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Determination of Morphological Characteristics of Some Prominent Tomato Genotypes

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ABSTRACT

This study was carried out to determine some morphological characteristics of 94 tomato genotypes at the S4 level and to reveal the relationships between these materials. In the study, leaf attitude, leaf length, leaf width, number of flowers, fruit color, fruit weight, fruit width, fruit length, the thickness of pericarp, fruit shape, fruit diameter, number of locules, and total soluble solid content (TTSC) were measured and observed in these genotypes. As a result of the phenotypic assessment, the maximum fruit weight values of the genotypes were observed as in G9 (317.59 g), G54 (310 g), G92 (292.85 g), G70 (287.01 g), and G110 (276.66 g); and the lowest fruit weight values were observed in G26 (18.302 g) and G8 (14.48 g). Average fruit length, fruit width, pericarp thickness, and the number of carpels were recorded (69.09 mm, 56.90 mm, 6.37 mm, and 4 carpels respectively). Tomato genotypes were also investigated using Cluster and Principal Component Analysis (PCA) method based on these measurements and observations. As a result of this analysis, five independent principal component axes were obtained. While these axes represent 69.28% of the total variation, the eigen values were ranged between 1.06 and 4.02. According to the PCA analysis results, genotypes G7, G81, G93, and G103 were prominent in terms of leaf length, fruit width, fruit weight, and carpel number parameters. Based on TSSC results, the G65 genotype was found to be the most prominent one, and the genotypes G12 and G114 exhibit promising results for fruit color. A high degree of morphological variation was detected among tomato genotypes.

1. Introduction

Tomato is one of the most important vegetable species with a high economic value which is a member of the *Solanum* genus of the *Solanaceae* family (Jenkins, 1948; Peralta et al., 2008). Today about 180 million tons of tomatoes are produced in an area of about 5 millions ha in the world. Turkey is among the three biggest tomato producers in the world with a 12.5 million tons production quantity (FAO, 2019). It also has an indispensable position in many countries' kitchens with its various usages. Tomato is a type of vegetable that is consumed fresh as well as frozen canned, tomato paste, ketchup, pickles, sauce, dried tomatoes, tomato juice, puree, and chopped (Günay, 2005). The high economic value of tomatoes has made it the subject of many researchers from cultivation to breeding. It is known that there is a constantly changing market in tomato breeding in Turkey and in the world. The main purpose of tomato production is yield and quality. For this, high genetic performance is required together with appropriate ecology and appropriate techniques. This is only possible with hybrid varieties having superior qualities and performance. Factors such as yield, quality, durability, and adaptability also provide advantages in hybrid varieties (Kaloo, 1988). In breeding studies, it is important to know the variation among the parental materials in the studied gene pool in terms of hybrid performance (Gözen, 2008; Keskin, 2014). The traditional markers used to determine the relationships between plants are morphological markers. Considering tomato's morphological characterizations; Major traits such as fruit shape, fruit size, green ridge formation in fruit, or intensity of fruit color are in the foreground (Altıntaş et al., 2016; UPOV, 2013). Researchers carry out their studies by making some modifications to the UPOV criteria for their purposes (Kurt, 2019). The fact that the parameters examined in morphological studies are under the influence of many factors and that the properties of the objects subject to observation are related to each other

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causes many variables to be encountered. To find a solution to this problem, multivariate analysis methods have been developed by examining more than one feature at the same time (Tahtalı, 2005). In characterization studies, the cluster and principal component analysis are being done commonly using similarity and differences (Karaağaç and Balkaya, 2010).

Bhattarai et al. (2018), examined 21 plant and fruit characteristics in 91 tomato genotypes. A collection of 123 genotypes, which are characteristiced of the main fruit, has been evaluated over eighteen morphological properties. Morphological traits were subjected to principal component analysis and as a result of the analysis,18 morphological traits explained 46% of the total variation (Sacco et al., 2015). Singh and Aakansha (2015), found that the average fruit weight of 24 tomato genotypes was 47.16 to 112.50 g, fruit length was 30.8 to 60.6 mm, fruit width was 40.9 to 67.1 mm, the number of seed cavity in fruits varied from 2 to 11, and the amount of TSSC (Total Soluble Solid Content) ranged from 4.00 to 5.60% and they found that the differences among the genotypes were significant at the 0.05 level (Terzopoulos and Bebeli, 2010). In another study, a total of 61 local genotypes collected from Eskişehir and Bilecik locations were examined in terms of some morphological and phenological traits. The first three principal component vectors explained 62.8% of the total variation in the Eskişehir region and 55.66% in the Bilecik region (Sönmez et al., 2015). Kal et al. (2020) stated that as a result of principal component analysis with 77 cherry tomatoes, the total variance explained 16.8% in PC_1, 12.6% in PC_2, and 10.2% in PC3. Kıymacı (2021) examined the morphological characteristics of 240 tomato lines and the results were subjected to principal component analysis. Finally, in terms of 11 traits examined, the three components explained approximately 48.39 of the studies, the first component explained 24.1% of the total variance. In the present study, it was aimed to perform the morphological characterization of 94 tomato half-way breeding material in the S4 level and to reveal the existing variability in detail with multivariate analyzes.

2. Materials and Methods

In the experiment 94 tomato genotypes obtained as a result of crosses made with genotypes showing superior characteristics from a large genetic pool, were used by Selko-Tarim company, which carries out Ar-Ge studies on different vegetable species in Antalya. In the experiment, the seeds were sown on February 10th. 2020, and on March 15th, the five seedlings from each genotype were planted in the greenhouse in Antalya Aksu at (90x50)x50 cm intervals.

From seed sowing to greenhouse planting and harvesting, all cultural operations have been carried out regularly. The measurements and observations were taken at appropriate times and this morphological measurements and observations were given in Table 1 (UPOV, 2013).

In the experiment, yield and fruit measurements taken from 94 tomato cultivar candidates were subjected to principal components analysis (PCA) in the JMP-14 computer package program. The distinctions between genotypes were determined by examining the Score Plot graph created in line with the components obtained because of the analysis.

Table 1
Measurements and observations made in tomato genotypes (UPOV, 2013)

Features	Value. ranges. measurement and observations
Leaf attitude	Semi-erect(3), horizontal(5), semi-dropping(7)
Leaf length	Short(3), Medium(5), Long(7)
Leaf width	Short(3), Medium(5), Long(7)
Flower number of cluster	3-5(3), 6-10(5), more than 10 (7)
Fruit color	Light Pink(1), Pink(3), Light Red(5), Red(7), Dark Red(9)
Fruit weight (g)	
Fruit width (mm)	
Fruit length (mm)	
Thickness of pericarp fruit shape	
Fruit shape	Slight Flattened(1), Round(3). Flattened(5), Vertical(7), Heart-shaped(9)
Fruit diameter	Slight Flattened(1), Round(3), Flattened(5), Vertical(7), Nonround(9)
Number of locules	
Total soluble solid content (TTSC)	

3. Results and Discussion

The measurements and observations made on 94 tomato genotypes at S4 level and the leaf and fruit results in these parameters are given below.

Leaf Traits: As a result of the evaluations it was determined that 43.6% of the genotypes were semi-drooping, 47.8% of the were horizontal and 8.5% of them were semi-erect in terms of leaf position. Leaf length values of the genotypes were determined as 19.1% short, 20.2% medium, and 61.70% long; in terms of leaf width, 32.9% of the genotypes had narrow leaves, 41.4% of them had medium leaves, and 26.5% of them had wide leaves. Although these different values are thought to be related to genetic diversity, ecological conditions and cultural practices are considered to be the partly affecting factors. Many studies have found different values in terms of leaf properties in tomatoes; Terzopoulos and Bebeli (2010) reported that 60% of the tomato genotypes had semi-erect leaves; Salim et al. (2020) observed 63.6% horizontal, 27.2% semi-upright and 13.6% semi-drooping leaves; Çukadar and Dursun (2012) determined 12.5% short, 50% medium and 43.7% long leaves and 8.3% narrow, 22.9% medium and 68.7% wide leaves.

Fruit Characteristics: The maturity time of the fruits was determined as 55.3% medium, 10.6% late, and 34.0% early. In the genotypes evaluated, the color of the fruit was 1.06% light pink, 39.36% pink, 22.3% light red, 35.1% red and 2.1% dark red. When fruit color is evaluated in different studies; Bhattarai et al. (2018) reported 89.5% red, 5.8% pink, and 4.7% yellow fruit color in tomato genotypes; Jin et al. (2019), observed 57.72% red, and 36.42% pink color; Çukadar and Dursun (2012) determined 2.08% pink, 97.92% red color; Mutlu et al. (2007) stated 1.12% yellow, 50.28% orange, 5.58% pink and 43.02% red color; Altıntaş et al. (2016) reported 1.6% orange, 25% pink, 73.4% red color. Tomato is a rich species for color diversity. On the other hand, easy hybridization with wild tomato species increases this color variance (Ayyıldız, 2017). In this context, different reports are seen in different literature.

Fruit shape and area are important both for the consumer and for transportation. In the present study, it was determined that there was a wide variation in fruit shape and area. When in longitudinal section of fruit shape was examined, the genotypes were classified slightly flattened as 37.2% round as 36.1%, flattened as 19.1%, vertical as 2.1%. and heart-shaped as 5.3%. When the fruit cross-section is examined; the genotypes were classified slightly flattened and flattened as 3.1%, rounded as 61.7%, not round as 31.9%. It has been determined that the number of flowers in the cluster is mostly from three to five. Salim et al. (2020) determined that the fruit shape was found 50% round, 9.10% heart, 31.82% flat, 4.54% elliptical and cylindrical in their tomato breeding lines. In another characterization study, Bota et al. (2014) reported that 50% of the tomato fruit shape was flat. 31% was round, and 19% was others in 171 local tomato genotypes. Bhattarai et al. (2018) reported that the tomato fruit shape was 60% flat, 6% slightly flattened, 1% very round, 8% round, 4% heart-shaped and 21% cylindrical. In the study of Keskin (2014), 11 of the parental tomatoes were round and 6 were not round, while in the hybrids 97 of them were not round, 39 of them were round. Ayyıldız (2017) determined that fruit cross-sectional shape od tomatoes was 80.55% round and 19.44% angular in 36 genotypes. In the study of Çukadar and Dursun (2012), the tomatoes fruit cross-section was determined as 77.08% round, 8.33% angular, 14.59% irregular. Since fruit shape trait is not affected by abiotic and biotic stress conditions, these different results are thought to be caused by the geneticially inherited variability among the genotypes.

The genotypes having the maximum fruit weight were determined as G9 (317.59 g), G54 (310 g), G92 (292.85 g), G70 (287.01 g), and G110 (276.66 g), while the genotypes having the lowest fruit weight were G26 (18.302 g), and G8 (14. 48 g). Oğuz (2010) found that the fruit weight values of 10 genotypes were 30 grams or less, 29 genotypes ranged from 30 to 100 grams, and 47 genotypes varied from 100 to 300 grams.

Ayyıldız (2017) determined the average fruit size as 30-100 g in 17 genotypes, 100-200 g in 8 genotypes, and 200-350 g in 11 genotypes. Our different findings from previously published results related to the fruit weight do not mean negative consequences. Because it is natural that there are differences in the genetic sources of genotypes. It is also thought that these differences may be caused by differences such as cultivation conditions, variety and climate conditions.

Average fruit length, fruit width and pericarp thickness were measured as 69.09 mm, 56.90 mm and 6.37 mm, respectively. The number of carpels between genotypes varies. The average number of carpels was found in 4. Salim et al. (2020) reported that fruit length and diameter varied from 3.91 to 6.57 cm and from 3.63 to 8.15 cm, respectively, among the genotypes in their tomato characterization study. Kouam et al. (2018) and Yesmin et al. (2014) found those values as from 3.74 to 5.34 and from 3.64 to 5.71, respectively in their tomato characterization studies. In Figàs et al. (2014) tomato characterization study; they foud fruit weight as 2.7-511.6 g, fruit length as 1.88- 9.57 cm, fruit width as 2.15–11.40 cm, number of carpels as 2.00–18.33 and yield per plant as 292–2.851 g. Ayyıldız (2017) determined that 55.55% of the genotypes had usually 2 and sometimes 3 carpels, 41.66% of the genotypes had generally more than 4 carpels, and 2.77% of the genotypes had generally 3 carpels in the S6 level. Keskin (2014) observed in his research that the number of carpel ranged from 2 to 9. In the study of Keskin (2014), the wide range of carpels in tomato is proof that the number of carpels exhibits great variation within genotypes. The TTSC values in tomatoes is 5% on average, and can reach up to 6.5% at most. In the present study, the average TTSC in fruit was measured as 4.3%. Kavitha et al. (2014) determined that the TSSC values ranged from 3.5% to 14.5% in 54 tomato genotypes. In another study, Kathayat et al. (2015) reported that the TSSC values varied from 3.25% to 6.32%.

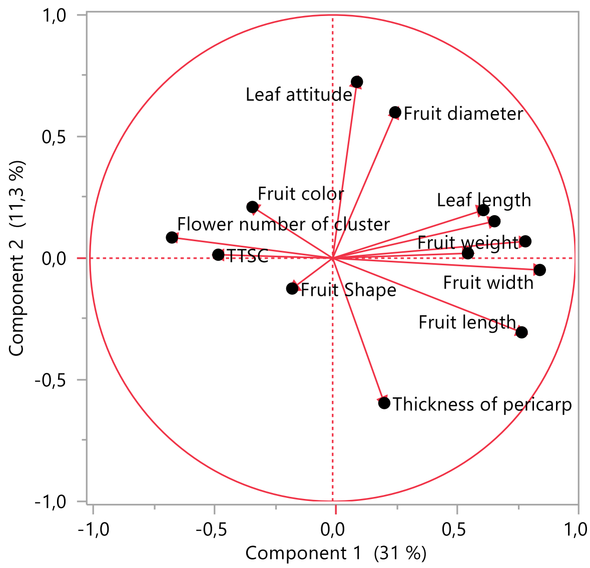
Principal Components Analysis: The principal component (PC) axes, eigenvalues, variation, and cumulative variation ratios were obtained as a result of Principal Component Analysis (PCA) and factor coefficients indicated the weight values of principal components based on features are presented in detail in Table 2. It has been stated that PCA analysis can be used effectively when the first two components explain more than 25% of the variation in the studies. (Mohammadi and Prasanna. 2003; Seymen et al.. 2019). As a result of the PCA analysis, five independent principal component axes were extracted concerning the 13 morphological characters. These axes represent 69.28% of the total variation. The eigen values of the first 5 basic components were found from 1.06 to 4.02. The eigenvalue 1 or greater means that the weight values of the principal component are reliable (Mohammadi and Prasanna, 2003). Özdamar (2004) reported that for factor coefficients to be reliable in principal component analysis, principal component axes should explain 2/3 of the total variation. When the analysis results are examined, it is seen that 2/3 of the total variation is more than explained by the first six principal component axes (69.28%). Therefore, these axes were taken into account in the evaluation of the analysis (Table 2). The first principal component axis accounts for 30.97 % of the total variation. The second and third principal components cover 11.31% and 10.31% of the total variation, respectively. In other studies on tomato, 71% (Bernousi et al., 2011), 71.6% (Henareh et al., 2015), 74.63% (Bhattarai et al., 2016), 78.54% (Zhou et al., 2015) observation accounted for the total variation.

Table 2
Eigen value, variation and principal component axes of the properties examined as a result of principal component analysis

Eigen value	40.26	14.703	13.411	11.058	10.637
Variance%	30.97	11.31	10.316	8.506	8.182
Total variance %	30.97	42.28	52.596	61.103	69.285
Traits	Prin1	Prin2	Prin3	Prin4	Prin5
Leaf attitude	0.049	0.597	-0.014	0.396	-0.164
Leaf length	0.309	0.163	0.322	-0.358	-0.204
Leaf width	0.277	0.016	0.301	-0.504	-0.211
Flower number of cluster	-0.33	0.070	0.466	0.153	0.085
Fruit color	-0.16	0.173	0.157	-0.291	0.723
Fruit weight	0.395	0.057	0.105	0.205	0.278
Fruit width	0.425	-0.040	0.021	0.123	0.212
Fruit length	0.388	-0.251	-0.029	0.215	0.034
Thickness of pericarp	0.106	-0.491	0.243	-0.048	-0.053
Fruit Shape	-0.08	-0.103	0.622	0.422	-0.198
Fruit diameter	0.128	0.494	0.089	-0.168	-0.178
Number of locules	0.332	0.125	0.116	0.170	0.354
TTSC	-0.23	0.011	0.284	-0.093	0.180

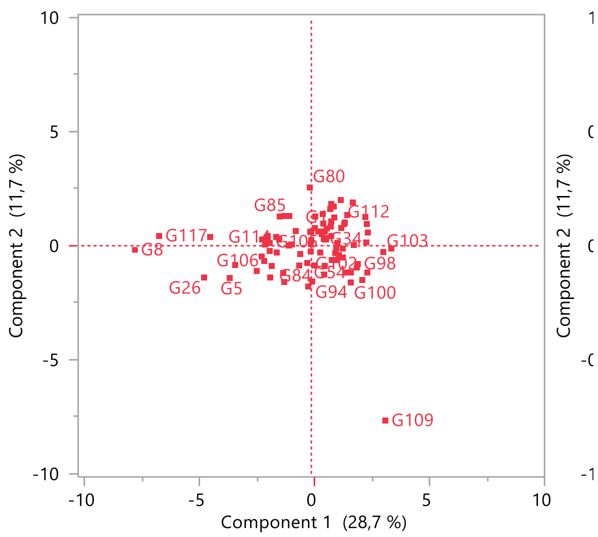
Evgenidis et al. (2011), evaluated three hybrid and four standard tomato cultivars and their morphological characteristics by using cluster and principal component analyses; these cultivars explained 49.15% of the total variance in PC1, in PC2 and PC3 29.63% and 21.23%, respectively; and the hybrid cultivars strongly explained 62.93% of the total variance and 49.15% of the total variance in PC1 associated with yield-related traits such as yield components and yield stability. In another study; the principal component analysis was performed in 71 tomato genotypes, 5 independent principal component axes were obtained regarding the properties examined; and the researchers stated that these axes explained more than 92% of the total variation. Based on this analysis, it is reported that certain fruit characteristics may be important for breeding programs according to consumer demands (Krishna et al., 2016). In a study of tomato breeding lines, they obtained six independent principal component axes for 17 identification traits. They reported that these axes explained 63.35% of the total variation (Jin et al., 2019), Kal et al. (2020) worked with 77 cherry tomatoes, they reported that the total variance explained 16.8% in PC1, 12.6% in PC2, and 10.2% in PC3. Using PC1 and PC2 components, a loading plot was created to examine the interrelationship among the traits. It has been reported that if the angle between the vectors in the figure is <90°, there is a positive relationship, if it is >90°, there is a negative relationship, and if the angle between the vectors is 90°, there is no significant relationship (Danin-Poleg and Reis, 2001; Seymen et al., 2019). When the figure 3 is examined, the highest correlation was found between leaf length, fruit width, fruit weight, and carpel number. On the other hand, the highest negative correlation was found between leaf attitude and thickness of pericarp.

Figure 3
Loading plot graph obtained from PC1 and PC2 as a result of PCA



A score plot was created for the evaluation of 94 tomato lines using PC1 and PC2 components (Figure 4). A score plot was created to evaluate 94 tomato genotypes using PC1 and PC2 components (Figure 4). When the Figure 4 is examined, the genotypes G7, G81, G93 and G103 emerged as the genotypes revealing the best performance associated with leaf length, fruit width, fruit weight, carpel number parameters, which were important in PC1. G65 genotype was found to be significant in terms of the TSSC parameter, while G12 and G114 genotypes were found to be significant in terms of fruit color parameters.

Figure 4
Score plot graph obtained from PCA result PC1 and PC2



4. Conclusion

The morphological and agronomic properties of the 94 tomato genotypes in the S4 stage have been evaluated and the relations between these characteristics have been interpreted in this study. As a result of the study, it was revealed that there are some differences in the morphological features obtained from plants and fruits. As a result of the evaluations, the genotypes having the highest fruit weight were G9 (317.59 g), G54 (310 g), G92 (292.85 g), G70 (287.01 g) and G110 (276.66 g), respectively; while the genotypes having the lowest fruit weight were G26 (18.302 g) and G8 (14.48 g), respectively. Average fruit length, fruit width and pericarp thickness, number of carpels were measured as 69.09 mm, 56.90 mm, 6.37 mm and 4 carpels, respectively. Tomato genotypes were investigated using Cluster and Principal Component Analysis (PCA) method based on these measurements and observations. As a result of the analysis, 5 independent principal component axes were obtained. While these axes represent 66.53% of the total variation, the eigen values were ranged from 1.02 to 3.73. According to the PCA analysis results, genotypes G7, G81, G93 and G103 were prominent in terms of leaf length, fruit width, fruit weight and carpel number parameters, respectively. When the TTSC parameter was examined, the G65 genotype came to the fore; and the G12 and G114 genotypes gave the best results in terms of fruit color. Morphological variability was determined to be high among the studied tomato genotypes.

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7. Appendices

Table 3
Leaf and fruit characteristics of tomato genotypes

Genotip adı	Leaf attitude	Leaf width	Leaf length	Flower of cluster	Fruit maturity	Fruit color	Genotip adı	Leaf attitude	Leaf width	Leaf length	Flower of cluster	Fruit maturity	Fruit color
G1	7	3	3	3	5	3	G66	3	7	7	3	7	5
G2	7	3	3	3	5	3	G67	7	3	7	3	7	3
G3	5	3	5	3	5	7	G69	5	3	5	3	7	3
G4	5	3	3	3	5	3	G70	7	7	7	3	3	3
G5	3	3	3	3	3	7	G72	5	7	7	3	3	3
G6	5	3	7	3	5	3	G74	3	7	7	3	3	5
G7	5	5	5	3	5	3	G76	7	3	7	3	5	5
G8	5	3	3	7	3	9	G77	7	7	7	3	3	3
G9	5	7	7	3	3	7	G79	7	3	3	7	3	7
G12	5	3	3	3	3	7	G80	7	3	7	3	7	7
G14	7	5	7	3	3	5	G81	5	7	7	3	5	3
G15	7	7	7	3	5	3	G82	5	3	3	3	3	7
G19	7	5	7	3	5	5	G83	5	7	7	3	7	7
G20	7	5	5	3	5	3	G84	5	7	7	5	5	3
G21	7	3	3	5	5	3	G85	7	5	5	3	5	7
G22	5	5	7	3	5	3	G87	5	5	7	3	3	3
G23	7	5	5	3	5	5	G88	5	5	7	3	5	3
G24	5	3	3	3	5	5	G90	7	7	7	3	5	1
G25	7	5	7	3	3	5	G91	5	5	5	3	3	7
G26	5	3	3	7	3	7	G92	7	3	7	3	3	5
G27	7	7	7	3	5	3	G93	5	7	7	3	5	3
G28	7	5	7	3	7	3	G94	5	5	5	3	3	5
G29	5	5	7	3	3	7	G95	5	5	7	3	5	3
G30	3	5	7	3	3	7	G97	5	7	7	3	5	7
G32	7	3	7	3	5	3	G98	5	5	7	3	3	7
G33	5	5	5	3	5	7	G99	5	7	7	3	5	7
G34	5	5	7	3	5	5	G100	5	7	7	3	3	7
G35	7	5	7	3	5	5	G101	5	7	7	3	5	7
G36	5	3	3	3	3	7	G102	7	7	7	3	3	3
G40	5	5	5	3	5	7	G103	7	7	7	3	5	3
G42	5	5	5	3	5	3	G104	7	7	7	3	5	5
G46	7	3	7	5	5	7	G105	7	3	7	5	5	5
G50	5	7	7	3	3	3	G106	5	5	5	3	3	3
G51	7	5	5	3	3	3	G107	5	5	7	5	7	7
G52	5	5	7	3	3	3	G108	7	5	7	3	5	5
G53	7	5	5	3	5	7	G109	3	7	7	3	3	3
G54	3	5	7	3	5	7	G110	7	3	7	3	5	7
G55	7	5	5	3	5	7	G111	5	5	5	3	3	7
G56	5	3	7	3	5	3	G112	7	5	5	3	3	7
G57	5	3	3	3	5	3	G113	5	5	7	5	5	5
G58	3	5	7	3	5	7	G114	5	3	3	3	7	5
G59	7	5	5	3	3	7	G115	5	3	7	3	3	5
G60	5	3	3	3	5	3	G117	7	3	3	7	3	9
G62	5	3	3	3	5	5	G119	7	5	7	3	5	7
G63	7	5	7	3	5	7	G120	7	5	5	3	3	3
G64	7	7	7	3	5	7	G122	7	7	7	3	5	7
G65	3	3	3	3	5	5	G124	7	5	7	3	5	5

Table 4
Fruit characteristics in tomato genotypes

Genotype Name	Fruit Weight (gr)	Fruit Width (mm)	Fruit Legth (mm)	Thickness Of Pericarp (mm)	Fruit Longitudinal Section	Fruit Cross Section	Number Of Locules	TTSC
G1	197.29	76.8±4.32	60.5±4.02	4.7±0.30	1	3	5	4.1
G2	227	77.4±1.69	64.3±1.17	6.9±0.03	3	3	5	4.2
G3	152.02	65.3±0.08	50.0±2.11	5.6±0.29	1	3	5	6.3
G4	181.96	68.1±2.86	62.6±0.76	5.5±0.24	3	3	4	3.6
G5	109.8	54.7±1.52	50.0±1.71	6.4±0.60	3	3	2	4
G6	134.28	61.4±2.11	57.6±4.08	4.2±0.71	3	5	4	5.81
G7	282.25	81.3±11.62	62.3±6.20	5.4±1.08	5	9	7	4.1
G8	14.49	27.8±1.93	25.7±1.27	3.0±0.26	7	3	2	7
G9	317.6	77.6±5.69	64.1±0.45	6.7±0.76	5	3	6	4.2
G12	168.71	65.9±3.61	53.8±2.20	4.8±0.47	1	9	4	5.5
G14	182.22	70.0±7.04	52.1±3.20	6.6±1.99	5	9	6	5.1
G15	140.99	63.2±5.32	58.3±2.91	5.2±1.35	3	9	4	2.7
G19	139.18	64.9±4.83	63.5±2.29	5.5±0.21	3	3	4	4.9
G20	172.99	63.4±3.71	57.1±4.6	5.6±0.56	1	3	5	4.2
G21	145.28	70.6±4.30	61.2±1.02	5.5±1.57	3	3	3	5.9

G22	168.03	71.60±2.99	63.9±1.71	5.4±1.13	3	3	4	4
G23	177.97	66.42±10.23	63.1±6.02	5.3±0.27	3	3	6	3.6
G24	154.13	60.4±	56.6±	6.4±	3	3	3	3.8
G25	297	75.95±2.41	51.5±1.39	4.0±0.02	1	9	6	4.4
G26	18.3	57.1±0.81	51.9±0.91	4.8±0.50	9	3	2	6.8
G27	161.5	65.5±8.05	55.2±2.71	5.0±0.43	3	5	4	3.9
G28	279	65.3±1.97	55.4±2.41	5.1±2.03	5	9	5	3.1
G29	78.31	65.0±3.09	50.3±3.57	4.5±1.54	3	9	2	4.9
G30	104.71	71.8±3.25	53.9±1.31	4.6±0.24	3	3	3	4.1
G32	166.3	72.7±3.90	55.0±2.76	4.8±0.30	1	3	7	3.8
G33	214.79	70.6±0.33	54.0±1.76	4.8±0.22	1	3	5	4.1
G34	111.5	72.2±7.73	58.0±6.03	5.8±0.28	1	9	5	3.4
G35	248.73	70.6±3.27	57.0±0.14	6.3±1.18	1	3	5	3.2
G36	118.58	69.3±5.27	56.8±3.71	6.3±0.79	3	1	3	4.7
40-1	204.46	74.9±5.04	58.5±1.19	5.9±0.29	5	9	6	4.9
42-1	255	74.1±	64.3±	6.5±	1	3	4	3.6
46-1	197	64.8±0.68	52.6±0.51	5.7±0.62	1	3	6	3.1
G50	106.34	55.2±6.53	47.8±0.19	6.3±0.14	1	3	2	4.6
G51	94.18	55.9±4.83	50.0±3.53	5.2±0.26	1	3	3	3.8
G52	150.74	63.0±2.29	52.3±2.39	5.8±1.24	3	3	5	3.1
G53	200	70.5±4.92	55.2±1.52	5.9±0.55	1	9	6	3
G54	310	79.6±5.70	62.6±3.46	5.6±1.42	1	3	6	5.5
G55	187.25	71.9±0.63	56.2±3.23	8.1±1.17	1	3	4	3.8
G56	204.73	71.3±6.90	63.8±2.99	6.8±0.55	9	9	4	2.8
G57	138.5	63.7±3.07	55.3±1.48	6.6±1.57	3	3	4	4.2
G58	110.62	63.7±7.14	55.9±3.26	6.2±1.12	3	3	2	5.9
G59	81.85	56.1±3.89	49.8±2.06	5.2±0.25	3	3	4	3.8
G60	136.91	63.9±13.49	51.2±4.67	5.6±0.46	1	3	3	4.4
G62	128.33	62.4±7.84	49.6±4.89	4.5±0.98	1	9	5	3.4
G63	167.79	71.6±71.56	60.0±1.47	4.6±0.40	1	3	6	4
G64	246	71.1±	59.5±	6.4±	1	9	4	3.8
G65	90.45	52.6±1.20	47.5±1.22	7.0±0.34	3	3	2	3.3
G66	158.46	68.8±5.16	56.7±1.40	7.1±1.14	3	3	3	2.9
G67	105.76	59.1±1.21	51.2±3.00	6.2±0.08	3	3	3	4.1
G69	243.3	88.1±	65.2±	4.8±	5	3	4	4.4
G70	287.01	77.4±	70.1±	6.7±	3	1	6	5.5
G72	186.57	69.7±4.45	58.6±3.22	5.5±0.46	3	3	4	4.3
G74	162.26	65.2±4.97	55.1±5.02	5.8±1.23	1	3	5	4.9
G76	190.76	69.6±7.36	61.9±2.98	6.3±0.65	1	9	5	4.3
G77	167.75	71.9±3.20	50.9±2.00	4.2±0.84	1	9	4	4.4
G79	86.33	51.3±0.72	43.1±1.51	5.1±0.38	3	3	3	6.5
G80	128.4	69.6±3.10	53.2±3.01	5.2±1.00	1	9	5	4.5
G81	232.75	77.2±6.76	56.7±4.87	5.7±1.09	5	9	5	4.3
G82	136.46	62.4±4.26	53.2±3.01	5.3±1.48	3	3	4	3.5
G83	259.69	85.0±0.17	61.6±2.95	5.3±0.65	5	9	5	4.7
G84	188.83	73.4±2.49	56.3±4.37	5.3±0.47	3	3	3	6.3
G85	264.74	57.6±2.22	41.8±4.06	6.2±0.29	3	5	4	3.8
G87	176.89	67.7±4.15	62.7±3.34	5.4±1.16	1	9	3	5.9
G88	232.27	77.7±7.27	64.0±1.39	5.8±0.57	1	3	4	4.6
G90	195.11	78.6±10.20	52.0±1.53	4.2±0.79	5	9	5	5.2
G91	184.5	71.0±5.40	58.9±1.14	6.8±0.86	3	3	2	5.3
G92	292.86	70.9±17.47	58.1±8.31	7.1±0.82	5	3	5	5.5
G93	219.81	88.2±8.70	77.1±3.26	6.0±0.29	1	9	4	3.4
G94	214.94	76.2±2.60	64.4±4.73	6.4±1.08	3	1	3	4.4
G95	165.83	75.7±11.53	60.8±2.17	5.1±0.74	5	3	5	3.4
G97	206.29	74.9±2.04	60.1±2.92	5.0±0.43	1	3	6	5.4
G98	258.26	83.4±7.29	56.9±5.43	3.8±0.58	5	3	9	4.1
G99	186.72	69.7±3.32	55.2±0.49	6.8±0.17	1	9	3	4.1
G100	274.31	86.0±3.26	60.2±1.55	8.0±0.59	5	3	5	4.8
G101	144.94	70.5±2.84	52.4±2.93	6.1±0.99	1	9	6	5.4
G102	213.22	72.9±4.00	55.4±2.29	3.6±0.45	5	3	5	4.01
G103	276.75	86.0±	64.3±	6.3±	5	3	7	4.8
G104	226.83	68.7±8.72	56.0±1.57	6.1±0.96	5	3	5	3.9
G105	176	62.5±3.44	60.7±2.64	7.5±0.14	9	9	2	4.7
G106	96.8	56.0±4.90	47.0±4.57	4.8±0.30	3	3	4	4.1
G107	196	72.9±11.68	57.2±0.31	6.8±0.19	3	3	3	2.8
G108	174	74.1±9.50	58.7±0.81	3.9±0.56	1	9	4	3.6
G109	219	70.2±	56.42±	70.2±	5	3	7	3.7
G110	276.67	78.6±0.40	53.9±0.57	4.8±0.48	1	9	6	4.7
G111	242	76.5±2.35	68.7±2.42	7.3±2.57	3	3	6	2.9
G112	261.67	79.2±3.25	63.4±1.77	5.8±0.42	1	9	4	2.7
G113	227.67	78.7±4.34	63.7±2.58	5.4±0.39	9	3	6	2.6
G114	158	66.2±	58.4±	5.6±	1	3	3	5.5
G115	156.75	67.1±6.85	59.1±4.93	7.1±0.39	3	3	4	3.9
G117	22.44	31.8±1.70	34.8±2.02	3.8±0.58	7	3	2	6.2
G119	264	87.5±1.09	58.9±4.6	9.2±0.07	5	9	6	3.9
G120	152.75	63.0±0.42	57.1±2.49	5.6±0.47	9	9	3	4.5
G122	159.67	80.8±	65.7±	6.0±	1	9	6	3.5
G124	214.5	72.6±3.17	59.7±2.02	6.7±0.09	3	3	3	3.8