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Investigation of Pomological and Morphological Traits of Some Peach (*Prunus persica* L.) Cultivars and Local Genotypes Grown in Çanakkale Ecological Conditions

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Abstract: The peach is a widespread and economically important fruit species all over the world. Due to its genetic diversity and the suitability of its ecological conditions, Türkiye is a leading country in the production of peaches. The temperate climate and fertile soils of Çanakkale provide an optimal environment for the cultivation of local peach genotypes. The aim of this study was to compare and evaluate the pomological and morphological traits of local peach genotypes grown in Çanakkale with the standard peach cultivars according to the criteria of UPOV TG/53/7 Rev. 2. The materials employed in this study included the standard cultivars Glohaven, Cresthaven, Şentürk, and J.H. Hale as well as the local genotypes Black Abdos and Sırrı. The analysis revealed a range of fruit width (52.17–75.64 mm), fruit weight (74.47–225.73 g), stone weight (5.56–12.28 g), flesh firmness (0.91–2.91 N), and soluble solids content (9.16%–12.16%) in the samples. The leaf areas ranged from 3672.190 to 5271.610 mm², which showed a considerable variation. In accordance with the criteria set forth by the UPOV, the leaf margins of the Black Abdos cultivar were observed to exhibit a serrated morphology, while the other cultivars displayed a crenate morphology. The nectarines of Black Abdos and Sırrı were observed to be reniform and present in two numbers. Additionally, the leaf bases of all genotypes were observed to be pointed. These findings provide invaluable insights for the conservation of genetic resources, the development of novel cultivars, and the improvement of production efficiency, while simultaneously guiding the preservation of regional diversity and the formulation of market-oriented production strategies.

Keywords: Peach local genotypes, standard cultivars, morphological traits, pomology, Çanakkale.

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Introduction

The peach (*Prunus persica* L.) is a member of the genus *Prunus*, which belongs to the subfamily *Prunoidea* of the family *Rosaceae*, within the order Rosales (Deveci, 1967; Rieger, 2007). The botanical name of the peach, *Prunus persica* L., has been attributed to its origin in Iran and the Caucasus (Gharaghani et al., 2017). Peach cultivation is practiced worldwide, both south and north of the equator, between latitudes 25 and 45 (Demirören, 1992). The diversity of our country's ecosystems, coupled with the peach's early yield, processing potential for fruit juice and canned products, and suitability for fresh consumption, renders it an important intermediate agricultural crop (Şeker & Kaya, 2024). Moreover, the considerable number of varieties and recent success in identifying suitable markets have contributed to the significance of peach production (Ekinci et al., 2024; Gür et al., 2024). The peach occupies a prominent position among fruit species, largely due to its economic value and extensive cultivation across the globe (Bayav & Çetinbaş, 2021). Given its extensive usage in both the fresh consumption and food processing industries, peaches are of great importance in Türkiye (Güneş et al., 2017). A review of the statistical data published by TUIK (2023) reveals that global peach production in 2022 was 26.354,497 tons, while Türkiye's production in 2023 was 1.076,852 tons. A further examination of export values in 2023 reveals a total of 227.106 tons. The total peach production in Çanakkale is 192.802 tons (TUIK, 2023). As a consequence of its favorable ecological conditions and genetic diversity, Türkiye is among the foremost countries in terms of peach production (Natalchuk et al., 2024). The fertile agricultural lands and microclimatic characteristics of the Marmara Region, particularly in Çanakkale, serve to further enhance the prominence of peach genotypes cultivated in this area (Yıldırım & Koyuncu, 2005; Layne & Bassi, 2008; Kaya & Şeker, 2023).

The evaluation of pomological and morphological characteristics of local genotypes is of paramount importance for both scientific research and applied agriculture (Yılmaz et al., 2017). The identification of such characteristics enables the determination of the region-specific adaptive abilities and superior traits of local genotypes (Demirel et al., 2024). This is of particular importance for the conservation of genetic resources, the breeding of new cultivars, and the optimization of cultivation practices. Furthermore, the pomological traits of local genotypes provide valuable insights into fruit quality, market value, and consumer preferences, while morphological traits provide essential information about agricultural performance, ecological adaptability, and disease resistance (Gariglio et al., 2012).

It is of the utmost importance to understand the differences between standard cultivars and local genotypes in order to enhance the competitiveness of the latter and develop appropriate cultivation strategies. Standard cultivars are usually known for their high yields, extensive geographical adaptability, and consistent quality. In contrast, local genotypes offer distinct advantages, such as greater resilience to regional environmental conditions, suitability for minimum input farming systems, and distinctive flavor profiles (Faust, 1989). Highlighting these differences enables producers to utilize genetic resources in a more effective manner, helps preserve regional diversity, and increases export potential (Reig Córdoba, 2013).

The region of Çanakkale, with its temperate climate, consistent rainfall patterns, and fertile soils, provides an optimal ecological foundation for peach cultivation (Şeker et al., 2013). Local genotypes in the region have adapted to these distinctive conditions over an extended period, resulting in a high level of genetic diversity. However, it has been observed that the pomological and morphological characteristics of these genotypes have not been sufficiently studied from a scientific perspective, thereby leaving their full potential untapped. This study aims to address this gap by revealing the superior traits of local genotypes and contributing to the genetic resources of Çanakkale in the scientific literature.

The study will inform producers of the varieties that are best suited to market demands and the most appropriate regional production strategies, by comparing local genotypes with standard varieties. In view of the growing consumer demand for environmentally sustainable, low-input, and distinctive taste profiles, it is anticipated that the results of this study will make an important contribution to both local producers and national agricultural policy.

Materials and Methods

Materials

The present study was conducted in the 2024 production season in a producer orchard in Umurbey Village, Lapseki District, Çanakkale Province (plot 285/19) (Figure 1), where peach varieties were grown under optimal conditions and harvested at the commercial maturity stage. The present study is concerned with the pomological and morphological characteristics of the following peach cultivars grafted onto GF677 rootstock: The cultivars included in the study were Glohaven, Cresthaven, Şentürk and J. H. Hale, as well as the local peach genotypes, Black Abdos and Sırrı (Figure 2). The age of the trees was 11 years. The trees were spaced 1 meter apart in each row and 3-meters apart between each row. The harvest dates of the peach cultivars and genotypes are provided in Table 1.

Figure 1. The image of the location where plant material was collected in the study.

Figure 2. Images of peach cultivars/genotypes used in the study.

Table 1. The harvest dates of the peach cultivars and genotypes.

Cultivars/Genotypes	Harvest Dates
Glohaven	28 July 2024
Cresthaven	20 August 2024
Şentürk	10 July 2024
J. H. Hale	20 August 2024
Black Abdos	25 August 2024
Sırrı	20 September 2024

Methods

Collection of Leaf Samples

Leaf samples were taken according to the following methodology, which is described in detail below. Fully developed leaves were collected from the four cardinal points of the tree. A total of 100 leaves and their petioles were taken from each tree (Figure 3). Sampling was carried out in an X-shape in the orchard in question, with one tree being omitted. The leaf samples were wrapped in aluminum foil and placed in an ice box. The name of the sample, the name of the orchard where the sample was taken, the date of sampling and the age of the tree were written on the label. The leaf samples were transported to the laboratory as quickly as possible under cold chain conditions.

Collection of Fruit Samples

Fruits were randomly selected from all four sides of the tree (X-shaped) to represent the production orchard. A total of 30 fruit samples were taken from each tree. The measurements performed on the fruits were determined in three replicates, with 10 fruits each.

Figure 3. An image of collected leaves (front and rear view).

Morphological, Physical, and Chemical Measurements

Fruit and stone weights were measured individually using a precision balance with ±0.01 g sensitivity. Dimensional measurements were performed using a caliper, with three replicates of 10 samples each. Fruit firmness was measured with a Chatillon penetrometer (9 mm tip), and color parameters (L*, a*, b*) were determined using a Minolta CR-400 colorimeter. Flesh ratio (%) was calculated by subtracting stone weight from fruit weight and expressing the result as a percentage. Titratable acidity (g/100 ml citric acid) was determined by diluting the juice with distilled water and titrating with 0.1 N NaOH to pH 8.10 using an Orion digital pH meter. Fruit juice pH was also measured using the same device. Soluble solids content (SSC) was determined using a digital Hanna refractometer and expressed as a Brix percentage. Leaf measurements were performed using a ruler and caliper, and leaf area was calculated using the Leaf Area Measurement Program v1.3. SPAD values were recorded as the mean of 10 randomly selected leaves per replicate. Nectary traits, leaf shape, margin type, hairiness, and other morphological characteristics were evaluated according to the UPOV TG/53/7 Rev. 2 guidelines.

Data Analysis

The results obtained in the study were evaluated using analysis of variance (ANOVA) with the statistical package "SAS 9.1.3 Portable". The differences between varieties and genotypes in the parameters studied were evaluated by the LSD multiple comparison test at the 0.05 significance level ($p<0.05$). For morphological data, the criteria developed by the International Union for the Protection of New Varieties of Plants (UPOV-TG/53/7 Rev. 2) for the peach species were taken into account.

Results and Discussion

Peach is a widely grown fruit with high economic value worldwide and is one of the most important fruits in Türkiye. However, the unique climate and soil conditions of each region can influence the yield and quality characteristics of different cultivars and local genotypes. In this study, the morphological and pomological traits of different fruit cultivars and genotypes were compared and their importance for commercial potential in terms of a number of parameters are elaborated. The data obtained revealed significant differences among the genotypes, which may influence the suitability of each genotype for different market requirements.

In the study, the genotype Sırrı had the widest fruit (75.64±0.26 mm) compared to the other varieties. This finding is consistent with the fruit size data for the Sırrı genotype presented in the study by Gür et al. (2020). Similarly, genotypes such as Black Abdos (71.56±2.17 mm) are also characterized by large fruit width in the literature (Gür et al., 2020). These large fruits are generally preferred due to their superior taste and market value. In this study, when compared to smaller varieties such as Cresthaven (52.17±1.31 mm) and Glohaven (59.05±2.61 mm), the larger fruit width was found to have significant advantages, particularly from a commercial perspective (Table 2).

The Sırrı and Black Abdos genotypes, with weights of 225.73±7.29g and 214.11±13.92g, respectively, had the heaviest fruit. This result is in line with findings by Gür et al. (2020), where it was also reported that the Sırrı and Black Abdos genotypes possess large fruit weights. However, in this study it was observed that the fruit weights of other cultivars such as Cresthaven (74.47±6.13 g) and Glohaven (129.86±8.81 g) were smaller, suggesting that their market value, especially for commercial production, might be lower. It has been emphasized in numerous studies that fruit width and weight are crucial parameters influencing market value (Table 2). The data on stone width and length indicate significant differences among cultivars. In particular, the stones of the Şentürk cultivar (27.88±3.86 mm) and Sırrı (23.01±0.74 mm) genotype were found to be wider and longer, whereas smaller stone widths were observed in cultivars such as Cresthaven (20.40±0.16 mm) and Glohaven (19.02±1.77 mm). This finding is consistent with Tecimer (2012), who reported that some cultivars have smaller stones, which could positively influence production processes. Peach cultivars with smaller stones may also be more attractive in terms of market and consumer demand (Table 2).

The highest stone weight value was observed in the Sırrı genotype (9.09±0.75 g). The Black Abdos genotype (12.28±1.14 g) and Şentürk cultivar (9.40±2.01 g) also exhibited high stone weights. However, high stone weight may result in increased production costs for stone fruit varieties and may not be preferred by certain markets. Consequently, varieties with lower stone weights may offer a more advantageous profile, particularly in terms of fresh consumption and overall market value (Table 2).

Stoneless fruit weight is generally important as a parameter of commercial production. The Sırrı genotype (216.64±6.61 g) had the highest value in terms of stoneless fruit weight, followed by Black Abdos (201.83±13.23 g) and Şentürk (141.36±8.48 g). Fruits with lower stone content have a higher economic value especially for fresh consumption and the processing industry. In this study, lower stone fruit weights were found in varieties such as Glohaven (124.30±8.55 g) and Cresthaven (67.68±6.16 g), suggesting that these varieties may provide lower yields in commercial production (Table 2).

The measurement of L*, a*, and b* values is of great importance for both the determination of quality and the optimization of marketing strategies. The L* value indicates the brightness of the fruit, and higher L* values are generally perceived as fresher and more attractive by consumers, which increases the market value of the fruit. The use of color measurements enables producers to accurately assess the ripeness of their peaches, thereby facilitating the optimization of harvest timing and the reduction of quality losses. Furthermore, the a* and b* values can indicate the fruit's acidic or sweet characteristics, helping in the selection of varieties better aligned with consumer preferences. In the processing industry, darker peach varieties are more commonly preferred due to their typically richer taste and texture. Consequently, the selection of appropriate fruit for processing can be made more efficiently through the use of color measurements. In addition, alterations in the fruit's peel pigmentation can be employed to ensure the maintenance of quality during storage and transportation, as color provides crucial indications regarding the freshness and quality of the peaches (Fallik & Ilic, 2018).

Table 2. The pomological traits of peach cultivars and genotypes.

Cultivar/Genotype	Fruit width (mm)	Fruit length (mm)	Fruit weight (g)	Stone width (mm)	Stone length (mm)	Stone weight (g)	Stoneless fruit weight (g)
Glohaven	59.05±2.61^{d}	66.11±0.25^{d}	129.86±8.81^{c}	19.02±1.77^{c}	35.76±1.90^{cb}	5.56±0.66^{c}	124.300±8.55^{d}
Cresthaven	52.17±1.31^{e}	54.07±2.77^{e}	74.47±6.13^{d}	20.40±0.16^{cb}	34.01±0.76^{c}	6.78±0.06^{c}	67.683±6.16^{e}
Şentürk	65.13±1.99^{c}	70.40±3.45^{cb}	150.75±7.69^{b}	27.88±3.86^{a}	40.34±1.49^{a}	9.40±2.01^{b}	141.357±8.48^{c}
Black Abdos	71.56±2.17^{b}	71.02±1.27^{b}	214.11±13.92^{a}	23.04±0.66^{b}	36.66±0.72^{b}	12.28±1.14^{a}	201.830±13.23^{b}
Sırrı	75.64±0.26^{a}	77.77±0.83^{a}	225.73±7.29^{a}	23.01±0.74^{b}	42.52±1.79^{a}	9.09±0.75^{b}	216.637±6.61^{a}
J.H. Hale	62.36±1.21^{c}	67.25±0.53^{cd}	129.53±2.43^{c}	21.42±0.95^{cb}	37.67±0.75^{b}	7.02±0.61^{c}	122.507±2.64^{d}
$LSD_{(0.05)}$	3.1498 **	3.4262 **	15.008 **	3.2429 **	2.3733 **	1.8824 **	14.678 **

** There are statistically significant differences among cultivars/genotypes in terms of the related trait (p<0.05).

The highest L* values were observed in Glohaven (48.55±2.41) and Şentürk (48.85±2.91) in this study. This indicates that the fruit peel is of a lighter hue, and these varieties are typically regarded as more aesthetically pleasing in the marketplace. It has been demonstrated that peels of a lighter hue are preferred by consumers, as they are perceived as fresher and more appealing (Minas et al., 2018). Conversely, the genotype Black Abdos (33.19±2.24) exhibited the lowest L values, indicating a darker peel color (Table 3). It has been demonstrated that peach varieties with darker hues may be more favored by the processing industry due to their superior storage and processing qualities. The significance of color in consumer preference is well documented, with associations between color and market value frequently observed, particularly in the context of fresh fruit and processed products (Christofi, 2021).

The highest values in terms of rind a* values are observed in Cresthaven (26.22±1.81) and Sırrı (30.42±1.41). This indicates that their red tones are more dominant, resulting in more vivid and remarkable colors. The studies conducted on the subject highlight red peel color as a feature that increases consumer appreciation. However, the a* values of the Black Abdos genotype (29.43±3.22) and the Şentürk cultivar (28.94±1.51) are also high, although their red color tones may be less prominent than those of Cresthaven (Table 3). Significant differences are evident between the varieties in terms of b value. It can be observed that certain genotypes, such as Black Abdos and Cresthaven cultivars, exhibit a more pronounced yellow color tone, which may be a significant factor in the visual representation of the fruit peel in the market.

The Şentürk cultivar exhibited the highest value for flesh a* with a mean of 0.91±0.51, while the Glohaven (0.39±0.99) and Cresthaven (-0.36±0.33) cultivars demonstrated lower red tones. The fruit flesh of the Şentürk cultivar is characterized by reddish tones, whereas the flesh of the other varieties exhibits more neutral hues. The flesh b* value is higher in the Black Abdos (1.68±1.89) and Sırrı (1.69±0.49) genotypes (Table 3), indicating that yellow tones are dominant. These tones may be more attractive, especially for fresh consumption.

The Şentürk cultivar exhibited the highest fruit firmness value, with an average of 2.91±0.14 N, while Black Abdos (0.91±0.29 N) and J.H. Hale (3.31±0.41 N) demonstrated notably lower firmness values (Table 3). The firmness of peach fruit is closely related to its suitability for consumption. Harder fruits are generally more durable during transport and storage, but may be less desirable for fresh consumption. Additionally, hard fruit flesh can be an important characteristic in the processing industry (Gür & Pırlak, 2011).

The genotype Sırrı (95.97±0.22) exhibited the highest value in terms of fruit flesh ratio, indicating that the fruit flesh constitutes a greater proportion of the fruit than the peel and therefore provides a higher yield. Additionally, the Glohaven (95.71±0.47) and J.H. Hale (94.57±0.51) cultivars exhibited elevated fruit flesh ratios, suggesting that these cultivars may be preferred by consumers for fresh consumption (Table 4). Similar ratios were observed in the Black Abdos genotype (94.26±0.40) and Şentürk (93.74±1.49) cultivars. The Cresthaven

(90.84±0.80) variety exhibited a significantly lower fruit flesh ratio compared to the other cultivars (Demiral & Ülger, 2021).

Table 3. The pomological traits of peach cultivars and genotypes.

Cultivar/Genotype	Fruit peel L*	Fruit peel a*	Fruit peel b*	Fruit flesh L*	Fruit flesh a*	Fruit flesh b*	Fruit flesh firmness (N)
Glohaven	48.55±2.41^{a}	21.19±4.19^{c}	30.03±4.24^{a}	69.14±5.75^{bc}	0.39±0.99^{ba}	59.86±1.76^{a}	1.96±0.37^{b}
Cresthaven	42.04±1.99^{b}	26.22±1.81^{a}	26.33±4.34^{ba}	75.10±0.60^{a}	-0.36±0.33^{b}	60.44±2.01^{a}	1.73±0.19^{b}
Şentürk	48.85±2.91^{a}	28.94±1.51^{ba}	30.68±1.81^{a}	72.73±0.39^{ba}	0.91±0.51^{ba}	57.55±1.82^{ba}	2.91±0.14^{a}
Black Abdos	33.19±2.24^{c}	29.43±3.22^{ba}	20.81±3.87^{b}	66.98±1.86^{c}	1.68±1.89^{a}	49.94±1.68^{c}	0.91±0.29^{c}
Sırrı	39.33±5.42^{b}	30.42±1.41^{a}	27.55±4.12^{a}	72.33±0.72^{ba}	1.69±0.49^{a}	56.25±2.12^{b}	1.68±0.12^{b}
J.H. Hale	38.41±0.30^{cb}	25.40±1.56^{bc}	20.26±1.36^{b}	71.89±0.72^{ba}	-0.24±0.40^{b}	54.77±0.06^{b}	3.31±0.41^{a}
LSD$_{(0.05)}$	5.2779 **	4.4721 **	6.2489 **	4.4852 **	1.6746 **	3.0599 **	0.4912 **

** There are statistically significant differences among cultivars/genotypes in terms of the related trait ($p<0.05$).

The analysis of titratable acidity values revealed that the genotype exhibiting the highest acidity was Black Abdos (0.82±0.010). The cultivar exhibiting the lowest acidity was Cresthaven, with a mean value of 0.46 ± 0.017. The remaining cultivars and genotypes fell within the intermediate group (Table 4). The determination of titratable acidity (TA) values among peach cultivars and genotypes offers significant advantages for consumers. The acidity content has a direct influence on the flavor of the peach. A higher acidity results in a more sour taste, whereas a lower acidity leads to a sweeter profile. This allows consumers to select peach cultivars that align with their personal taste preferences. Moreover, the acidic characteristics affect both the consumption of fresh peaches and the shelf life of processed peach products, such as jams, compotes, and fruit juices. Higher acidity helps maintain the freshness of fruit products and contributes to better quality in processed goods. Therefore, titratable acidity is an important quality indicator for both peach producers and consumers (Serrano & Valero, 2010).

Table 4. The pomological traits of peach cultivars and genotypes.

Cultivar/Genotype	Fruit flesh ratio (%)	Titratable acidity (g citric acid 100 ml^{-1})	Fruit juice pH	Brix (%)	SPAD
Glohaven	95.71±0.47^{ba}	0.71±0.006^{b}	3.38±0.01^{e}	10.73±0.15^{c}	42.38±1.0^{ba}
Cresthaven	90.84±0.80^{d}	0.82±0.010^{a}	3.63±0.01^{b}	10.20±0.17^{d}	41.50±1.0^{bc}
Şentürk	93.74±1.49^{c}	0.72±0.029^{b}	3.93±0.02^{a}	9.16±0.06^{e}	40.22±1.0^{c}
Black Abdos	94.26±0.40^{c}	0.46±0.017^{e}	3.62±0.01^{b}	11.73±0.12^{b}	43.50±1.0^{a}
Sırrı	95.97±0.22^{a}	0.50±0.004^{d}	3.48±0.02^{c}	12.16±0.25^{a}	43.00±1.0^{ba}
Hale	94.57±0.51^{bc}	0.65±0.006^{c}	3.42±0.02^{d}	11.86±0.42^{ba}	43.74±1.0^{a}
LSD$_{(0.05)}$	1.3629 **	0.4003 **	0.0244 **	0.4022 **	1.779 **

** There are statistically significant differences among cultivars/genotypes in terms of the related trait ($p<0.05$).

Upon analysis of the pH values, it was observed that the highest pH value was (3.93±0.02) in the Şentürk cultivar, while the lowest pH was (3.38±0.01) in the Glohaven cultivar (Table 4). The remaining cultivars and genotypes fell within the intermediate range. This indicates that the flesh has an acidic profile, resulting in a sourer flavor (Ilgın & Yüce, 2019). Low acid peach cultivars are more suitable for processing with sweeteners, generally offering a sweeter flavor profile. Cultivars with lower pH, such as Glohaven, exhibit stronger acidic characteristics and are thus suitable for use in processed food products.

The genotypes Sırrı (12.16±0.25) and Black Abdos (11.73±0.12) exhibited the highest soluble solids content (SSC) ratios (Table 4). This suggests that these varieties contain a greater proportion of soluble carbohydrates, which contributes to a more pronounced sweetness in their flavor profile. The cultivars Glohaven (10.73±0.15) and Cresthaven (10.20±0.17) exhibited lower soluble solids content (SSC) values, which may indicate a relative weakness in terms of sweetness. These findings are directly relevant to consumer taste preferences. The determination of soluble solids content (SSC) in peach cultivars and genotypes offers significant benefits to producers (Anthony & Minas, 2022). It directly influences the sweetness and overall flavor quality of the fruit. A high soluble solids content (SSC) is an essential factor in the production of sweet and flavorful peaches. By measuring the SSC values of different genotypes, producers can cultivate high-quality fruits that meet consumer demand (Lachkar et al., 2020). Furthermore, determining the SSC content provides a competitive advantage in the market, as consumers generally prefer sweet and flavorful fruits. This allows producers to offer their products to the market more efficiently, increase their income and make sustainable production.

The highest SPAD values were observed in Black Abdos (43.50±1.0) and J.H. Hale (43.74±1.0). This indicates that these genotypes and cultivars possess elevated chlorophyll concentrations, thereby conferring greater intensity of green hue (Table 4). The varieties Glohaven (42.38±1.0) and Sırrı (43.00±1.0) exhibited moderate chlorophyll content, whereas Cresthaven (41.50±1.0) and Şentürk (40.22±1.0) displayed lower SPAD values and paler green colors. This suggests that chlorophyll content is related to fruit ripeness, with high SPAD values indicating that the fruit flesh is close to reaching full maturity. Chlorophyll is a vital component of the photosynthetic process in plants and provides insights into plant health, nutritional status, and environmental stress tolerance (Ahmad et al., 2023). The use of SPAD measurements allows for the rapid and non-invasive determination of chlorophyll content in peach plants. This enables producers to obtain early warnings regarding the plant's nutritional status and health, facilitating the detection of adverse conditions such as nitrogen deficiency, water stress, or disease. Furthermore, monitoring chlorophyll levels indicates the plant's high photosynthetic capacity, which correlates with higher yield and quality potential (Wang et al., 2015). This assists producers in improving both productivity and product quality. Additionally, SPAD values are a valuable tool for determining the plant's nutrient requirements, optimizing fertilization strategies and overall nutrient management (Shah et al., 2017).

The data obtained in this study on fruit flesh ratio, titratable acidity, pH, soluble solids content and SPAD values demonstrate that there is considerable variation in the quality parameters of peach cultivars. The elevated fruit flesh ratio and soluble solids content observed in genotypes such as Sırrı and Black Abdos confer a significant advantage in terms of sweetness and productivity. The combination of high acidity and elevated pH. Şentürk may appeal to consumers who prefer acidic flavors. It is anticipated that the results of measurements of the relevant parameters may provide important insights into the commercial differentiation of fruit characteristics and the impact of peach production on marketing strategies.

The Glohaven (44.2±1.0) cultivar exhibited the widest leaf width, which may be indicative of a high photosynthetic capacity. This is due to the fact that larger and wider leaves are associated with greater photosynthetic efficiency. Additionally, the Şentürk (41.8±1.0) and J.H. Hale (41.8±1.0) cultivars exhibited relatively large leaves. The Cresthaven cultivar (38.0±1.0) and Black Abdos (35.4±1.0) genotype exhibited narrower leaves (Table 5). It has been demonstrated that there is a direct correlation between leaf width and water loss and photosynthetic efficiency. In this context, varieties with wider leaves can more efficiently utilize water and nutrients (Örs & Yıldırım, 2023).

The cultivar Glohaven exhibited the longest leaf length, while the Cresthaven and Black Abdos demonstrated shorter leaves, with lengths of 159.0±1.0 and 152.8±1.0, respectively. Similarly, the cultivars Şentürk (149.6 ± 1.0) and J.H. Hale (144.0 ± 1.0) also exhibited relatively shorter leaf lengths Longer leaves have the potential to capture more light, thereby enhancing photosynthetic efficiency, whereas shorter leaves may be associated with accelerated water loss (Derecik, 2018).

The J.H. Hale (3.37±1.0) cultivar was observed to have a significantly longer and wider petiole than other cultivars. The Şentürk cultivar (1.33±1.0) and Black Abdos genotype (1.42±1.0) were found to have narrower petioles (Table 5). The length of the petiole was found to be generally similar, with slightly longer petioles observed in the Şentürk cultivar (11.8±1.0) and the Sırrı (11.0±1.0) genotype. Petiole length has been demonstrated to affect the plant's water and nutrient transport capacity (Koçak, 2021).

Table 5. The morphological traits of peach cultivars and genotypes.

Cultivar/ Genotype	**Leaf width (mm)**	**Leaf length (mm)**	**Petiol width (mm)**	**Petiol length (mm)**	**Leaf margins**	**Nectaries number (piece)**	**Nectaries shape**	**Angle at base**	**Angle at apex**	**Leaf area (mm^2)**	**Leaf hairiness**	**Leaf shape**
Glohaven	44.2 ± 1.0^{a}	159.0 ± 1.0^{a}	1.56 ± 1.0^{b}	10.2 ± 1.0^{bdc}	crenate	0	-	acute	acute	5271.610 ± 2.0^{a}	absent	flat
Cresthaven	38.0 ± 1.0^{c}	152.0 ± 1.0^{b}	1.24 ± 1.0^{b}	9.2 ± 1.0^{d}	crenate	0	-	acute	acute	4388.880 ± 2.0^{d}	absent	flat
Şentürk	41.8 ± 1.0^{b}	149.6 ± 1.0^{c}	1.33 ± 1.0^{b}	11.8 ± 1.0^{ba}	crenate	0	-	acute	acute	4625.877 ± 6.43^{b}	absent	flat
Black Abdos	35.4 ± 1.0^{d}	152.8 ± 1.0^{b}	1.42 ± 1.0^{b}	9.8 ± 1.0^{dc}	deep serrate	2	reniform	acute	acute	3672.190 ± 2.0^{f}	absent	flat
Sırrı	38.0 ± 1.0^{c}	160.6 ± 1.0^{a}	1.46 ± 1.0^{b}	11.0 ± 1.0^{bac}	crenate	2	reniform	acute	acute	3976.050 ± 2.0^{e}	absent	flat
J.H. Hale	41.8 ± 1.0^{b}	144.0 ± 1.0^{d}	3.37 ± 1.0^{a}	12.0 ± 1.0^{a}	crenate	0	-	acute	acute	4552.830 ± 2.0^{c}	absen	flat
$LSD_{(0.05)}$	1.779 **	1.779 **	1.779 **	1.779 **	-	N.S.*	-	-	-	5.6878 **	-	-

** There are statistically significant differences among cultivars/genotypes in terms of the related trait ($p<0.05$).

*N.S. There are not statistically significant differences among cultivars/genotypes in terms of the related trait ($p<0.05$).

The Black Abdos (deep serrate) genotype is distinguished from the others by its distinctive leaf margin shape. The remaining cultivars predominantly display a crenate leaf margin shape (Table 5). The shape of the leaf margin is directly associated with genetic diversity, which may influence the cultivars' resilience to environmental stresses. It is hypothesized that plants with deep serrate margins may demonstrate greater resistance to water stress. The morphology of a plant's leaf margins, including the presence of crenate and serrate patterns, can be indicative of the plant's ability to adapt to specific environmental conditions. These margin types serve various functions, such as minimizing water loss, enhancing nutrient absorption, and reinforcing defensive mechanisms. The evolution of crenate leaf margins may have been driven by the need to minimize water evaporation, particularly in humid environments. The undulating structure helps retain atmospheric moisture, thereby reducing t water loss from the leaf surface. Conversely, serrate leaf margins, defined by sharp, tooth-like projections along the edge, facilitate more efficient water accumulation on the leaf surface, thus assisting the plant in maintaining a balance between water intake and output. Furthermore, these types of leaf margins may deter herbivores from feeding on the plant, thereby conferring a protective advantage. Both crenate and serrate leaf margins contribute to the plant's resistance to water stress, promoting more efficient water use and enabling the plant to better cope with environmental challenges. These morphological characteristics are critical adaptations that support plant survival in their respective ecosystems (Akbulut et al., 2017).

The number of nectaries was observed to be two in the Black Abdos and Sırrı genotypes. This indicates that the leaves of these genotypes have more nectaries, which may be associated with enhanced plant health. In other cultivars, no nectaries were observed (Table 5). Nectaries located on the petiole of peach trees serve as vital structures involved in various plant functions. These nectaries play a pivotal role in pollination. They attract bees and other pollinators, thereby facilitating pollination and potentially enhancing fruit yield. Furthermore, nectaries can attract certain pests, thereby strengthening the plant's defense mechanisms. Additionally, these structures contribute to the plant's overall defense strategies, aiding its survival and maintaining overall vitality. In this way, the nectaries on the petiole support the peach tree's adaptation to environmental factors and its survival strategies (Lim & Lim, 2012).

In all peach cultivars/genotypes identified within the scope of the study, it was determined that leaf base angles one of the UPOV TG/53/7 Rev. 2 criteria, were found to be acute (Table 5). Previous research has indicated that leaf base angles can affect plant water uptake capacity and their adaptation to environmental conditions. Additionally, different leaf base shapes have been shown to affect root architecture and the plant's hydraulic capacity.

The Glohaven cultivar (5271.610±2.0) exhibited the greatest leaf area, indicating a large leaf surface and a high photosynthetic capacity for this cultivar. The Cresthaven cultivar (4388.880±2.0) and the Black Abdos genotype (3672.190±2.0) exhibited reduced leaf area (Table 5), indicating potential limitations in their photosynthetic capacity relative to other cultivars. It can be hypothesized that larger leaves may increase light absorption and, as a consequence, result in higher yields. To assess the photosynthetic capacity and environmental responses of peach cultivars and genotypes, it is essential to determine their leaf area. Leaf area has a direct influence on water management, allowing for the assessment of the plant is resilience to water stress. Furthermore, leaf area provides insight into the overall health and developmental stage of the plant, which is associated with fruit yield and quality. The measurement of leaf area can assist in the identification of cultivars that demonstrate higher yields and superior fruit quality. Additionally, this measurement is valuable for understanding how different genotypes adapt to environmental conditions (Anamur & Türkmen, 2021). The leaf shapes of the related cultivars and genotypes were observed to be flat in form (Table 5). Previous research has indicated that leaf shape can influence water conservation and temperature regulation.

Conclusion

This study offers a comprehensive analysis of the pomological and morphological characteristics of the Black Abdos and Sırrı peach genotypes grown under the specific ecological conditions of Çanakkale, with a comparison to standard peach cultivars. The findings indicate that both local genotypes exhibit notable advantages, including a delayed harvest period, larger fruit weight, and superior fruit width compared with standard cultivars. In particular, the late harvesting nature of Black Abdos and Sırrı provides producers with a longer harvesting window, allowing for the availability of fresh fruit in the market for an extended period. This extended market presence is particularly advantageous for markets requiring a steady supply of fresh peaches, thereby conferring a competitive advantage to producers. Moreover, the augmented fruit dimensions and mass of these local genotypes contribute to the production of peaches with elevated commercial value. When compared with standard cultivars, Black Abdos and Sırrı not only exhibited superior fruit quality and size, but also demonstrated the potential for higher market demand, which translates into increased profitability for producers. This quality makes them particularly valuable for both domestic and international markets that prioritize premium fruit, thus offering significant commercial opportunities.

It is of paramount importance to integrate local peach genotypes into breeding programs. Local genotypes, being well-adapted to specific regional climatic and soil conditions, have the potential to enhance the resilience of peach production against environmental stresses, such as those posed by climate change. The integration of these local genotypes into breeding efforts can foster more sustainable and efficient peach production practices. Furthermore, the utilization of these local genotypes not only guarantees commercial profitability but also contributes to the preservation of regional genetic diversity. The Black Abdos and Sırrı genotypes, with their adaptability and high yield potential, represent a valuable resource for the development of more resilient and high-quality peach cultivars.

This study highlights the significant commercial and ecological value of local peach genotypes, such as Black Abdos and Sırrı, which offer distinct advantages over standard cultivars. Their incorporation into breeding programs can contribute to more efficient, sustainable and high-quality peach production, which benefiting both local agriculture and broader markets.

Additional Information and Declarations

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