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## Comparative performance of dual purpose tomato hybrids for yield and processing traits

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**Abstract**

The experiment was conducted to evaluate the comparative performance of forty four tomato hybrids at Vegetable Research Station, Rajendranagar, Hyderabad, Telangana during 2015-16. There was significant differences among the characters studied. Crosses EC-620360 × Pusa Ruby and EC-619982 × EC-620557 exhibited significant values for fruit yield per plant (3.13 kg, 3.04 kg), pericarp thickness (4.24 mm, 4.73 mm), total soluble solids (5.37<sup>0</sup>Brix, 4.92<sup>0</sup>Brix), fruit pH (4.39, 4.94), titrable acidity (0.47%, 0.39%), ascorbic acid content (27.21 mg/100g, 22.69 mg/100g), total sugars (4.12%, 4.30%), reducing sugars (2.90%, 3.58%) and lycopene content (6.63 mg/100g, 8.60 mg/100g) are suitable for processing purpose. EC-608415 × Arka Abha with higher fruit yield per plant (3.29 kg), pericarp thickness (4.03 mm), total soluble solids (4.71<sup>0</sup>Brix), fruit pH (4.87), titrable acidity (0.42%), ascorbic acid content (21.42 mg/100g), total sugars (3.62%), reducing sugars (2.97%) and lycopene content (6.32 mg/100g) is suitable for culinary purpose and EC-608415 × Punjab Chhuhara with significant fruit yield per plant (3.04 kg), pericarp thickness (4.21 mm), total soluble solids (4.59<sup>0</sup>Brix), fruit pH (4.81), titrable acidity (0.45%), ascorbic acid content (22.38 mg/100g), total sugars (3.77%), reducing sugars (3.08%) and lycopene content (6.83 mg/100g) is suitable for dual purpose (culinary and processing). The potential of these hybrids to be further tested under the other climatic conditions to elicit substantial conclusions.

**Keywords:** comparative performance, tomato, yield and processing

**Introduction**

Tomato (*Solanum lycopersicum* L., 2n=24) is a widely grown vegetable in the world in varying climatic conditions. It is consumed fresh as salad and in processed forms like soup, sauce, ketchup, paste, puree, powder and canned whole fruit *etc.* and tops the list of processed vegetables. Tomato is a versatile fruit; it contains most powerful anti-oxidant, lycopene which have effective anti-cancer properties (Islam *et al.*, 2010) [3]. Tomato flushes out free radicals, protect against inflammation, heart diseases and prevent DNA damage in human body. It is also used for preparation of natural beauty cosmetics (Mahajan *et al.*, 2010) [7].

Most of the farmers in Telangana cultivate tomato under rainfed conditions due to which there will be heavy glut in the markets at peak harvesting stage. Because of which farmers may not meet the expenses incurred for its cultivation. Moreover, there are no popular hybrids which can serve dual purpose for meeting the needs of the processing industries and consumers. Most of the commercial hybrids developed are either for culinary or processing purposes. By developing dual purpose types farmers can sell the produce to processing industries when there is severe glut compensating the low prices of markets.

Keeping in view the above facts the present investigation has been taken up the objective to study the mean performance of different F1 hybrids developed and to find out the promising ones suitable for fresh market, processing and dual purpose.

**Materials and Methods**

The experiment was conducted during 2015-16 at Vegetable Research Station of Sri Konda Lakshman Telangan State Horticultural University at Hyderabad which falls under the Southern Telangana Zone and is situated at an altitude of 542.6 m above mean sea level. Geographically the experimental area lies at latitude of 17.19<sup>0</sup> N and a longitude of 79.23<sup>0</sup> E. The treatments comprise thirty F1 hybrids (five lines and six testers crossed in line × tester fashion) of tomato along with eleven parents and three commercial checks (US-440, Arka Rakshak and NS-516). The experimental material was evaluated in a Randomized Block Design with three replications under three diverse time at one month interval tailored at single location (Vegetable Research Station, Rajendranagar, Hyderabad).

Necessary prophylactic measures were taken up to ensure good crop stand. Five plants were tagged for recording ten quantitative and qualitative traits viz., plant height (cm), fruit yield per plant (kg), pericarp thickness (mm), total soluble solids (°Brix), fruit pH, titrable acidity (%), ascorbic acid content (mg/100g), total sugars (%), reducing sugars (%) and lycopene content (mg/100g). The data was subjected to statistical analysis as per the methods outlined by Panse and Sukhatme (1985) [8] and the results were analysed. Collected data were analyzed statistically and treatment means were compared by Duncan Multiple Range Test (DMRT).

## Results and Discussion

The mean values of parents, hybrids and standard checks for ten characters in three different dates of sowing (at monthly intervals) and in pooled analysis are presented in Table 1 to 5. There existed significant variability among the parents and hybrids for all the characters. This is an essential pre requisite for further study of the genotypes. The character wise, mean performance of the genotypes is presented below.

**Table 1:** Mean performance of parents and hybrids for plant height (cm) and fruit yield per plant (kg) over environments and pooled

Genotypes		Plant height (cm)				Fruit yield per plant (kg)			
		E1	E2	E3	Pooled	E1	E2	E3	Pooled
<b>Lines</b>									
L <sub>1</sub>	EC-620407	97.19	101.96	104.61	101.25	1.82	1.92	2.06	1.93
L <sub>2</sub>	EC-620428	106.86	102.32	106.38	105.19	1.88	1.89	2.01	1.93
L <sub>3</sub>	EC-620360	103.88	103.84	109.55	105.76	1.74	1.73	1.90	1.79
L <sub>4</sub>	EC-608415	87.84	88.69	91.01	89.18	1.87	1.97	1.99	1.94
L <sub>5</sub>	EC-619982	83.82	89.15	92.49	88.49	1.73	1.73	1.83	1.76
	Mean	95.91	97.19	100.81	97.97	1.81	1.85	1.96	1.87
<b>Testers</b>									
T <sub>1</sub>	Arka Saurabh	85.66	85.56	87.43	86.22	1.19	1.22	1.25	1.22
T <sub>2</sub>	Arka Abha	87.15	95.47	97.51	93.38	1.31	1.28	1.31	1.30
T <sub>3</sub>	Punjab Chhuhara	91.34	86.45	96.42	91.41	1.40	1.45	1.44	1.43
T <sub>4</sub>	Pusa Ruby	114.40	103.06	116.06	111.17	1.62	1.64	1.73	1.67
T <sub>5</sub>	EC-520078	156.58	170.58	182.45	169.87	1.12	1.12	1.14	1.13
T <sub>6</sub>	EC-620557	125.26	134.26	144.26	134.59	1.41	1.47	1.52	1.46
	Mean	110.06	112.57	120.69	114.44	1.35	1.37	1.40	1.37
	Parental mean	103.63	105.57	111.65	106.96	1.55	1.58	1.65	1.60
<b>Crosses</b>									
C <sub>1</sub>	EC-620407 × Arka Saurabh	84.19	90.05	95.17	89.80	2.21	2.26	2.36	2.28
C <sub>2</sub>	EC-620407 × Arka Abha	94.14	97.96	110.91	101.01	2.17	2.27	2.41	2.28
C <sub>3</sub>	EC-620407 × Punjab Chhuhara	84.27	92.49	95.33	90.70	2.34	2.51	2.56	2.47
C <sub>4</sub>	EC-620407 × Pusa Ruby	100.37	115.04	121.84	112.42	2.53	2.65	2.74	2.64
C <sub>5</sub>	EC-620407 × EC-520078	168.99	177.66	193.31	179.99	1.49	1.68	1.64	1.61
C <sub>6</sub>	EC-620407 × EC-620557	120.20	130.80	137.42	129.48	2.18	2.12	2.29	2.20
C <sub>7</sub>	EC-620428 × Arka Saurabh	91.52	97.83	109.14	99.50	2.01	2.19	2.18	2.13
C <sub>8</sub>	EC-620428 × Arka Abha	101.70	109.33	112.71	107.92	1.89	2.09	2.08	2.02
C <sub>9</sub>	EC-620428 × Punjab Chhuhara	85.75	94.35	105.84	95.31	2.09	2.15	2.22	2.15
C <sub>10</sub>	EC-620428 × Pusa Ruby	99.40	107.89	115.15	107.48	2.66	2.75	2.77	2.72
C <sub>11</sub>	EC-620428 × EC-520078	185.21	203.18	192.05	193.48	1.67	1.84	1.83	1.78
C <sub>12</sub>	EC-620428 × EC-620557	104.73	125.30	137.79	122.60	2.14	2.24	2.38	2.25
C <sub>13</sub>	EC-620360 × Arka Saurabh	100.52	118.10	128.38	115.67	2.23	2.38	2.60	2.40
C <sub>14</sub>	EC-620360 × Arka Abha	93.60	108.65	115.97	106.07	1.82	1.90	2.03	1.92
C <sub>15</sub>	EC-620360 × Punjab Chhuhara	96.26	112.65	125.75	111.55	2.77	2.83	2.90	2.83
C <sub>16</sub>	EC-620360 × Pusa Ruby	109.74	121.94	131.92	121.20	3.12	3.12	3.15	3.13
C <sub>17</sub>	EC-620360 × EC-520078	159.35	173.01	171.64	168.00	2.00	2.05	1.63	1.89
C <sub>18</sub>	EC-620360 × EC-620557	133.54	150.20	161.87	148.54	2.44	2.52	2.57	2.51
C <sub>19</sub>	EC-608415 × Arka Saurabh	84.27	91.94	99.23	91.81	2.81	2.84	3.02	2.89
C <sub>20</sub>	EC-608415 × Arka Abha	83.40	94.91	102.82	93.71	3.28	3.30	3.32	3.30
C <sub>21</sub>	EC-608415 × Punjab Chhuhara	80.90	91.88	106.71	93.17	3.21	3.23	3.25	3.23
C <sub>22</sub>	EC-608415 × Pusa Ruby	119.87	126.46	134.24	126.85	2.65	2.74	2.86	2.75
C <sub>23</sub>	EC-608415 × EC-520078	170.67	176.48	200.65	182.60	1.92	1.97	2.10	2.00
C <sub>24</sub>	EC-608415 × EC-620557	140.86	153.09	163.72	152.56	2.84	2.85	2.87	2.85
C <sub>25</sub>	EC-619982 × Arka Saurabh	80.18	81.07	93.62	84.96	1.83	1.91	2.09	1.94
C <sub>26</sub>	EC-619982 × Arka Abha	91.66	101.22	111.04	101.31	2.18	2.23	2.29	2.23
C <sub>27</sub>	EC-619982 × Punjab Chhuhara	93.78	97.52	113.29	101.53	2.26	2.35	2.46	2.36
C <sub>28</sub>	EC-619982 × Pusa Ruby	99.50	110.79	126.38	112.22	2.41	2.56	2.65	2.54
C <sub>29</sub>	EC-619982 × EC-520078	191.84	191.84	175.98	186.55	1.94	2.03	2.10	2.02
C <sub>30</sub>	EC-619982 × EC-620557	116.74	125.38	144.19	128.77	3.02	3.05	3.06	3.04
	Crosses mean	112.23	122.29	131.13	121.89	2.33	2.42	2.48	2.41
<b>Checks</b>									
	US-440	87.71	86.07	90.05	87.72	1.97	2.14	2.23	2.11
	Arka Rakshak	91.03	95.45	98.90	95.12	2.79	2.92	3.16	2.95
	NS-516	84.75	82.51	84.84	84.03	1.96	1.99	2.06	2.00
	G. Mean	109.93	117.81	125.90	115.90	2.12	2.19	2.25	2.20

SE.D.	3.39	4.07	3.99	2.60	0.05	0.06	0.07	0.04
C.D. (0.05)	6.78	8.15	8.00	6.10	0.10	0.13	0.14	0.08
C.D. (0.01)	9.03	10.85	10.64	8.14	0.13	0.17	0.18	0.10

**Table 2:** Mean performance of parents and hybrids for pericarp thickness (mm) and fruit pH over environments and pooled

Genotypes		Pericarp thickness (mm)				Fruit pH			
		E1	E2	E3	Pooled	E1	E2	E3	Pooled
Lines									
L <sub>1</sub>	EC-620407	4.65	5.23	5.28	5.05	4.04	4.08	4.14	4.08
L <sub>2</sub>	EC-620428	3.83	3.79	3.98	3.86	4.79	4.61	4.87	4.76
L <sub>3</sub>	EC-620360	4.32	4.28	4.52	4.37	4.42	4.45	4.50	4.45
L <sub>4</sub>	EC-608415	4.27	4.27	4.37	4.30	5.04	4.98	5.14	5.05
L <sub>5</sub>	EC-619982	4.00	3.41	4.03	3.81	4.37	4.36	4.48	4.40
Mean		4.21	4.20	4.44	4.28	4.53	4.50	4.63	4.55
Testers									
T <sub>1</sub>	Arka Saurabh	4.18	4.21	4.31	4.23	4.45	4.45	4.54	4.48
T <sub>2</sub>	Arka Abha	4.44	4.44	4.54	4.47	4.49	4.49	4.56	4.51
T <sub>3</sub>	Punjab Chhuhara	4.74	4.84	4.94	4.84	4.34	4.34	4.44	4.37
T <sub>4</sub>	Pusa Ruby	2.71	2.83	2.93	2.82	4.09	4.09	4.21	4.13
T <sub>5</sub>	EC-520078	0.91	0.97	1.01	0.96	5.36	5.19	5.24	5.26
T <sub>6</sub>	EC-620557	4.46	4.21	4.98	4.55	5.23	5.16	5.39	5.26
Mean		3.57	3.59	3.79	3.65	4.66	4.62	4.72	4.67
Parental mean		3.86	3.86	4.08	3.94	4.60	4.56	4.68	4.62
Crosses									
C <sub>1</sub>	EC-620407 × Arka Saurabh	4.18	5.48	4.25	4.64	4.38	4.37	4.36	4.37
C <sub>2</sub>	EC-620407 × Arka Abha	3.50	3.64	3.76	3.63	4.40	4.39	4.38	4.39
C <sub>3</sub>	EC-620407 × Punjab Chhuhara	4.34	4.39	4.48	4.40	4.51	4.50	4.51	4.50
C <sub>4</sub>	EC-620407 × Pusa Ruby	3.53	3.61	3.62	3.59	4.20	4.19	4.25	4.21
C <sub>5</sub>	EC-620407 × EC-520078	1.09	1.21	1.42	1.24	4.73	4.72	4.71	4.72
C <sub>6</sub>	EC-620407 × EC-620557	4.29	4.28	4.34	4.30	4.79	4.77	4.75	4.77
C <sub>7</sub>	EC-620428 × Arka Saurabh	4.22	4.37	4.48	4.36	4.76	4.74	4.73	4.74
C <sub>8</sub>	EC-620428 × Arka Abha	3.62	3.81	3.94	3.79	4.77	4.75	4.74	4.75
C <sub>9</sub>	EC-620428 × Punjab Chhuhara	3.42	3.52	3.81	3.58	4.51	4.50	4.48	4.49
C <sub>10</sub>	EC-620428 × Pusa Ruby	3.10	3.14	3.16	3.13	4.58	4.56	4.53	4.55
C <sub>11</sub>	EC-620428 × EC-520078	1.08	2.10	2.06	1.75	5.09	5.08	5.06	5.08
C <sub>12</sub>	EC-620428 × EC-620557	4.00	4.14	4.03	4.06	5.15	5.12	5.14	5.13
C <sub>13</sub>	EC-620360 × Arka Saurabh	4.32	4.46	4.54	4.44	4.59	4.57	4.59	4.58
C <sub>14</sub>	EC-620360 × Arka Abha	4.34	4.56	4.61	4.50	4.53	4.57	4.58	4.56
C <sub>15</sub>	EC-620360 × Punjab Chhuhara	4.09	4.15	4.30	4.18	4.52	4.50	4.55	4.52
C <sub>16</sub>	EC-620360 × Pusa Ruby	4.19	4.24	4.32	4.25	4.39	4.37	4.43	4.39
C <sub>17</sub>	EC-620360 × EC-520078	1.55	1.74	1.84	1.71	4.93	4.90	4.85	4.89
C <sub>18</sub>	EC-620360 × EC-620557	4.35	4.63	4.82	4.60	4.98	4.95	4.94	4.95
C <sub>19</sub>	EC-608415 × Arka Saurabh	3.89	4.04	4.13	4.02	4.89	4.86	4.86	4.87
C <sub>20</sub>	EC-608415 × Arka Abha	4.05	4.00	4.06	4.04	4.90	4.88	4.86	4.87
C <sub>21</sub>	EC-608415 × Punjab Chhuhara	4.13	4.19	4.31	4.21	4.84	4.80	4.80	4.81
C <sub>22</sub>	EC-608415 × Pusa Ruby	3.70	3.88	3.99	3.86	4.70	4.68	4.70	4.69
C <sub>23</sub>	EC-608415 × EC-520078	0.92	0.87	0.99	0.93	5.22	5.16	5.20	5.19
C <sub>24</sub>	EC-608415 × EC-620557	4.68	4.73	4.83	4.75	5.26	5.20	5.26	5.24
C <sub>25</sub>	EC-619982 × Arka Saurabh	4.58	4.65	4.62	4.62	4.56	4.55	4.53	4.54
C <sub>26</sub>	EC-619982 × Arka Abha	4.17	4.40	4.42	4.33	4.58	4.49	4.44	4.50
C <sub>27</sub>	EC-619982 × Punjab Chhuhara	3.80	3.94	4.16	3.97	4.50	4.49	4.48	4.48
C <sub>28</sub>	EC-619982 × Pusa Ruby	4.49	4.55	4.72	4.59	4.38	4.37	4.33	4.35
C <sub>29</sub>	EC-619982 × EC-520078	1.94	2.10	2.16	2.07	4.96	4.88	4.84	4.89
C <sub>30</sub>	EC-619982 × EC-620557	4.42	4.74	5.06	4.74	4.97	4.95	4.91	4.94
Crosses mean		3.59	3.78	3.84	3.74	4.71	4.69	4.69	4.70
Checks									
US-440		3.49	3.55	3.33	3.46	4.92	4.98	4.94	4.94
Arka Rakshak		4.67	4.80	5.10	4.85	4.78	4.71	4.85	4.78
NS-516		4.86	4.97	5.13	4.98	4.44	4.59	4.61	4.54
G. Mean		3.67	3.80	3.90	3.83	4.68	4.66	4.69	4.68
SE.D.		0.09	0.08	0.06	0.16	0.02	0.03	0.03	0.04
C.D. (0.05)		0.19	0.17	0.13	0.33	0.04	0.07	0.06	0.08
C.D. (0.01)		0.25	0.23	0.17	0.44	0.05	0.09	0.08	0.10

**Table 3:** Mean performance of parents and hybrids for total soluble solids (°Brix) and titrable acidity (%) over environments and pooled

Genotypes		Total soluble solids (°Brix)				Titrable acidity (%)			
		E1	E2	E3	Pooled	E1	E2	E3	Pooled
Lines									
L <sub>1</sub>	EC-620407	4.22	4.22	4.26	4.23	0.43	0.37	0.42	0.41
L <sub>2</sub>	EC-620428	4.99	5.03	5.09	5.03	0.35	0.39	0.38	0.37
L <sub>3</sub>	EC-620360	4.42	4.26	4.42	4.36	0.44	0.35	0.48	0.43
L <sub>4</sub>	EC-608415	4.85	4.45	4.95	4.75	0.37	0.38	0.39	0.38
L <sub>5</sub>	EC-619982	4.71	4.64	4.81	4.72	0.33	0.35	0.38	0.36
Mean		4.64	4.52	4.71	4.62	0.38	0.37	0.41	0.39
Testers									
T <sub>1</sub>	Arka Saurabh	4.24	4.22	4.32	4.26	0.36	0.35	0.41	0.38
T <sub>2</sub>	Arka Abha	4.28	4.28	4.38	4.31	0.44	0.37	0.45	0.42
T <sub>3</sub>	Punjab Chhuhara	4.04	4.10	4.18	4.11	0.36	0.37	0.40	0.38
T <sub>4</sub>	Pusa Ruby	5.06	5.06	5.19	5.10	0.39	0.38	0.44	0.40
T <sub>5</sub>	EC-520078	5.62	6.27	6.36	6.08	0.41	0.31	0.39	0.37
T <sub>6</sub>	EC-620557	5.12	5.06	5.15	5.11	0.35	0.31	0.36	0.35
Mean		4.73	4.84	4.93	4.83	0.38	0.35	0.41	0.38
Parental mean		4.68	4.69	4.83	4.74	0.38	0.36	0.41	0.39
Crosses									
C <sub>1</sub>	EC-620407 × Arka Saurabh	4.42	4.39	4.33	4.38	0.46	0.31	0.45	0.41
C <sub>2</sub>	EC-620407 × Arka Abha	4.44	4.37	4.33	4.37	0.45	0.44	0.43	0.44
C <sub>3</sub>	EC-620407 × Punjab Chhuhara	4.50	4.31	4.23	4.34	0.49	0.35	0.44	0.43
C <sub>4</sub>	EC-620407 × Pusa Ruby	4.72	4.74	4.71	4.72	0.44	0.44	0.41	0.43
C <sub>5</sub>	EC-620407 × EC-520078	5.24	5.30	5.31	5.28	0.43	0.45	0.42	0.43
C <sub>6</sub>	EC-620407 × EC-620557	4.76	4.74	4.71	4.73	0.42	0.42	0.41	0.42
C <sub>7</sub>	EC-620428 × Arka Saurabh	4.82	4.77	4.70	4.76	0.44	0.44	0.42	0.43
C <sub>8</sub>	EC-620428 × Arka Abha	4.76	4.75	4.72	4.74	0.45	0.43	0.44	0.44
C <sub>9</sub>	EC-620428 × Punjab Chhuhara	4.74	4.68	4.62	4.67	0.43	0.42	0.40	0.42
C <sub>10</sub>	EC-620428 × Pusa Ruby	5.23	5.16	4.99	5.12	0.46	0.44	0.42	0.44
C <sub>11</sub>	EC-620428 × EC-520078	5.47	5.67	5.62	5.58	0.43	0.42	0.41	0.42
C <sub>12</sub>	EC-620428 × EC-620557	5.20	4.81	5.16	5.05	0.42	0.40	0.39	0.41
C <sub>13</sub>	EC-620360 × Arka Saurabh	4.36	4.33	4.36	4.35	0.48	0.36	0.46	0.43
C <sub>14</sub>	EC-620360 × Arka Abha	4.47	4.38	4.42	4.42	0.52	0.39	0.50	0.47
C <sub>15</sub>	EC-620360 × Punjab Chhuhara	4.31	4.31	4.33	4.31	0.50	0.41	0.47	0.46
C <sub>16</sub>	EC-620360 × Pusa Ruby	5.39	5.37	5.36	5.37	0.37	0.42	0.38	0.39
C <sub>17</sub>	EC-620360 × EC-520078	5.53	5.45	5.39	5.45	0.48	0.38	0.46	0.44
C <sub>18</sub>	EC-620360 × EC-620557	4.84	4.84	4.76	4.81	0.46	0.39	0.44	0.43
C <sub>19</sub>	EC-608415 × Arka Saurabh	4.76	4.72	4.62	4.70	0.44	0.40	0.43	0.42
C <sub>20</sub>	EC-608415 × Arka Abha	4.74	4.73	4.66	4.71	0.49	0.43	0.44	0.45
C <sub>21</sub>	EC-608415 × Punjab Chhuhara	4.64	4.60	4.56	4.59	0.42	0.44	0.42	0.43
C <sub>22</sub>	EC-608415 × Pusa Ruby	5.22	5.14	5.08	5.14	0.45	0.45	0.42	0.44
C <sub>23</sub>	EC-608415 × EC-520078	5.61	5.53	5.58	5.57	0.42	0.42	0.36	0.40
C <sub>24</sub>	EC-608415 × EC-620557	5.23	5.15	5.06	5.14	0.42	0.41	0.32	0.38
C <sub>25</sub>	EC-619982 × Arka Saurabh	4.66	4.65	4.57	4.63	0.42	0.41	0.39	0.41
C <sub>26</sub>	EC-619982 × Arka Abha	4.71	4.71	4.62	4.68	0.45	0.43	0.41	0.43
C <sub>27</sub>	EC-619982 × Punjab Chhuhara	4.61	4.58	4.47	4.55	0.42	0.41	0.40	0.41
C <sub>28</sub>	EC-619982 × Pusa Ruby	5.18	5.10	5.01	5.09	0.43	0.42	0.34	0.40
C <sub>29</sub>	EC-619982 × EC-520078	5.83	5.85	5.83	5.83	0.43	0.41	0.34	0.39
C <sub>30</sub>	EC-619982 × EC-620557	5.02	4.92	4.84	4.92	0.41	0.40	0.31	0.37
Crosses mean		4.91	4.86	4.83	4.87	0.44	0.41	0.41	0.42
Checks									
US-440		4.62	4.63	5.77	4.67	0.47	0.44	0.34	0.42
Arka Rakshak		4.93	5.04	5.27	5.07	0.36	0.37	0.38	0.37
NS-516		4.34	4.33	4.35	4.34	0.40	0.40	0.26	0.35
G. Mean		4.85	4.82	4.83	4.82	0.43	0.39	0.41	0.41
SE.D.		0.05	0.06	0.05	0.09	0.01	0.01	0.01	0.03
C.D. (0.05)		0.10	0.13	0.10	0.18	0.02	0.01	0.02	0.07
C.D. (0.01)		0.14	0.18	0.14	0.24	0.03	0.02	0.03	0.09

**Table 4:** Mean performance of parents and hybrids for ascorbic acid content (mg/100 g) and total sugars (%) over environments and pooled

Genotypes		Ascorbic acid content (mg/100 g)				Total sugars (%)			
		E1	E2	E3	Pooled	E1	E2	E3	Pooled
Lines									
L <sub>1</sub>	EC-620407	16.22	17.14	17.33	16.90	3.50	3.50	3.65	3.55
L <sub>2</sub>	EC-620428	22.10	23.49	24.36	23.32	3.33	3.30	3.43	3.35
L <sub>3</sub>	EC-620360	27.01	25.89	28.46	27.12	3.68	3.66	3.78	3.71
L <sub>4</sub>	EC-608415	18.40	17.82	18.82	18.35	3.80	4.08	4.01	3.96
L <sub>5</sub>	EC-619982	24.91	25.48	22.93	24.44	4.11	4.13	4.24	4.16
	Mean	21.73	21.97	22.38	22.03	3.68	3.74	3.83	3.75
Testers									
T <sub>1</sub>	Arka Saurabh	24.17	21.90	24.20	23.42	3.61	3.62	3.71	3.65
T <sub>2</sub>	Arka Abha	24.65	25.15	26.15	25.32	3.22	3.19	3.29	3.23
T <sub>3</sub>	Punjab Chhuhara	26.57	25.79	28.01	26.79	3.54	3.60	3.69	3.61
T <sub>4</sub>	Pusa Ruby	25.01	25.40	26.24	25.55	2.83	2.75	2.85	2.81
T <sub>5</sub>	EC-520078	27.30	27.31	27.84	27.48	2.09	2.13	2.15	2.12
T <sub>6</sub>	EC-620557	16.62	16.15	16.97	16.58	4.21	4.18	4.30	4.23
	Mean	24.05	23.62	24.91	24.19	3.25	3.25	3.34	3.28
	Parental mean	23.00	22.86	23.75	23.21	3.45	3.47	3.55	3.49
Crosses									
C <sub>1</sub>	EC-620407 × Arka Saurabh	19.22	19.20	19.17	19.20	3.66	3.71	3.73	3.70
C <sub>2</sub>	EC-620407 × Arka Abha	21.68	21.66	21.62	21.65	3.32	3.35	3.35	3.34
C <sub>3</sub>	EC-620407 × Punjab Chhuhara	22.61	22.59	22.56	22.59	3.59	3.66	3.73	3.66
C <sub>4</sub>	EC-620407 × Pusa Ruby	21.68	21.72	21.65	21.68	3.13	3.20	3.21	3.18
C <sub>5</sub>	EC-620407 × EC-520078	21.52	21.40	21.44	21.45	2.48	2.53	2.63	2.54
C <sub>6</sub>	EC-620407 × EC-620557	17.09	17.07	17.00	17.05	4.09	4.17	4.22	4.16
C <sub>7</sub>	EC-620428 × Arka Saurabh	24.17	24.20	24.17	24.18	3.56	3.53	3.70	3.60
C <sub>8</sub>	EC-620428 × Arka Abha	25.16	25.18	25.05	25.13	3.38	3.42	3.48	3.43
C <sub>9</sub>	EC-620428 × Punjab Chhuhara	26.42	26.07	25.99	26.16	3.60	3.67	3.72	3.66
C <sub>10</sub>	EC-620428 × Pusa Ruby	24.86	25.21	25.17	25.08	4.38	3.18	3.21	3.59
C <sub>11</sub>	EC-620428 × EC-520078	24.93	24.91	24.57	24.80	2.51	2.58	2.60	2.56
C <sub>12</sub>	EC-620428 × EC-620557	20.60	20.58	20.33	20.50	4.15	4.25	4.33	4.24
C <sub>13</sub>	EC-620360 × Arka Saurabh	25.83	26.22	26.11	26.06	3.63	3.70	3.76	3.70
C <sub>14</sub>	EC-620360 × Arka Abha	27.14	27.21	27.14	27.16	3.66	3.78	4.42	3.95
C <sub>15</sub>	EC-620360 × Punjab Chhuhara	28.03	28.14	28.11	28.09	3.58	3.67	4.33	3.86
C <sub>16</sub>	EC-620360 × Pusa Ruby	27.18	27.27	27.20	27.22	3.48	3.53	5.36	4.13
C <sub>17</sub>	EC-620360 × EC-520078	27.08	27.07	26.95	27.03	2.15	2.21	5.39	3.25
C <sub>18</sub>	EC-620360 × EC-620557	22.65	22.63	22.38	22.55	3.93	4.06	4.09	4.03
C <sub>19</sub>	EC-608415 × Arka Saurabh	21.45	21.43	21.39	21.42	3.80	3.89	3.96	3.89
C <sub>20</sub>	EC-608415 × Arka Abha	22.41	22.40	22.35	22.39	3.58	3.60	3.68	3.62
C <sub>21</sub>	EC-608415 × Punjab Chhuhara	23.31	23.33	23.94	23.53	3.70	3.78	3.84	3.77
C <sub>22</sub>	EC-608415 × Pusa Ruby	22.43	22.44	22.38	22.42	3.68	3.80	3.88	3.79
C <sub>23</sub>	EC-608415 × EC-520078	22.27	22.25	22.17	22.23	2.02	2.11	2.17	2.10
C <sub>24</sub>	EC-608415 × EC-620557	17.84	17.81	17.65	17.76	4.02	4.03	4.13	4.06
C <sub>25</sub>	EC-619982 × Arka Saurabh	23.50	23.48	23.30	23.43	4.16	4.32	4.38	4.29
C <sub>26</sub>	EC-619982 × Arka Abha	24.79	24.46	24.34	24.53	3.86	3.85	3.93	3.88
C <sub>27</sub>	EC-619982 × Punjab Chhuhara	25.67	25.38	25.22	25.42	3.59	3.70	3.78	3.69
C <sub>28</sub>	EC-619982 × Pusa Ruby	24.49	24.50	24.35	24.45	3.83	3.89	3.96	3.89
C <sub>29</sub>	EC-619982 × EC-520078	24.33	24.30	22.38	23.67	2.51	2.60	2.68	2.60
C <sub>30</sub>	EC-619982 × EC-620557	19.89	19.87	28.34	22.70	4.17	4.33	4.41	4.30
	Crosses mean	23.34	23.33	23.48	23.38	3.50	3.53	3.80	3.61
Checks									
	US-440	17.72	17.77	17.74	17.74	3.83	3.91	3.94	3.89
	Arka Rakshak	22.15	24.41	25.04	23.86	3.60	3.64	3.83	3.69
	NS-516	18.72	18.26	18.21	18.40	3.65	3.55	3.63	3.61
	G. Mean	23.24	23.20	23.55	23.11	3.49	3.51	3.73	3.59
	SE.D.	0.24	0.18	0.29	0.36	0.03	0.02	0.03	0.11
	C.D. (0.05)	0.48	0.36	0.58	0.72	0.07	0.04	0.05	0.22
	C.D. (0.01)	0.64	0.49	0.77	0.97	0.09	0.06	0.07	0.30

**Table 5:** Mean performance of parents and hybrids for reducing sugars (%) and lycopene content (mg/100 g) over environments and pooled

Genotypes		Reducing sugars (%)				Lycopene content (mg/100 g)			
		E1	E2	E3	Pooled	E1	E2	E3	Pooled
Lines									
L <sub>1</sub>	EC-620407	3.24	3.15	3.33	3.24	5.64	6.04	6.45	6.05
L <sub>2</sub>	EC-620428	2.85	2.85	2.95	2.88	7.09	6.82	7.90	7.27
L <sub>3</sub>	EC-620360	2.86	2.84	2.96	2.88	6.49	6.49	7.46	6.81
L <sub>4</sub>	EC-608415	3.53	3.34	3.70	3.52	6.29	5.98	6.98	6.42
L <sub>5</sub>	EC-619982	3.75	3.60	3.82	3.73	7.64	7.76	8.55	7.99
Mean		3.25	3.16	3.36	3.25	6.63	6.62	7.47	6.91
Testers									
T <sub>1</sub>	Arka Saurabh	2.75	2.72	2.85	2.77	5.06	5.00	5.13	5.07
T <sub>2</sub>	Arka Abha	2.40	2.40	2.50	2.43	5.73	5.71	5.85	5.77
T <sub>3</sub>	Punjab Chhuhara	3.14	3.21	3.31	3.22	6.33	6.51	6.76	6.54
T <sub>4</sub>	Pusa Ruby	2.33	2.34	2.42	2.36	6.10	6.04	6.15	6.10
T <sub>5</sub>	EC-520078	1.53	1.60	1.61	1.58	8.18	8.38	9.14	8.57
T <sub>6</sub>	EC-620557	3.69	3.60	3.85	3.71	7.64	7.70	8.71	8.02
Mean		2.64	2.65	2.76	2.68	6.50	6.56	6.96	6.68
Parental mean		2.91	2.87	3.03	2.94	6.56	6.58	7.19	6.78
Crosses									
C <sub>1</sub>	EC-620407 × Arka Saurabh	3.04	3.09	3.12	3.09	5.83	5.80	6.01	5.88
C <sub>2</sub>	EC-620407 × Arka Abha	2.54	2.60	2.67	2.60	5.94	6.09	6.31	6.11
C <sub>3</sub>	EC-620407 × Punjab Chhuhara	2.81	2.88	2.94	2.88	6.42	6.60	6.70	6.57
C <sub>4</sub>	EC-620407 × Pusa Ruby	2.44	2.52	2.57	2.51	6.20	6.25	6.35	6.27
C <sub>5</sub>	EC-620407 × EC-520078	1.76	1.82	1.88	1.82	8.42	8.62	8.74	8.60
C <sub>6</sub>	EC-620407 × EC-620557	3.37	3.42	3.53	3.44	7.20	7.43	7.67	7.43
C <sub>7</sub>	EC-620428 × Arka Saurabh	2.88	2.93	2.99	2.93	6.15	6.42	6.65	6.40
C <sub>8</sub>	EC-620428 × Arka Abha	2.64	2.72	2.77	2.71	6.46	6.73	6.80	6.67
C <sub>9</sub>	EC-620428 × Punjab Chhuhara	2.89	2.94	3.01	2.95	7.17	7.31	7.47	7.32
C <sub>10</sub>	EC-620428 × Pusa Ruby	3.14	2.57	2.63	2.78	6.83	6.96	7.13	6.97
C <sub>11</sub>	EC-620428 × EC-520078	1.87	1.94	1.99	1.93	8.28	8.36	8.64	8.43
C <sub>12</sub>	EC-620428 × EC-620557	3.51	3.48	3.63	3.54	8.13	8.20	8.35	8.23
C <sub>13</sub>	EC-620360 × Arka Saurabh	2.93	3.00	3.05	2.99	6.13	6.23	6.35	6.24
C <sub>14</sub>	EC-620360 × Arka Abha	2.96	3.07	3.14	3.06	6.45	6.53	6.73	6.57
C <sub>15</sub>	EC-620360 × Punjab Chhuhara	2.93	2.99	3.05	2.99	6.89	7.02	7.26	7.06
C <sub>16</sub>	EC-620360 × Pusa Ruby	2.85	2.90	2.96	2.90	6.50	6.65	6.77	6.64
C <sub>17</sub>	EC-620360 × EC-520078	1.54	1.60	1.63	1.59	8.12	8.19	8.25	8.18
C <sub>18</sub>	EC-620360 × EC-620557	3.41	3.46	3.54	3.47	7.88	8.20	8.11	8.06
C <sub>19</sub>	EC-608415 × Arka Saurabh	3.17	3.23	3.31	3.24	5.74	5.94	6.14	5.94
C <sub>20</sub>	EC-608415 × Arka Abha	2.90	2.98	3.03	2.97	6.16	6.32	6.48	6.32
C <sub>21</sub>	EC-608415 × Punjab Chhuhara	3.03	3.07	3.14	3.08	6.67	6.83	7.01	6.84
C <sub>22</sub>	EC-608415 × Pusa Ruby	3.08	3.15	3.19	3.14	6.38	6.43	6.88	6.56
C <sub>23</sub>	EC-608415 × EC-520078	1.45	1.51	1.58	1.51	7.76	7.79	8.11	7.88
C <sub>24</sub>	EC-608415 × EC-620557	3.31	3.36	3.44	3.37	7.57	7.52	7.93	7.67
C <sub>25</sub>	EC-619982 × Arka Saurabh	3.58	3.61	3.74	3.65	6.67	6.81	7.05	6.84
C <sub>26</sub>	EC-619982 × Arka Abha	3.08	3.14	3.20	3.14	6.93	7.12	7.33	7.13
C <sub>27</sub>	EC-619982 × Punjab Chhuhara	3.13	3.18	3.22	3.18	7.51	7.66	7.56	7.57
C <sub>28</sub>	EC-619982 × Pusa Ruby	3.19	3.25	3.32	3.25	7.33	7.33	7.51	7.39
C <sub>29</sub>	EC-619982 × EC-520078	1.87	1.96	2.03	1.96	8.64	8.72	8.82	8.73
C <sub>30</sub>	EC-619982 × EC-620557	3.51	3.56	3.68	3.58	8.57	8.66	8.59	8.61
Crosses mean		2.82	2.86	2.93	2.87				
Checks									
US-440		3.12	3.22	3.26	3.20	6.36	6.48	6.68	6.51
Arka Rakshak		2.98	2.98	3.01	2.99	7.18	8.25	9.40	8.27
NS-516		2.88	3.06	3.24	3.06	6.18	6.35	7.09	6.54
G. Mean		2.85	2.86	2.95	2.91	6.90	7.00	7.28	7.07
S.E.D.		0.03	0.04	0.03	0.06	0.07	0.06	0.06	0.11
C.D. (0.05)		0.06	0.07	0.06	0.12	0.15	0.13	0.12	0.21
C.D. (0.01)		0.08	0.09	0.08	0.16	0.21	0.17	0.17	0.28

**Plant height (cm)**

Plant height determines the plant growth habit of a genotype. Dwarf genotypes with determinate growth habit are an essential pre requisite for a successful hybrid. There was a significant difference among the genotypes with respect to plant height. From the data of pooled analysis, plant height varied from 84.96 cm (EC-619982 × Arka Saurabh) to 193.48 cm (EC-620428 × EC-520078) with a general mean of 115.90

cm. Among the parents it varied from 86.22 cm to 182.45 cm and in crosses from 84.96 cm (EC-619982 × Arka Saurabh) to 193.48 cm (EC-620428 × EC-520078). Three crosses EC-619982 × Punjab Chhuhara, EC-619982 × Pusa Ruby and EC-620407 × EC-520078 were significantly on par with best cross EC-620428 × EC-520078 whereas EC-620407 × Punjab Chhuhara, EC-620407 × EC-520078, EC-620428 × Punjab Chhuhara, EC-620428 × Pusa Ruby, EC-620428 × EC-

520078, EC-620360 × Arka Saurabh, EC-620360 × Punjab Chhuhara, EC-620360 × Pusa Ruby, EC-620360 × EC-620557, EC-608415 × Punjab Chhuhara, EC-608415 × Pusa Ruby, EC-608415 × EC-520078, EC-619982 × Punjab Chhuhara, EC-619982 × Pusa Ruby and EC-619982 × EC-520078 were significantly superior to the best check Arka Rakshak. Information on variation in plant height is available from the studies of Dod *et al.*, (1992)<sup>[2]</sup>, Kumar *et al.*, (1995)<sup>[5]</sup> and Makesh *et al.*, (2003)<sup>[6]</sup>, Alam *et al.*, (2010)<sup>[11]</sup>, Raju *et al.*, (2014)<sup>[9]</sup> and Jindal (2015)<sup>[4]</sup>.

#### Fruit yield per plant (kg)

The fruit yield per plant among the genotypes over the environments ranged between 1.13 kg (EC-520078) and 3.30 kg (EC-608415 × Arka Abha) with a general mean of 2.20 kg. Among the parents variation was from 1.13 g (EC-520078) to 1.94 kg (EC-608415) and among the crosses it ranged from 1.61 kg (EC-620407 × EC-520078) to 3.30 kg (EC-608415 × Arka Abha). Cross EC-608415 × Punjab Chhuhara recorded significantly on par with EC-608415 × Arka Abha whereas four crosses EC-620360 × Pusa Ruby, EC-608415 × Arka Abha, EC-608415 × Punjab Chhuhara and EC-619982 × EC-620557 recorded significantly superior performance than the best check Arka Rakshak (2.95 kg). Findings of Makesh *et al.*, (2003)<sup>[6]</sup>, Alam *et al.*, (2010)<sup>[11]</sup>, Raju *et al.*, (2014)<sup>[9]</sup>, Jindal (2015)<sup>[4]</sup> also support the results of this trial.

#### Pericarp thickness (mm)

From the data of Pooled analysis over three environments, the pericarp thickness ranged from 0.93 mm (EC-608415 × EC-520078) to 5.05 mm (EC-620407) with an overall mean of 3.83 mm. The variation among the parents was from 0.96 mm (EC-520078) to 5.05 mm (EC-620407). Among the crosses it varied from 0.93 mm (EC-608415 × EC-520078) to 4.75 mm (EC-608415 × EC-620557). Seven crosses EC-620407 × Arka Saurabh, EC-620360 × Arka Saurabh, EC-620360 × Arka Abha, EC-620360 × EC-620557, EC-619982 × Arka Saurabh, EC-619982 × Pusa Ruby and EC-619982 × EC-620557 was statistically on par with cross EC-608415 × EC-620557 while cross EC-608415 × EC-620557 was significantly superior to the best check NS-516 (4.98 mm). The present results are in accordance with the experiments conducted by Makesh *et al.*, (2003)<sup>[6]</sup>, Raju *et al.*, (2014)<sup>[9]</sup> and Jindal (2015)<sup>[4]</sup>.

#### Fruit pH

Pooled analysis over three environments revealed that among all the genotypes tested, the fruit pH ranged from 4.08 (EC-620407) to 5.26 (EC-520078) with an overall mean of 4.68. The range among the parents was from 4.08 to 5.26. Among the crosses this trait ranged from 4.21 (EC-620407 × Pusa Ruby) to 5.24 (EC-608415 × EC-620557). However, six crosses *viz.*, EC-620407 × Arka Saurabh, EC-620407 × Arka Abha, EC-620407 × Punjab Chhuhara, EC-620407 × Pusa Ruby, EC-620360 × Pusa Ruby and EC-619982 × Pusa Ruby were statistically superior over the check NS-516 (4.54).

#### Total soluble solids (<sup>o</sup>Brix)

Over the environments, the genotypes exhibited a general mean of 4.82 with a range of 4.11 (Punjab Chhuhara) to 6.08 (EC-520078). Among the parents, the value ranged from 4.11 to 6.08 and from 4.31 (EC-620360 × Punjab Chhuhara) to 5.83 (EC-619982 × EC-520078) in crosses. Six crosses (EC-620407 × EC-520078, EC-620428 × EC-520078, EC-620360 × Pusa Ruby, EC-620360 × EC-520078, EC-608415 × EC-520078 and EC-619982 × EC-520078) were significantly

superior to the best check Arka Rakshak (5.07). Makesh *et al.*, (2003)<sup>[6]</sup>, Alam *et al.*, (2010)<sup>[11]</sup>, Raju *et al.*, (2014) and Jindal (2015)<sup>[4]</sup> reported similar type of variations.

#### Titration acidity (%)

Pooled analysis over three environments revealed that among all the genotypes tested, the titration acidity ranged from 0.35 (EC-620557) to 0.47 (EC-620360 × Arka Abha) with an overall mean of 0.41. The range among the parents was from 0.35 (EC-620557) to 0.43 (EC-620360). Among the crosses this trait varied from 0.37 (EC-619982 × EC-620557) to 0.47 (EC-620360 × Arka Abha). The crosses EC-620407 × Arka Saurabh, EC-620407 × Arka Abha, EC-620407 × Punjab Chhuhara, EC-620407 × Pusa Ruby, EC-608415 × EC-520078, EC-619982 × Arka Saurabh and EC-619982 × Pusa Ruby was statistically on par with best cross EC-620360 × Arka Abha and are significantly superior to the best check US-440 (0.42). The present results are in consonance with the results of Makesh *et al.*, (2003)<sup>[6]</sup>, Raju *et al.*, (2014)<sup>[9]</sup> and Jindal (2015)<sup>[4]</sup>.

#### Ascorbic acid content (mg/100g)

Pooled analysis over three intervals revealed the variation from 16.90 mg/100g (EC-620407) to 28.09 mg/100g (EC-620360 × Punjab Chhuhara) with an overall mean of 23.11 mg/100g. The range among the parents was from 16.90 mg/100g (EC-620407) to 27.48 mg/100g (EC-520078). Among the crosses this trait varied from 17.05 mg/100g (EC-620407 × EC-620557) to 28.09 mg/100g (EC-620360 × Punjab Chhuhara). Ten crosses (EC-620428 × Arka Abha, EC-620428 × Punjab Chhuhara, EC-620428 × Pusa Ruby, EC-620428 × EC-520078, EC-620360 × Arka Saurabh, EC-620360 × Arka Abha, EC-620360 × Punjab Chhuhara, EC-620360 × Pusa Ruby, EC-620360 × EC-520078 and EC-619982 × Punjab Chhuhara) recorded significantly more ascorbic acid content compared to the best check Arka Rakshak (23.86 mg/100g). The results of Makesh *et al.*, (2003)<sup>[6]</sup>, Raju *et al.*, (2014)<sup>[9]</sup> and Jindal (2015)<sup>[4]</sup> are in agreement with present ones.

#### Total sugars (%)

Pooled analysis over three environments revealed that among all the genotypes tested, this trait ranged from 2.10% (EC-608415 × EC-520078) to 4.30% (EC-619982 × EC-620557) with an overall mean of 3.59%. The range of among the parents was from 2.12% (EC-520078) to 4.23% (EC-620557). Among the crosses this trait ranged from 2.10% (EC-608415 × EC-520078) to 4.30 % (EC-619982 × EC-620557). The crosses, EC-620407 × EC-620557, EC-620428 × EC-620557, EC-620360 × Pusa Ruby and EC-620360 × Punjab Chhuhara were significantly superior to the best cross EC-619982 × EC-620557. However, five crosses were statistically on par with the superior check US-440 (3.89 %).

#### Reducing sugars (%)

The reducing sugar content among the genotypes over the environments varied between 1.51% (EC-608415 × EC-520078) to 3.73% (EC-619982) with a general mean of 2.91%. Among the parents it ranged from 1.58% (EC-620407 × EC-520078) to 3.73% (EC-619982) and in crosses it varied between 1.51% (EC-608415 × EC-520078) to 3.65% (EC-619982 × Arka Saurabh). Crosses EC-620428 × EC-620557 and EC-619982 × EC-620557 were statistically on par with EC-619982 × Arka Saurabh. Six crosses EC-620407 × EC-620557, EC-620428 × EC-620557, EC-620360 × EC-

620557, EC-608415 × EC-620557, EC-619982 × Arka Saurabh and EC-619982 × EC-620557 recorded significantly superior performance compared to superior check US-440 (3.20 %).

#### Lycopene content (mg/100g)

Pooled analysis over three environments revealed that among all the genotypes tested, the trait lycopene content ranged from 5.07 (Arka Saurabh) to 8.73 (EC-619982 × EC-520078) with an overall mean of 7.07. The range among the parents varied from 5.07 (Arka Saurabh) to 8.57 (EC-520078). Among the crosses it varied from 5.88 (EC-620407 × Arka Saurabh) to 8.73 (EC-619982 × EC-520078). The crosses EC-620407 × EC-520078 and EC-619982 × EC-620557 exhibited statistically on par values with EC-619982 × EC-520078, while crosses EC-620407 × EC-520078 and EC-619982 × EC-620557 registered more lycopene content than superior check Arka Rakshak (8.27). Jindal (2015) [4] also reported similar type of results.

#### Conclusion

The crosses EC-620360 x Pusa Ruby and EC-619982 x EC-620557 exhibited significant values for fruit yield per plant (3.13 kg, 3.04 kg), pericarp thickness (4.24 mm, 4.73 mm), total soluble solids (<sup>0</sup>5.37, 4.92 <sup>0</sup>Brix), fruit pH (4.39, 4.94), titrable acidity (0.47%, 0.39%), ascorbic acid content (27.21 mg/100g, 22.69 mg/100g), total sugars (4.12%, 4.30%) reducing sugars (2.90%, 3.58%) and lycopene content (6.63 mg/100g, 8.60 mg/100g) are suitable for processing purpose. EC-608415 x Arka Abha with fruit yield per plant (3.29 kg), pericarp thickness (4.03 mm), total soluble solids (4.71 <sup>0</sup>Brix), fruit pH (4.87), titrable acidity (0.42%), ascorbic acid content (21.42 mg/100g), total sugars (3.62%), reducing sugars (2.97%) and lycopene content (6.32 mg/100g) is suitable for culinary purpose and EC-608415 x Punjab Chhuhara with fruit yield per plant (3.04 kg), pericarp thickness (4.21 mm), total soluble solids (4.59 <sup>0</sup>Brix), fruit pH (4.81), titrable acidity (0.45%), ascorbic acid content (22.38 mg/100g), total sugars (3.77%), reducing sugars (3.08%) and lycopene content (6.83 mg/100g) is suitable for dual purpose (culinary and processing) (Table 6). These crosses may be further evaluated other regions to elicit substantial conclusions.

**Table 6:** Fruit yield and quality parameters of promising crosses

Cross	Category	Fruit yield per plant (kg)	Quality parameters							
			Pericarp thickness (mm)	Total soluble solids ( <sup>0</sup> Brix)	Fruit pH	Titrable acidity (%)	Ascorbic acid content (mg/100g)	Total sugars (%)	Reducing sugars (%)	Lycopene content (mg/100g)
EC-620360 × Pusa Ruby	Processing type	3.13	4.24	5.37	4.39	0.39	27.21	4.12	2.90	6.63
EC-608415 × Arka Abha	Culinary type	3.29	4.03	4.71	4.87	0.42	21.42	3.62	2.97	6.32
EC-608415 × Punjab Chhuhara	Dual type	3.23	4.21	4.59	4.81	0.45	22.38	3.77	3.08	6.83
EC-619982 × EC-620557	Processing type	3.04	4.73	4.92	4.94	0.37	22.69	4.30	3.58	8.60

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