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Performance of tomato (*Solanum lycopersicum* Mill) genotypes (parents with crosses) for yield and quality traits under temperature conditions of Kashmir

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Abstract

The present investigation was carried out at three locations including Vegetable Experimental Field, Division of Vegetable Science, SKUAST-Kashmir Shalimar, KVK Malangpora Pulwama and KVK Budgam during kharif 2021-22. During the study a comparative performance of twelve parents of tomato along with their sixty-six crosses were evaluated for maturity, yield attributing and quality traits for identifying genotypes with high yielding ability, better quality and significant variation were found among the genotypes for the traits studied. The maximum fruit yield per plant and per hectare was recorded in parents SKAU-T-1424 (1.79 kg/plant, 662.96 q/ha) followed by SKAU-T-1009 (1.76 kg/plant, 653.08 q/ha) and SKAU-T-9801 (1.76 kg/plant, 651.85 q/ha) whereas in crosses SKAU-T-1219 × SKAU-T-1429 (2.07 kg/plant, 777.77 q/ha) followed by SKAU-T-1429 × SKAU-T-9862 (2.06 kg/plant, 764.19 q/ha) and SKAU-T-1219 × SKAU-T-1701 (2.05 kg/plant, 759.25 q/ha). For quality traits maximum ascorbic acid (mg/100 g) was found in SKAU-T-1429 (47.7) followed by SKAU-T-1464 (47.5) and SKAU-T-1701 (33.3) and in crosses SKAU-T-1429 × SKAU-T-9862 (49.5), SKAU-T-1429 × SKAU-T-1009 (46.8) and SKAU-T-0922 × SKAU-T-1429 (38.8). Maximum lycopene content (mg/100 g) was found in parents SKAU-T-1429 (5.69) followed by SKAU-T-9801 (5.42) and SKAU-T-0301 (4.75), and in crosses SKAU-T-1429 × SKAU-T-1701 (5.78), SKAU-T-1429 × SKAU-T-1009 (5.67) and SKAU-T-0922 × SKAU-T-1464 (5.48). Thus overall mean performance depicted that there exists sufficient amount of variation in the given set of parents and crosses, thereby indicating a good scope for improvement of the population through various breeding procedures.

Keywords: Parents, crosses, mean, improvement, breeding, yield and quality

Introduction

Tomato (*Solanum lycopersicum* L.), family *Solanaceae*, is native of Andean region mainly Peru- South America (Rick 1973, Taylor 1986) ^[20, 24]. It is one of the most popular vegetable crop grown widely all over the world as it is a very versatile vegetable, ranking third in importance after potato and onion. It is often referred to as a luxury crop because of its high consumption rate in developed and developing countries. The ripe tomato fruits are consumed fresh as salad or after cooking. A large proportion of tomato is utilized in the preparation of various value added durable products such as puree, paste, powder, ketchup and sauce. The fully ripened whole fruits are canned, while the green unripe fruits are used for making pickles and chutney. The production of tomato is highly influenced by environmental factors such as temperature, light, relative humidity and carbon dioxide level in the atmosphere. Tomatoes are an excellent source of minerals, vitamins (Akinfasoy *et al.*, 2011) ^[2] and antioxidants *viz.*, lycopene and beta-carotene which prevent cancer and other heart diseases (Kaur *et al.*, 2013) ^[10]. The quality of tomato genotypes plays an important role in deciding the suitability of the genotype for processing purpose, fresh market or table purpose. The antioxidant content of tomato mostly depends on genetic and environmental factors (Martinez *et al.* 2002) ^[11]. There are a few high yielding, disease and insect resistant varieties but they do not perform well throughout the year because of their photo-sensitiveness and less adaptability. The present investigation was undertaken to identify suitable genotypes capable of giving higher fruit yield and quality performance under temperate conditions of Kashmir.

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Materials and Methods

The experimental material for present study consists of twelve diverse genotypes of tomato (*Solanum lycopersicum* L.) maintained by Division of Vegetable Science, SKUAST-Kashmir, Shalimar. By using these twelve parents, sixty six F1 crosses were generated through 12×12 diallel mating design (excluding reciprocals) at Vegetable Experimental Field, Division of Vegetable Science, SKUAST-Kashmir Shalimar, during kharif 2021. The set of seventy eight genotypes viz., sixty six crosses along with their twelve parents were evaluated in randomized complete block design at Experimental Farm, Division of Vegetable Science, SKUAST-K Shalimar, Krishi Vigyan Kendra, Malangpora and KrishiVigyan Kendra, Budgam during kharif 2022. The row to row and plant to plant spacing was maintained at 60 × 45 cm. Recommended package of practices were adopted to raise a healthy crop. The observations were recorded on number of days to 1st flowering, number of days to 1st fruit set, number of days to 1st fruit harvest, number of flowers cluster⁻¹, number of fruits cluster⁻¹, number of pickings, number of fruits plant⁻¹, fruit length (cm), fruit diameter (cm), number of locules fruit⁻¹, pericarp thickness (mm), number of primary branches plant⁻¹, plant height (cm), average fruit weight (g), fruit yield plant⁻¹ (kg), fruit yield hectare⁻¹(q), average number of seeds fruit⁻¹, 100-seed weight (g), juice to pulp ratio, titrable acidity (% citric acid), lycopene content (mg/100g), ascorbic acid content (mg/100g), TSS (° Brix) and total carotenoids (mg/100 g).

Result and Discussion

The mean performance of twelve parents and sixty-six crosses for growth, yield and yield attributing traits in tomato (*Solanum lycopersicum* L.) is present in Table 1. The result clearly indicated that genotypes differed significantly for all the traits, however no genotype was superior for all the characters under study. Earliness is one of the important desirable traits for crop improvement programme. The present study also brought out certain genotypes with significant early flowering, fruiting and harvesting. For number of days to first flowering minimum days was taken by parent SKAU-T-1701 (30.43) followed by SKAU-T-1700 (31.36) whereas in crosses minimum days were taken by SKAU-T-1700 × SKAU-T-1464 (29.50) followed by SKAU-T-1315 × SKAU-T-1701(30.20). For number of days to first fruit set minimum days were taken by parent SKAU-T-1700 (42.30) followed by SKAU-T-1701 (42.56) and in crosses SKAU-T-1700 × SKAU-T-1464 (39.13) followed by SKAU-T-1700 × SKAU-T-1315 (40.20). Similarly for number of days to first fruit harvest minimum days taken by parent SKAU-T-9801 (76.63) followed by SKAU-T-1219 (77.56) and in crosses SKAU-T-1315 × SKAU-T-0301 (62.33) followed by SKAU-T-0301 × SKAU-T-9862 (70.96). Maximum number of flowers cluster⁻¹ was observed in parents SKAU-T-9801 (6.8) followed by SKAU-T-1315 (6.6) whereas in crosses maximum flower cluster⁻¹observed in SKAU-T-9801× SKAU-T-0301 (7.53) followed by SKAU-T-1701 × SKAU-T-9862 (6.93). For number of fruits cluster⁻¹ maximum mean value was observed in parents SKAU-T-1701 (3.9) followed by SKAU-T-1464

(3.8) and in crosses maximum mean value was observed in SKAU-T-1315 × SKAU-T-1009 (4.20) followed by SKAU-T-0922 × SKAU-T-1009 (4.16). Maximum number of pickings was observed in parents SKAU-T-1219 (8.4) followed by SKAU-T-1009 (8.1) and in crosses SKAU-T-1219 × SKAU-T-1429 (12.70) followed by SKAU-T-1429 × SKAU-T-9862(12). For number of fruits plant⁻¹ mean value was found to be highest in parents SKAU-T-9801 (36.3) followed by SKAU-T-1700 (34.7) and maximum number of fruits was observed in crosses SKAU-T-1700 × SKAU-T-1424 (38.83) followed by SKAU-T-1219 × SKAU-T-1701(37.46). Similar observations in tomato were also reported by Singh *et al.* 2006 [21]; Hayadar *et al.* 2007 [6]. For fruit length (cm) maximum mean value was observed in parents SKAU-T-1429 (5.2) followed by SKAU-T-1424 (4.7) and crosses SKAU-T-1219 × SKAU-T-1429 (5.63) followed by SKAU-T-1429 × SKAU-T-9862 (5.46). Similarly for fruit diameter (cm) maximum mean value was observed in parents SKAU-T-1429 (5.2) followed by SKAU-T-1464 (5.1) and in crosses SKAU-T-1009 × SKAU-T-1464 (5.80) followed by SKAU-T-1219 × SKAU-T-1429 (5.76). Maximum number of locules fruit⁻¹was observed in parents SKAU-T-1219 (5.2) followed by SKAU-T-1464 (4.5) and in crosses SKAU-T-1424 × SKAU-T-1315 (5.60) followed by SKAU-T-1700 × SKAU-T-1429 (5.50). Highest mean value for pericarp thickness was observed in parents SKAU-T-1700 (7.4) followed by SKAU-T-1429 (5.9) and in crosses SKAU-T-1700 × SKAU-T-1464 (6.0) followed by SKAU-T-1219 × SKAU-T-1429 (5.96). Maximum number of primary branches plant⁻¹ was observed in parents SKAU-T-1464 (3.6) followed by SKAU-T-1429 (3.5) and in crosses SKAU-T-0301 × SKAU-T-1429 (4.33) followed by SKAU-T-0922 × SKAU-T-1429 (4.16). Plant height (cm) was found to be highest in parents SKAU-T-1464 (115.2) followed by SKAU-T-1429 (114.5) and in crosses SKAU-T-1219 × SKAU-T-1464 (147.43) followed by SKAU-T-1700 × SKAU-T-1464 (134.73). Similar observations in tomato were also reported by Mohammed *et al.*, 2012 [12] and Narolia *et al.*, 2012 [14]. Maximum value for average fruit weight (g) was observed in parents SKAU-T-1429 (55.6) followed by SKAU-T-1424 (55.5) and in crosses SKAU-T-1429 × SKAU-T-1701(73.70) followed by SKAU-T-1429 × SKAU-T-1464 (70.10). Fruit yield plant⁻¹ (kg) was found to be maximum in SKAU-T-1424 (1.79) followed by SKAU-T-9801 (1.76) and in crosses SKAU-T-1219 × SKAU-T-1429 (2.10) followed by SKAU-T-1429 × SKAU-T-9862 (2.06). Fruit yield hectare⁻¹ (q) was found maximum in parents SKAU-T-1424 (662.96) followed by SKAU-T-1009 (653.08) and in crosses SKAU-T-1219 × SKAU-T-1429 (777.77) followed by SKAU-T-1429 × SKAU-T-9862 (764.19). Average number of seeds fruits⁻¹ was found to be highest in parent SKAU-T-1429 (211.1) followed by SKAU-T-0922 (135.2) and in crosses SKAU-T-1429 × SKAU-T-1464 (286.20) followed by SKAU-T-1219 × SKAU-T-1429 (261.20). 100 Seed weight (g) was found to be maximum in SKAU-T-1701 (0.449) followed by SKAU-T-1315 (0.362) and in crosses SKAU-T-1700 × SKAU-T-1219 (0.37) followed by SKAU-T-1700 × SKAU-T-1009 (0.33).

Table 1: Mean performance of different genotypes (parents with their crosses) for growth, yield and yield attributing traits in tomato (*Solanum lycopersicum* L.) (Data pooled over environments)

Parents	Number of days to first flowering	Number of days to first fruit set	Number of days to first fruit harvest	Number of flowers cluster ⁻¹	Number of fruits cluster ⁻¹	Number of pickings	Number of fruits plant ⁻¹	Fruit length (cm)	Fruit diameter (cm)	Number of locules fruit ⁻¹	Pericarp thickness	Number of primary branches plant ⁻¹	Plant height (cm)	Average fruit weight (g)	Fruit yield plant ⁻¹	Fruit yield hectare ⁻¹ (q)	Average number of seeds fruit ⁻¹	100 Seed Weight
SKAU-T-9801	34.3	48.8	76.6	6.8	3.1	7.2	36.3	3.0	3.6	3.7	3.5	2.6	82.7	48.6	1.76	651.85	77.1	0.169
SKAU-T-1700	31.4	42.3	80.6	5.7	3.5	7.9	34.7	3.5	3.9	2.5	7.4	2.6	84.7	49.9	1.75	649.38	115.8	0.303
SKAU-T-0922	35.9	51.5	85.8	5.1	3.3	4.3	16.1	3.4	3.9	2.6	4.6	2.5	78.9	31.1	0.50	186.42	135.2	0.174
SKAU-T-1424	34.4	44.5	80.5	5.1	2.8	7.5	32.5	4.7	4.8	3.3	5.4	3.4	90.2	55.5	1.79	662.96	111.3	0.274
SKAU-T-1219	31.6	43.5	77.5	5.9	3.5	8.4	31.3	4.1	3.8	5.2	5.0	2.8	79.6	48.3	1.51	558.02	125.2	0.252
SKAU-T-1315	33.6	43.1	77.6	6.6	2.9	7.7	27.9	4.6	4.1	2.5	4.4	3.2	74.0	30.3	0.84	311.02	89.4	0.362
SKAU-T-0301	34.3	45.4	82.3	5.6	3.3	7.8	22.0	4.3	3.6	2.4	4.3	3.1	81.6	36.2	0.79	293.82	119.9	0.241
SKAU-T-1429	35.0	47.4	86.5	5.3	2.6	7.8	31.5	5.2	5.2	3.7	5.9	3.5	114.5	55.6	1.75	648.14	211.1	0.258
SKAU-T-1701	30.4	42.6	81.5	6.1	3.9	6.8	20.3	3.6	3.9	3.2	4.2	2.6	74.9	34.4	0.70	258.84	87.1	0.449
SKAU-T-1009	35.2	46.4	80.5	6.5	3.7	8.1	34.2	4.6	3.1	2.6	4.4	3.2	68.7	51.6	1.76	653.08	74.9	0.249
SKAU-T-9862	36.3	47.4	82.0	5.2	3.3	6.8	17.4	4.1	3.8	3.8	4.1	3.2	84.6	41.9	0.73	270.37	103.4	0.161
SKAU-T-1464	35.4	46.9	80.6	5.0	3.8	8.1	22.2	4.7	5.1	4.5	3.4	3.6	115.2	35.7	0.79	293.82	48.3	0.259
Crosses																		
SKAU-T-9801 × SKAU-T-1700	32.5	41.8	81.5	6.5	2.9	4.0	16.9	2.9	2.2	2.4	3.7	2.4	71.9	31.0	0.52	194.77	102.7	0.257
SKAU-T-9801 × SKAU-T-0922	34.5	43.6	77.8	5.6	3.8	7.1	34.1	3.9	4.0	2.3	3.0	3.3	63.6	32.0	1.08	400.41	174.1	0.194
SKAU-T-9801 × SKAU-T-1424	33.6	44.6	77.9	6.8	3.9	7.9	34.5	3.9	3.9	2.7	2.6	3.3	61.4	51.4	1.77	655.55	110.4	0.187
SKAU-T-9801 × SKAU-T-1219	31.7	42.5	76.5	6.1	3.3	6.5	20.0	2.9	4.2	3.3	3.2	3.2	95.9	36.7	0.73	272.01	65.5	0.313
SKAU-T-9801 × SKAU-T-1315	33.8	46.2	77.4	5.8	2.8	7.2	34.2	3.9	3.0	2.7	5.4	3.0	69.3	54.7	1.87	691.35	62.4	0.224
SKAU-T-9801 × SKAU-T-0301	34.6	46.5	78.8	7.5	3.8	5.5	19.2	3.0	2.7	2.7	3.0	2.7	71.3	31.3	0.61	224.68	119.9	0.246
SKAU-T-9801 × SKAU-T-1429	35.4	45.6	79.6	6.4	3.1	4.1	12.3	3.0	3.9	5.2	3.4	2.8	75.9	44.7	0.55	204.93	203.4	0.213
SKAU-T-9801 × SKAU-T-1701	32.6	43.4	73.5	5.6	3.0	8.6	36.3	3.7	4.1	2.9	4.3	3.4	72.9	49.8	1.79	661.72	150.6	0.169
SKAU-T-9801 × SKAU-T-1009	35.0	46.5	82.6	5.7	3.9	8.3	30.2	3.9	3.6	2.7	4.1	3.2	99.4	32.2	0.97	361.31	50.6	0.272
SKAU-T-9801 × SKAU-T-9862	34.4	44.5	72.6	5.2	3.8	8.1	27.4	3.4	4.0	4.2	4.6	3.6	69.6	32.1	0.89	331.68	128.9	0.206
SKAU-T-9801 × SKAU-T-1464	32.5	40.6	78.9	6.3	3.2	7.7	18.3	4.1	2.6	3.6	3.1	2.7	83.9	41.2	0.75	278.60	147.5	0.220
SKAU-T-1700 ×	34.5	43.2	80.8	5.7	2.8	8.8	30.3	2.8	3.9	4.1	4.4	3.4	76.1	46.5	1.41	520.98	114.3	0.293

SKAU-T-0922																		
SKAU-T-1700 × SKAU-T-1424	31.4	43.1	79.9	6.0	3.1	9.2	38.8	4.1	4.4	2.8	3.1	2.5	69.2	49.1	1.91	706.17	110.1	0.287
SKAU-T-1700 × SKAU-T-1219	33.5	41.7	77.7	5.9	4.1	10.3	37.3	4.1	3.9	3.1	5.0	2.7	115.8	49.6	1.85	683.95	123.1	0.371
SKAU-T-1700 × SKAU-T-1315	30.5	40.2	73.7	6.4	3.2	7.6	36.4	3.6	3.3	3.5	4.5	2.4	58.6	50.6	1.84	681.48	96.6	0.257
SKAU-T-1700 × SKAU-T-0301	33.1	46.5	79.6	6.1	3.3	8.3	21.5	3.5	4.1	3.4	4.6	2.9	70.3	53.1	1.14	424.69	133.7	0.220
SKAU-T-1700 × SKAU-T-1429	35.1	46.3	84.5	5.4	2.4	9.4	35.8	2.7	4.3	5.5	5.0	2.6	82.0	53.8	1.92	712.34	173.3	0.273
SKAU-T-1700 × SKAU-T-1701	32.6	42.5	78.5	4.5	3.4	6.2	14.3	3.9	3.9	3.1	5.1	2.6	72.2	41.5	0.60	221.39	113.5	0.269
SKAU-T-1700 × SKAU-T-1009	34.1	44.5	75.5	5.6	2.5	8.9	25.4	4.5	3.9	2.7	5.2	2.7	71.3	43.5	1.10	409.05	142.0	0.330
SKAU-T-1700 × SKAU-T-9862	31.5	43.0	75.8	6.1	3.0	9.9	20.3	3.8	3.5	2.6	5.3	2.6	67.8	52.7	1.07	396.29	102.6	0.301
SKAU-T-1700 × SKAU-T-1464	29.5	39.1	81.6	5.8	3.5	11.7	34.9	4.7	5.2	3.0	5.9	3.7	134.7	57.5	2.00	741.97	123.4	0.287
SKAU-T-0922 × SKAU-T-1424	40.4	50.1	77.7	5.0	3.1	7.6	33.4	3.7	4.1	2.4	4.0	2.7	60.8	56.4	1.88	687.65	132.8	0.162
SKAU-T-0922 × SKAU-T-1219	35.3	46.5	76.7	6.2	3.9	8.7	23.1	3.6	3.9	2.8	4.5	3.4	79.2	51.9	1.20	429.87	127.9	0.206
SKAU-T-0922 × SKAU-T-1315	35.1	51.2	80.5	6.3	3.1	10.1	30.7	4.5	4.0	2.4	4.0	3.6	77.4	64.9	1.99	738.26	115.3	0.261
SKAU-T-0922 × SKAU-T-0301	38.3	51.5	86.8	6.1	2.9	8.1	33.7	3.7	2.6	2.3	3.4	2.6	67.2	56.3	1.89	699.99	149.9	0.221
SKAU-T-0922 × SKAU-T-1429	33.3	43.7	84.5	5.5	3.4	9.2	26.8	4.5	2.8	2.5	4.3	4.2	120.8	42.9	1.15	427.15	234.5	0.242
SKAU-T-0922 × SKAU-T-1701	32.5	44.7	79.6	5.6	3.3	7.8	23.0	3.8	3.7	2.4	4.0	2.3	76.8	34.7	0.80	295.88	170.6	0.246
SKAU-T-0922 × SKAU-T-1009	34.3	42.6	77.6	6.3	4.2	8.2	31.2	3.8	2.7	2.9	3.6	3.2	79.5	36.1	1.13	416.87	163.4	0.245
SKAU-T-0922 × SKAU-T-9862	32.3	45.4	81.5	6.0	4.0	8.2	29.0	4.4	5.1	2.6	4.7	2.4	96.8	41.6	1.21	446.91	140.8	0.211
SKAU-T-0922 × SKAU-T-1464	34.5	46.8	82.1	6.1	3.0	8.9	26.0	3.8	3.9	2.7	4.0	4.1	72.9	49.1	1.28	473.66	122.9	0.241
SKAU-T-1424 × SKAU-T-1219	35.2	46.5	81.5	5.2	2.8	9.1	32.7	4.7	4.2	2.4	3.8	2.5	96.5	54.7	1.79	661.72	66.9	0.297
SKAU-T-1424 × SKAU-T-1315	33.3	50.5	84.2	6.4	4.1	6.8	26.2	4.3	4.0	5.6	4.4	2.5	93.1	38.6	1.01	364.19	123.4	0.270
SKAU-T-1424 ×	32.5	42.9	75.4	6.6	3.8	9.2	34.3	3.8	3.6	4.4	3.6	2.3	78.8	53.1	1.82	672.83	154.1	0.169

SKAU-T-0301																		
SKAU-T-1424 × SKAU-T-1429	32.5	42.3	81.5	5.8	3.9	8.3	25.2	4.2	3.9	3.9	4.1	2.8	94.6	49.6	1.25	462.96	105.6	0.276
SKAU-T-1424 × SKAU-T-1701	33.5	41.6	86.5	5.7	3.9	6.9	25.8	3.6	4.1	2.6	3.9	3.0	89.0	36.0	0.93	345.26	160.0	0.221
SKAU-T-1424 × SKAU-T-1009	31.5	41.9	75.9	6.3	2.8	7.6	29.3	3.9	3.5	2.3	4.0	3.4	82.4	40.1	1.18	435.39	83.6	0.234
SKAU-T-1424 × SKAU-T-9862	34.4	42.5	81.5	5.8	3.9	5.9	24.2	3.9	4.1	2.2	4.3	2.6	78.2	30.0	0.74	274.89	89.5	0.242
SKAU-T-1424 × SKAU-T-1464	34.5	42.7	81.7	5.6	4.1	6.3	27.0	3.4	3.6	4.2	4.2	2.6	81.2	29.9	0.81	299.17	130.8	0.222
SKAU-T-1219 × SKAU-T-1315	36.6	48.4	85.5	5.4	3.9	6.5	17.5	4.0	3.9	2.5	3.7	3.1	73.9	46.3	0.81	300.41	114.0	0.239
SKAU-T-1219 × SKAU-T-0301	31.6	40.3	76.5	5.9	3.0	8.0	30.4	3.6	3.9	2.5	2.6	2.3	67.4	41.1	1.25	461.72	111.9	0.227
SKAU-T-1219 × SKAU-T-1429	32.2	43.6	85.8	5.9	4.1	12.7	32.4	5.6	5.7	3.3	6.0	3.4	124.9	64.0	2.07	777.77	261.2	0.238
SKAU-T-1219 × SKAU-T-1701	31.5	43.6	76.6	6.0	3.4	11.6	37.5	4.8	5.0	3.0	5.4	2.2	81.0	54.8	2.05	759.25	164.2	0.262
SKAU-T-1219 × SKAU-T-1009	35.4	45.4	75.9	5.4	3.5	11.1	35.7	4.3	3.9	2.3	4.4	2.7	76.3	50.9	1.82	672.42	118.7	0.130
SKAU-T-1219 × SKAU-T-9862	31.3	44.5	78.4	6.0	3.4	10.9	31.4	3.8	4.6	3.1	3.1	2.8	92.6	49.3	1.55	572.42	49.2	0.247
SKAU-T-1219 × SKAU-T-1464	32.5	42.5	78.5	5.9	3.8	10.9	34.0	4.3	4.1	2.4	5.1	2.8	147.4	56.0	1.91	706.17	140.7	0.259
SKAU-T-1315 × SKAU-T-0301	33.5	44.6	62.3	6.2	3.2	6.4	24.4	3.9	3.7	2.7	4.3	3.8	93.0	30.0	0.73	272.01	101.1	0.228
SKAU-T-1315 × SKAU-T-1429	32.6	42.3	76.3	4.9	2.7	9.1	27.3	3.3	4.3	2.6	4.0	3.7	88.3	45.2	1.23	455.96	131.2	0.223
SKAU-T-1315 × SKAU-T-1701	30.2	45.5	79.4	5.4	3.6	8.2	22.6	3.8	4.8	3.0	3.7	3.4	90.5	65.9	1.49	551.02	94.6	0.251
SKAU-T-1315 × SKAU-T-1009	31.5	43.1	78.0	5.8	4.2	7.4	27.2	3.9	3.9	2.8	4.3	2.3	70.8	35.3	0.96	355.96	78.9	0.228
SKAU-T-131 × SKAU-T-9862	32.4	45.3	81.4	5.4	3.9	4.9	17.6	3.8	3.8	3.0	4.1	2.7	69.5	31.3	0.55	203.70	98.3	0.217
SKAU-T-1315 × SKAU-T-1464	37.2	45.8	85.3	5.9	3.3	7.8	27.4	4.4	4.1	2.4	4.3	3.4	105.6	52.7	1.43	534.56	68.6	0.240
SKAU-T-0301 × SKAU-T-1429	32.5	46.5	79.4	5.5	2.5	7.2	24.2	4.4	4.4	4.1	3.7	4.3	93.4	54.1	1.31	484.36	200.1	0.293
SKAU-T-0301 × SKAU-T-1701	34.7	44.6	81.4	4.7	3.9	7.9	29.3	3.9	4.0	2.4	3.2	3.6	81.1	41.7	1.22	452.26	145.9	0.246
SKAU-T-0301 ×	34.6	46.4	81.9	5.6	3.0	7.8	30.1	4.4	3.9	3.7	3.1	2.6	84.3	39.8	1.20	444.03	91.9	0.240

SKAU-T-1009																		
SKAU-T-0301 × SKAU-T-9862	33.6	47.5	70.9	6.6	3.7	7.0	28.9	3.7	4.2	2.8	4.8	3.0	61.1	34.8	1.01	372.42	82.9	0.241
SKAU-T-0301 × SKAU-T-1464	34.9	48.3	84.3	6.0	2.5	7.2	28.8	3.5	3.9	2.8	4.1	3.6	66.9	40.1	1.15	426.33	112.8	0.252
SKAU-T-1429 × SKAU-T-1701	35.5	44.5	86.4	5.0	3.1	7.8	20.8	4.4	3.8	2.5	3.0	3.2	90.5	73.7	1.53	566.66	227.1	0.249
SKAU-T-1429 × SKAU-T-1009	30.5	45.6	79.8	6.6	3.4	11.5	34.3	4.6	5.2	3.6	4.3	3.4	92.4	59.3	2.03	751.85	178.5	0.263
SKAU-T-1429 × SKAU-T-9862	31.5	43.5	71.3	6.0	2.4	11.9	35.4	5.5	5.2	4.6	4.2	2.3	107.6	58.4	2.06	764.19	137.7	0.257
SKAU-T-1429 × SKAU-T-1464	34.2	48.4	82.5	6.3	2.6	9.0	18.7	4.4	4.9	3.9	4.2	2.9	108.9	70.1	1.31	483.53	286.2	0.298
SKAU-T-1701 × SKAU-T-1009	34.7	46.5	81.6	5.7	3.3	7.3	21.4	3.7	3.9	4.1	2.7	2.8	78.4	55.1	1.18	435.39	159.1	0.321
SKAU-T-1701 × SKAU-T-9862	33.3	46.5	82.3	6.9	3.9	8.1	25.0	4.1	4.2	3.5	4.3	3.1	79.3	63.9	1.60	592.59	116.0	0.205
SKAU-T-1701 × SKAU-T-1464	33.4	44.6	77.5	6.5	3.3	9.0	32.0	4.5	4.5	3.1	5.0	2.8	86.1	53.7	1.72	637.44	202.7	0.222
SKAU-T-1009 × SKAU-T-9862	35.5	45.6	80.5	6.0	3.8	7.5	37.3	4.7	3.1	3.7	4.1	2.5	76.4	32.1	1.19	443.21	114.2	0.218
SKAU-T-1009 × SKAU-T-1464	32.8	41.5	77.4	5.6	3.5	10.0	36.0	4.7	5.7	3.2	5.3	3.1	80.6	55.5	2.00	740.74	91.9	0.268
SKAU-T-9862 × SKAU-T-1464	36.1	48.1	83.5	5.7	3.5	6.3	27.5	4.0	4.0	3.7	3.7	3.3	70.8	29.6	0.81	301.23	160.3	0.176
Mean	33.63	44.90	79.66	5.87	3.39	8.11	27.97	4.01	4.02	3.16	4.22	3.00	84.04	46.25	1.31	485.45	127.55	0.24
C.V	0.67	0.24	0.20	1.59	1.92	0.79	0.77	1.25	1.17	2.18	1.19	2.14	0.49	0.66	1.79	1.90	0.41	0.93
S.Em±	0.13	0.06	0.09	0.05	0.03	0.03	0.12	0.02	0.02	0.03	0.02	0.03	0.24	0.17	0.01	5.32	0.30	0.01
C.D at 5%	0.36	0.17	0.26	0.15	0.10	0.10	0.35	0.08	0.07	0.11	0.08	0.10	0.67	0.49	0.03	14.89	0.86	0.02

Average performance of tomato parents and their crosses also significantly differ for various quality traits and is shown in Table 2. TSS is the important parameter that determines processing quality of tomato. Maximum mean value for TSS ($^{\circ}$ Brix) was found in parent SKAU-T-1315 (7.0) followed by SKAU-T-1009 (5.2) and in crosses SKAU-T-1700 \times SKAU-T-1219 (6.1) followed by SKAU-T-1315 \times SKAU-T-0301 (6). These findings are in support to the findings of Dufera, 2013^[4]; Jyothi *et al.*, 2012^[9] and Raju *et al.*, 2014^[16]. Titrable acidity (%) was found to be maximum in parent SKAU-T-1429 (0.82) followed SKAU-T-0301 (0.72) and in crosses SKAU-T-1429 \times SKAU-T-9862 (1.25) followed by SKAU-T-1429 \times SKAU-T-1009 (1.21). Lycopene content (mg/100g) was found to be maximum in SKAU-T-1429 (5.69) followed by SKAU-T-9801 (5.42) and in crosses SKAU-T-1429 \times SKAU-T-1701 (5.78) followed by SKAU-T-1429 \times SKAU-T-1009 (5.67). Juice to pulp ratio was found to be maximum in parent SKAU-T-9801 (3.13) followed by SKAU-T-1701 (3.05) and in crosses SKAU-T-1701 \times SKAU-T-1009 (3.15)

followed by SKAU-T-1701 \times SKAU-T-9862 (3.08). Ascorbic acid content (mg/100g) was found to be maximum in SKAU-T-1429 (47.7) followed by SKAU-T-1464 (47.5) and in crosses SKAU-T-1429 \times SKAU-T-9862 (49.5) followed by SKAU-T-1429 \times SKAU-T-1009 (46.8). These results are in accordance with the findings of Zahedi *et al.*, 2012^[26]; Gosavi *et al.*, 2010^[5]; Cheema *et al.*, 2013^[3] and Reddy *et al.*, 2013^[18]. Total carotenoids (mg/100 g) was found to be maximum in SKAU-T-1429 (3.95) followed by SKAU-T-9801 (3.85) and in crosses SKAU-T-1429 \times SKAU-T-1464 (5.95) followed by SKAU-T-1429 \times SKAU-T-9862 (4.85). Since no genotype could be identified to have superior performance for all the growth, yield and quality characters. Similar pattern of results for various growth, yield and quality parameters have also been reported by Ramya *et al.*, 2016^[17]; Renuka *et al.*, 2017^[19]; Spaldon and Hussain, 2017^[22] and Jatav *et al.*, 2017^[8]; Najema *et al.*, 2018^[13]; Venkadeswaran *et al.*, 2018^[25]; Prakash *et al.*, 2019^[15]; Sultan *et al.*, 2020^[23]; Akhter *et al.* 2021^[1]; Indrabi *et al.*, 2022^[7].

Table 2: Mean performance of tomato (*Solanum lycopersicum* L.) genotypes (parents with their crosses) for different quality traits (individual and pooled date)

Parents	TSS ($^{\circ}$ Brix)	Ascorbic acid (mg/100 gm)	Juice to pulp ratio	Lycopene content (mg/100 gm)	Titration Acidity (% citric acid)	Carotenoid content (mg/100 gm)
SKAU-T-9801	4.1	30.2	3.13	5.42	0.28	3.85
SKAU-T-1700	3.2	23.5	1.48	4.72	0.38	2.89
SKAU-T-0922	3.5	26.1	1.05	3.25	0.21	3.71
SKAU-T-1424	3.4	28.7	2.30	4.37	0.26	3.21
SKAU-T-1219	4.4	30.9	1.32	4.32	0.33	3.40
SKAU-T-1315	7.0	20.1	1.21	3.85	0.23	2.69
SKAU-T-0301	4.2	31.5	1.89	4.75	0.72	2.85
SKAU-T-1429	4.7	47.7	2.14	5.69	0.82	3.95
SKAU-T-1701	4.4	33.3	3.05	2.95	0.16	3.54
SKAU-T-1009	5.2	22.8	1.13	3.23	0.25	2.83
SKAU-T-9862	4.3	18.9	2.80	2.79	0.32	2.10
SKAU-T-1464	3.9	37.5	1.85	3.87	0.43	2.66
Crosses						
SKAU-T-9801 \times SKAU-T-1700	3.5	34.2	2.41	4.78	0.32	4.05
SKAU-T-9801 \times SKAU-T-0922	4.1	32.7	2.35	4.52	0.25	4.20
SKAU-T-9801 \times SKAU-T-1424	3.3	35.4	1.85	5.23	0.3	4.35
SKAU-T-9801 \times SKAU-T-1219	4.0	31.8	3.01	4.15	0.34	3.95
SKAU-T-9801 \times SKAU-T-1315	4.1	37.2	2.48	4.32	0.24	4.12
SKAU-T-9801 \times SKAU-T-0301	4.0	30.9	1.98	4.05	0.29	4.00
SKAU-T-9801 \times SKAU-T-1429	5.1	33.2	1.78	5.12	0.36	3.92
SKAU-T-9801 \times SKAU-T-1701	4.4	38.6	2.32	3.98	0.4	4.45
SKAU-T-9801 \times SKAU-T-1009	5.1	30.4	2.62	4.68	0.42	4.62
SKAU-T-9801 \times SKAU-T-9862	5.2	31.4	1.92	4.92	0.31	3.78
SKAU-T-9801 \times SKAU-T-1464	3.6	36.2	2.46	5.02	0.26	3.89
SKAU-T-1700 \times SKAU-T-0922	5.1	30.8	1.23	4.32	0.43	3.32
SKAU-T-1700 \times SKAU-T-1424	4.2	33.8	1.52	5.20	0.45	3.44
SKAU-T-1700 \times SKAU-T-1219	6.1	35.4	1.62	4.62	0.39	3.48
SKAU-T-1700 \times SKAU-T-1315	3.2	32.6	1.48	4.82	0.36	3.30
SKAU-T-1700 \times SKAU-T-0301	4.4	30.2	1.41	3.78	0.47	3.50
SKAU-T-1700 \times SKAU-T-1429	5.1	31.4	1.36	5.34	0.37	3.62
SKAU-T-1700 \times SKAU-T-1701	5.2	28.7	1.68	4.15	0.41	3.42
SKAU-T-1700 \times SKAU-T-1009	4.1	29.4	1.72	4.68	0.36	3.38
SKAU-T-1700 \times SKAU-T-9862	3.3	27.5	1.38	3.78	0.34	2.80
SKAU-T-1700 \times SKAU-T-1464	4.2	32.8	1.46	4.10	0.32	3.08
SKAU-T-0922 \times SKAU-T-1424	5.2	35.8	1.15	3.92	0.28	3.92
SKAU-T-0922 \times SKAU-T-1219	4.3	32.1	1.23	3.62	0.32	4.21
SKAU-T-0922 \times SKAU-T-1315	4.4	30.4	1.28	4.38	0.34	4.48
SKAU-T-0922 \times SKAU-T-0301	3.5	36.4	1.31	3.78	0.36	4.52
SKAU-T-0922 \times SKAU-T-1429	4.1	38.8	1.11	4.92	0.25	4.65
SKAU-T-0922 \times SKAU-T-1701	3.4	27.4	1.18	4.28	0.26	4.72
SKAU-T-0922 \times SKAU-T-1009	3.5	28.9	1.29	4.52	0.29	4.75
SKAU-T-0922 \times SKAU-T-9862	4.2	30.9	1.34	3.42	0.30	4.62
SKAU-T-0922 \times SKAU-T-1464	4.2	31.2	1.36	5.48	0.37	4.34

SKAU-T-1424 × SKAU-T-1219	3.4	37.2	2.42	4.72	0.30	3.52
SKAU-T-1424 × SKAU-T-1315	4.3	33.2	2.12	3.32	0.32	3.48
SKAU-T-1424 × SKAU-T-0301	4.1	35.2	2.24	3.72	0.28	3.57
SKAU-T-1424 × SKAU-T-1429	4.4	31.4	2.31	4.78	0.42	3.50
SKAU-T-1424 × SKAU-T-1701	4.1	28.5	2.45	3.68	0.45	3.62
SKAU-T-1424 × SKAU-T-1009	3.5	30.8	2.80	3.42	0.36	3.72
SKAU-T-1424 × SKAU-T-9862	4.3	29.5	1.85	3.15	0.29	3.28
SKAU-T-1424 × SKAU-T-1464	5.1	32.5	1.68	4.19	0.31	3.45
SKAU-T-1219 × SKAU-T-1315	4.6	28.9	1.38	4.52	0.38	3.80
SKAU-T-1219 × SKAU-T-0301	3.7	27.4	1.42	3.62	0.42	4.21
SKAU-T-1219 × SKAU-T-1429	4.2	35.7	1.24	3.92	0.44	4.24
SKAU-T-1219 × SKAU-T-1701	5.1	33.5	1.52	2.94	0.46	4.28
SKAU-T-1219 × SKAU-T-1009	4.2	28.4	1.18	3.32	0.52	4.29
SKAU-T-1219 × SKAU-T-9862	4.2	30.4	1.15	3.81	0.55	4.32
SKAU-T-1219 × SKAU-T-1464	4.5	31.4	1.36	3.42	0.35	4.15
SKAU-T-1315 × SKAU-T-0301	6.0	28.7	1.28	3.95	0.34	3.41
SKAU-T-1315 × SKAU-T-1429	4.1	23.2	1.32	2.75	0.25	3.21
SKAU-T-1315 × SKAU-T-1701	4.0	30.8	1.18	2.45	0.27	3.15
SKAU-T-1315 × SKAU-T-1009	4.2	21.8	1.22	3.54	0.29	2.94
SKAU-T-131 × SKAU-T-9862	3.4	25.4	1.35	2.68	0.32	2.78
SKAU-T-1315 × SKAU-T-1464	5.0	34.5	1.37	3.82	0.38	3.48
SKAU-T-0301 × SKAU-T-1429	4.1	32.5	1.62	4.48	0.82	3.95
SKAU-T-0301 × SKAU-T-1701	4.2	30.4	1.78	4.21	0.78	3.85
SKAU-T-0301 × SKAU-T-1009	5.3	31.2	1.82	3.92	0.94	3.92
SKAU-T-0301 × SKAU-T-9862	4.2	28.7	1.96	3.72	1.02	4.20
SKAU-T-0301 × SKAU-T-1464	4.4	29.5	1.75	3.64	0.86	4.26
SKAU-T-1429 × SKAU-T-1701	4.3	38.7	1.86	5.78	0.96	4.20
SKAU-T-1429 × SKAU-T-1009	3.6	46.8	2.18	5.67	1.21	4.25
SKAU-T-1429 × SKAU-T-9862	4.3	49.5	2.28	4.92	1.25	4.85
SKAU-T-1429 × SKAU-T-1464	4.5	36.3	2.32	4.78	1.06	5.95
SKAU-T-1701 × SKAU-T-1009	4.3	34.8	3.15	2.98	0.21	4.20
SKAU-T-1701 × SKAU-T-9862	3.4	32.5	3.08	3.12	0.24	4.12
SKAU-T-1701 × SKAU-T-1464	4.2	31.2	2.85	2.42	0.28	3.82
SKAU-T-1009 × SKAU-T-9862	5.3	34.7	1.17	3.52	0.42	3.42
SKAU-T-1009 × SKAU-T-1464	3.8	38.4	1.21	3.12	0.54	3.74
SKAU-T-9862 × SKAU-T-1464	4.4	25.8	2.62	2.82	0.45	2.92
Mean	4.3	31.88	1.81	4.08	0.43	3.78
SD	0.70	5.29	0.59	0.81	0.23	0.63
CV	0.16	0.16	0.33	0.20	0.55	0.16

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