
124	11P4	G-162	122.33	9.00	4.25	3.45	40.53	4.71
125	12P1	G-163	77.67	6.00	4.00	3.50	38.51	3.12
126	13P3	G-164	202.33	6.00	2.55	3.40	50.17	3.42
127	14P6	G-165	60.00	6.67	3.45	3.20	25.76	3.34
128	15P4	G-166	102.33	7.00	4.55	3.55	30.97	4.53
129	16P2	G-167	61.33	5.67	3.00	2.60	64.54	5.73
130	17P5	G-168	86.67	7.33	3.25	2.85	48.77	4.86
131	18P3	G-169	115.33	5.67	3.70	3.45	39.28	3.20
132	19P8	G-170	81.00	6.67	4.20	3.85	33.51	2.21
133	20	G-171	76.33	6.67	3.55	3.35	37.35	3.64
134	21	G-172	82.33	9.00	4.10	3.20	41.97	3.71
135	23P4	G-173	105.67	8.00	3.85	3.60	52.59	2.95
136	25P2	G-175	78.33	7.33	3.75	3.10	43.99	4.23
137	27P2	G-177	96.00	8.33	5.45	4.30	32.12	4.03
138	28P2	G-178	115.00	9.67	2.85	3.45	41.51	5.49
139	29P4	G-179	57.33	5.67	3.45	3.55	22.89	3.97
140	30P2	G-180	96.00	9.33	3.90	3.75	30.61	2.92
141	33P2	G-183	92.67	7.00	3.75	3.35	43.27	5.14
142	34P2	G-184	61.00	6.33	3.50	4.35	34.00	3.68

S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
143	35P2	G-185	68.00	8.00	5.35	3.10	59.62	3.01
144	36	G-186	73.33	5.00	4.55	4.95	43.14	3.55
145	37P2	G-187	71.67	8.00	4.55	3.65	51.75	2.21
146	38P2	G-188	87.00	6.00	4.05	3.70	36.85	2.09
147	40P4	G-190	91.33	5.00	3.05	3.00	40.03	3.69
148	43	G-193	80.67	6.67	2.85	3.00	33.89	1.91
149	44P2	G-194	86.33	7.33	4.10	3.30	31.80	1.53
150	45	G-195	84.67	7.33	4.35	3.60	52.73	1.30
151	46P5	G-196	66.00	5.33	4.15	3.90	46.48	2.38
152	47P2	G-197	59.00	5.33	3.30	2.95	63.94	2.38
153	48P4	G-198	59.00	6.33	3.65	3.90	64.45	2.45
154	51	G-201	103.33	8.33	4.10	3.50	30.85	5.60
155	53	G-202	63.67	7.33	2.70	3.75	37.83	2.63
156	54P3	G-203	79.00	8.00	4.15	3.55	40.04	3.45
157	55P2	G-204	108.67	8.33	3.85	3.25	54.25	4.97
158	56P2	G-205	80.00	6.67	3.80	4.00	54.05	3.03
159	58	G-206	62.67	7.00	4.90	3.85	52.80	2.81
160	59	G-207	44.67	8.33	4.30	3.35	73.31	2.26
161	61P4	G-208	58.33	9.00	3.40	3.60	40.29	2.20
162	62P4	G-209	88.00	7.33	2.50	3.90	35.00	2.53
163	63P3	G-210	70.67	9.00	4.05	2.60	35.00	1.72
164	64	G-211	56.67	7.67	4.00	3.50	40.68	3.54
165	65P5	G-212	87.00	9.33	5.30	2.20	77.71	2.01
166	66P1	G-213	54.33	7.33	4.00	4.45	45.52	3.82
167	70	G-214	52.33	8.33	3.10	3.60	37.44	2.72
168	71P2	G-215	51.00	7.67	3.75	4.55	27.68	1.72
169	72P2	G-216	50.33	8.33	5.05	3.15	42.79	2.67
170	73P2	G-217	95.00	9.00	2.50	2.00	61.34	2.41
171	74P5	G-218	51.00	8.00	3.95	3.05	20.00	1.92
172	75P3	G-219	54.00	6.67	4.90	3.15	46.30	3.25
173	76P1	G-220	92.00	4.00	3.90	2.95	45.31	2.50
174	77P1	G-221	92.00	6.33	3.80	4.00	28.77	0.91



S.N	Original code	Genotypes	Plant height (cm)	Number of branches/plant	Fruit width (cm)	Fruit length (cm)	Average fruit weight (g)	Yield per plant (kg/cm <sup>2</sup> )
175	78P4	G-222	113.33	6.33	2.70	2.30	50.65	1.14
176	83P1	G-223	80.67	6.67	4.65	3.05	22.97	1.62
177	84P1	G-224	60.33	5.33	3.85	5.05	47.38	2.43
178	86P2	G-225	89.67	7.00	3.85	3.90	55.51	2.93
179	67	G-226	82.00	5.67	2.85	3.30	45.15	3.40
180	68	G-227	66.67	6.67	3.80	3.40	48.53	3.09
181	Nandhi	G-228	65.33	3.33	3.45	3.85	59.26	2.40
182	Pant Polyhouse-2	G-229	107.33	6.33	4.70	4.75	31.35	2.00
183	AR-28	G-230	92.67	6.33	3.05	4.85	83.04	1.44
184	Anaga	G-231	55.33	2.67	2.65	3.00	24.25	2.23
185	IIHR-2195	G-233	67.00	3.33	3.00	3.00	35.23	2.01
186	AR-21	G-234	96.67	5.67	5.20	4.00	24.92	2.78
187	AR-56	G-235	132.67	11.33	3.20	4.00	47.71	3.39
188	AR-4	G-237	109.33	7.00	3.65	4.00	21.00	2.26
189	IHR-2199	G-239	66.00	6.00	4.00	4.30	38.21	3.27
190	IIHR-2198	G-240	75.00	4.00	4.05	4.35	38.04	2.98
191	IHR-2197	G-242	59.00	2.00	4.10	5.05	42.63	1.28
192	AR-29	G-244	93.33	8.67	3.00	3.50	30.06	2.00
193	IIHR-2196	G-246	60.00	5.67	3.25	4.45	23.47	2.49
194	Utkal Local-2	G-247	98.00	5.67	3.95	3.30	24.45	2.49
195	Pant Polyhouse	G-248	138.33	6.67	4.65	3.50	62.69	2.00
196	Pant-3	G-249	55.33	9.00	3.70	4.00	73.38	1.55
197	IIHR-2200	G-250	65.00	5.33	3.75	4.05	30.46	3.79
198	IIHR-2201	G-251	60.33	6.33	4.10	4.75	55.44	1.33
199	H-24-1	G-252	57.33	8.33	4.40	3.50	41.17	1.77
200	Solan-2	G-254	80.33	10.67	4.20	3.65	41.20	2.21

### 2.3.4 Average fruit weight

Average fruit weight in grams was computed by using the formula

$$\text{Average fruit weight (g) per fruit} = \frac{\text{Total fruit weight from all the pickings}}{\text{Total number of fruits from all the pickings}}$$

### 2.3.5 Fruit yield per plant

Fruit yield was determined by adding the total fruit weight of all the pickings from each tagged plant and expressed in kilograms (kg).

## 2.4 Statistical and Genetic Analyses

The experiments were carried out in randomized complete block design (RCBD) with ten plants in each genotype. Analysis of variance was computed for 13 characters. Highly Significant difference was observed among the genotypes for all the characters (Table 3) studied.

## 2.5 Performance of 200 Tomato Genotypes for Fruit Weight, Average Yield and Quality Attributes

Two hundred genotypes collected from different parts of India were evaluated for the growth, yield and quality parameters during summer, season 2015-16. The *per se* performance is presented in the Table 4. The plant height ranged from 43.67 (9P4) to 202.33 cm (13P3) with a population mean of 74.54 cm (Table 4). The genotypic and phenotypic variances were 365.82 and 417.51, respectively. The number of branches per plant ranged from 2.00 (IHR-2197) to 11.33 (AR-56) with an average of 6.34 branches per plant. The GV and PV were 2.06 and 2.52, respectively. Fruit width (cm) of the tomato shown Wide variability was observed for fruit width in tomato. The width of tomato fruit ranged between 2.50 (62P4) and 8.15 cm (H-86). The average fruit width was 4.41cm. Fruit length (cm), wide variability was observed for tomato fruit length. The length of tomato fruit ranged between 2.00 cm (73P2) and 7.45 cm (EC-321426). The average fruit length was recorded as 4.21 cm. Average fruit weight (g), highest average fruit weight was observed in H-86 (131.94 g) and the lowest in 73P2 (20.00 g) with over all mean of 48.47 g. The average total tomato fruit yield recorded per plant was 2.96 kg.

## 3. RESULTS AND DISCUSSION

With respect to the growth parameter the genotype 13P3 recorded highest plant height

(202.33 cm) followed by Pant Polyhouse (138.33 cm) at final harvesting stage [6,7] indicated that, different genotypes recorded the different heights due to each genotype having different potential of growth. With regard to number of branches per plant, the genotype AR-56 (11.33) recorded maximum branches per plant at final harvesting stage.

Among yield and yield related attributes yield per plant is very important trait as it is dependent character. The highest yield per plant was recorded in genotype 6.48 kg (4P1) followed by H-86 (6.45 kg), PTR-6 (5.96 kg) because increase in yield per plant in these germplasm was due to higher number of fruits per plant in 4P1 (108.31) followed by H-86 (48.85) and PTR-6 (79.80) [6,7], Maximum average fruit weight is observed in H-86 (131.94) [6,7,8,9]. Vegetable improvement for yield and quality needs a sound knowledge on the genetic architecture of the crop and inheritance of economic characters are of great interest to the breeder. Tomato is one of the important and most demanded vegetable crop [10]. Therefore, improvement of tomato productivity with quality and high nutritional value and resistance to diseases can play significant role in the overall production and nutritional security.

## 4. CONCLUSION

Considering the mean performance, five superior genotypes for fruit yield may be utilized as parents after multi location, multi seasonal studies. Hence, the identified superior genotypes should be utilized in further improvement studies through various breeding strategies. Genetic diversity is largely contributed by number of fruits per plant and average fruit weight and plant height. Thus, these characters may be given high emphasis while selecting the lines for hybridization programme to generate large variability and it will provide immense scope for improvement of yield through selection.

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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