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Original article

# Morphological Characterization of Sumac Species Naturally Distributed in The Kahramanmaraş, Mersin and Adana Regions

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**Abstract**

Türkiye is one of the world's leading countries in terms of plant biodiversity due to its geographical location at the intersection of three major phytogeographical regions (Euro–Siberian, Mediterranean and Irano–Turanian), as well as its diverse climate types and topographical structure. Approximately 12,000 plant taxa are recorded in Türkiye, with a remarkably high level of endemism. Within this rich flora, sumac (Rhus spp.), which occurs naturally, stands out as a plant of both economic and ecological importance. Sumac is the common name given to nearly 150 species belonging to the genus Rhus within the family Anacardiaceae. In Türkiye, two main species occur naturally: Rhus coriaria L. (Sicilian sumac) and Rhus cotinus L. (smoke tree). Among these, R. coriaria L. is primarily used as a spice and is widely distributed in the temperate–subtropical regions of the Mediterranean basin. Naturally distributed sumac species in Türkiye are utilized in various sectors, particularly in food, medicinal–aromatic plants, ornamental horticulture, and health-related industries. The aim of this study was to identify local Rhus coriaria L. genotypes with high yield potential and superior morphological characteristics in terms of ornamental value. In this context, a two-year field study including site determination, sampling, and morphological observations was successfully conducted in Kahramanmaraş, Mersin, and Adana provinces. Plant materials obtained from the study were evaluated based on the "Sumac Variety Characteristic Document" published by the Ministry of Agriculture and Forestry (2024). Morphological and technological characterization of the genotypes was carried out, taking their potential use as ornamental plants into consideration. A total of ten morphological traits were measured and observed, including branching structure, plant growth habit, cluster density per plant, fruit density per cluster, fruit color, leaf length, leaf width, cluster length, cluster width, and cluster weight. The observed variation offers significant potential for selecting ornamental plant candidates with high aesthetic value and constitutes a strategic resource for the conservation of local genetic resources and the development of sustainable production systems. This study highlights the importance of sumac not only in terms of food and industrial uses but also for biodiversity conservation and its evaluation as a landscape ornamental plant.

**Keywords:** Rhus Coriaria L., Morphological Characterization, Ornamental Plant, Biodiversity, Sustainable Production

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## INTRODUCTION

Türkiye is among the leading countries in the world in terms of plant biodiversity due to its geographical location, climatic diversity, and topographical structure. The country lies at the intersection of the Euro–Siberian, Mediterranean, and Irano–Turanian phytogeographical regions, allowing numerous plant taxa to develop naturally within the same geographical area. Approximately 12,000 vascular plant taxa have been reported in the flora of Türkiye, a significant proportion of which are endemic (Güner et al., 2012). Within this rich floristic structure, one of the plant families that stands out due to its diverse uses and ecological adaptability is the Anacardiaceae family.

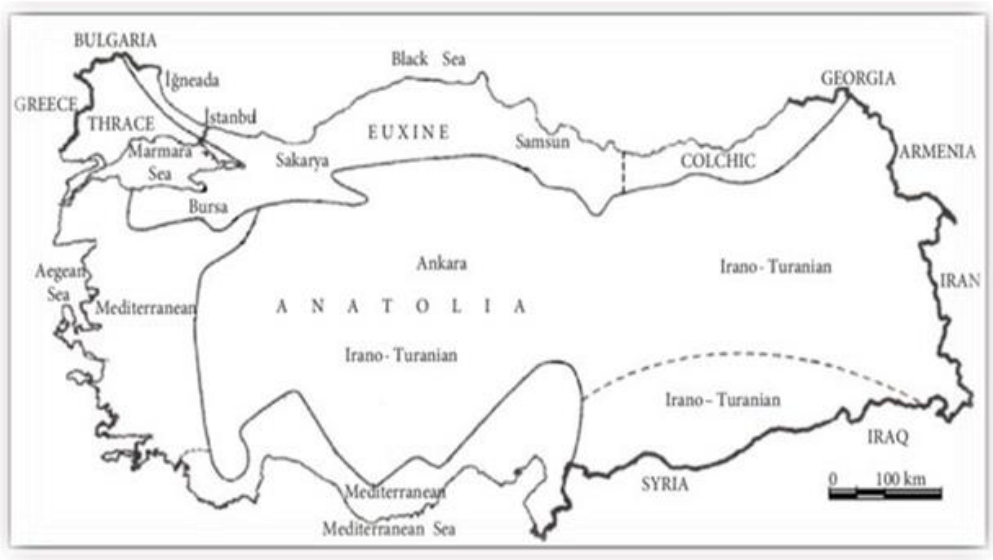



**Figure 1.** Phytogeographical regions of Türkiye (Euro–Siberian, Mediterranean, and Irano–Turanian) (Davis, 1982)

The Anacardiaceae family consists mainly of woody plants exhibiting tree or shrub forms and has a wide distribution, particularly in tropical and subtropical regions. The genera within this family offer significant economic value in terms of food, medicine, industry, and ornamental horticulture. In particular, the genera Pistacia, Mangifera, Anacardium, and Rhus attract attention due to their widespread use and commercial potential worldwide (Mabberley, 2017).

The genus Rhus comprises approximately 150 species and is naturally distributed across North America, the Mediterranean Basin, Western Asia, and the Middle East. Species within this genus are characterized by rapid growth, tolerance to environmental stress factors, and low maintenance requirements. Rhus species typically grow as shrubs or small trees and can survive even in marginal areas due to their strong root systems (Dirr, 2009).

The main Rhus species naturally distributed in the flora of Türkiye are *Rhus coriaria* L. and *Rhus cotinus* L., both of which are important in terms of different usage areas. While Rhus coriaria is traditionally valued for its acidic aroma and rich phenolic content and used mainly as a spice and

medicinal plant, Rhus cotinus stands out as an ornamental plant due to its aesthetic characteristics (Davis, 1982).

Sumac species have historically been used for multiple purposes in different cultures. In particular, the high levels of phenolic compounds, flavonoids, and tannins in the fruits of *Rhus coriaria* contribute to its antioxidant, antimicrobial, and anti-inflammatory properties. These features support the use of sumac in traditional medicine and functional food products (Kosar et al., 2007; Shabbir, 2012).

Recent studies indicate that Rhus species are not limited to food and medicinal uses but also possess significant potential in landscape architecture and ornamental horticulture. Especially Rhus cotinus creates strong visual impact in outdoor landscape designs with its broad crown, striking inflorescences, and autumn foliage colors ranging from red to orange and purple. Therefore, this species is widely preferred in parks, recreational areas, and roadside landscaping (Dirr, 2009).

The drought tolerance and ability of Rhus species to grow under low-fertility soil conditions make them advantageous for sustainable landscape applications in water-limited regions. Moreover, their strong root systems provide potential for erosion control, slope stabilization, and rehabilitation of degraded areas (Ferrini and Fini, 2011).

In recent years, the ornamental use potential of Rhus species has increased worldwide. In the United States, species commonly known as staghorn sumac and smoke tree are widely used in landscape designs due to their autumn coloration, growth form, and drought tolerance (Gilman and Watson, 2014). Similar applications are observed in Europe, where Rhus species are evaluated as ornamental shrubs. In Türkiye, however, studies focusing on the ornamental use of local *Rhus coriaria* genotypes remain limited.

Most studies conducted in Türkiye on Rhus species have focused on taxonomic classification, chemical composition, and traditional uses, while comprehensive studies addressing morphological diversity, ornamental potential, and landscape applications are scarce. However, Rhus species naturally distributed across different ecological regions of the country represent an important resource in terms of both genetic diversity and aesthetic characteristics (Sütlüpınar et al., 2016).

Rhus species generally grow as shrubs or small trees and contribute to spatial depth in landscape designs through their spreading or semi-upright growth habits. Rhus cotinus L., in particular, is aesthetically prominent due to its broad crown, fine branching structure, and characteristic inflorescences formed during summer. The smoky appearance of the inflorescences after flowering enhances the ornamental value of the species and enables its use as an accent plant in landscape designs (Dirr, 2009).

One of the most distinctive ornamental features of Rhus species is the intense autumn foliage coloration. The transition of leaves from green to yellow, orange, red, and purple tones makes these species visually attractive in parks, gardens, and recreational areas where seasonal color change is

emphasized. This characteristic allows Rhus species to be used in both monoculture plantings and mixed landscape compositions (Mabberley, 2017).

A detailed evaluation of the morphological and phenological characteristics of Rhus species, determination of their suitability for ornamental use, and identification of alternative utilization areas are crucial for both biodiversity conservation and the introduction of new species into horticultural production and landscape sectors.

Accordingly, the main objective of this study was to contribute to the selection of high aesthetic value forms by determining the morphological variation of R. coriaria genotypes naturally growing in different regions of Türkiye.

## MATERIALS and METHODS

In this study, was conducted as part of planned field surveys carried out between 2022 and 2024 in the provinces of Kahramanmaraş, Mersin, and Adana, which are located within the Mediterranean and transitional climate zones of Türkiye. The field studies were performed over a two-year period with the aim of identifying areas where species of the genus Rhus occur naturally, determining population structures, and revealing morphological variation.

In the selection of study areas, literature data, local floristic records, and preliminary field observations were evaluated together, and locations representing different altitudes and ecological conditions where the species naturally occur were preferred. In each province, multiple locations were selected to represent independent and naturally occurring populations. Field surveys conducted at these locations were carried out using a systematic sampling approach, and the sampling process was carefully managed to avoid any damage to the natural structure of the plants (Kent, 2012).

At least ten different genotypes were selected from each location. Genotype selection was based on criteria such as healthy plant development, high representativeness in terms of morphological characteristics, and distribution within the population. The selected genotypes were marked without being removed from the natural populations, and morphological observations were conducted in situ without disturbing habitat integrity. This approach was preferred to ensure the conservation of natural genetic variation and to comply with the principles of sustainable sampling (Hammer et al., 2003).

The evaluation of the genotypes was performed using the criteria defined in the “Sumac Variety Characteristic Document” (2024) of the Ministry of Agriculture and Forestry. Accordingly, the following ten fundamental morphological characteristics were measured and recorded.

**Table 1.** Morphological traits used for measurement and observation.

| Traits | Score | Score Range |
|---|---|---|
| Plant Growth Form | 10 | Upright-Semi-upright-Flat/Dropping |
| Tree Branching Characteristic | 10 | Frequent-Moderate-Infrequent |
| Fruit Density in the Cluster | 15 | Infrequent-Moderate-Intense-Very Intense |
| Cluster Density Per Plant | 15 | Infrequent-Moderate-Frequent |
| Fruit Peel Color | 10 | Light Red<br>Red<br>Reddish Brown<br>Brown |
| Leaf Length | 5 | |
| Leaf Width | 5 | |
| Cluster Length | 5 | Short <15 cm<br>Medium (15-25 cm)<br>Long (>25 cm) |
| Cluster Width | 5 | Narrow <4 cm<br>Medium 4-7 cm<br>Wide> 7 cm |
| Cluster Weight | 5 | |
| Branching Structure | 10 | Sparsely branchedModerately denseDensely branched |

Qualitative characteristics such as plant growth form and branching structure were determined through visual assessment and classification; leaf and panicle measurements were performed using digital calipers and precision balances. Measurements were taken multiple times for each genotype, and average values were included in the evaluation.

A scoring system ranging from 1 to 10 was applied for each morphological characteristic. During scoring, a relative evaluation was made based on the minimum and maximum values of the relevant characteristic within the population.

The scores assigned to all evaluated traits were summed to calculate a total morphological performance score for each genotype. This total score was used to assess the overall morphological superiority of the genotypes. The resulting data were organized to allow comparisons both among locations and between provinces.



**Figure 2.** *Rhus coriaria* L. Plant Specimens

Addressing morphological characterization through such a holistic approach contributes to revealing the existing genetic and phenotypic diversity within Rhus species and simultaneously provides a scientific basis for identifying genotypes suitable for use as ornamental and landscape plants.

## RESULTS and DISCUSSION

Within the scope of the study, the morphological performance of Rhus genotypes naturally distributed in the provinces of Kahramanmaraş, Mersin, and Adana was evaluated by scoring ten selected morphological traits. The sum of the scores obtained for each genotype was used to represent the overall morphological performance of the genotypes.

According to the evaluation results, the total morphological performance scores of the genotypes ranged from 48.5 to 95. The lowest performance was recorded for genotype G2 (48.5), whereas genotypes G8, G9, and G10 exhibited the highest performance with scores of 95. These genotypes were followed by G1 (82) and G7 (76), respectively. Several genotypes originating from the Mersin location (G6, G5, and G4) were classified within the moderate to high performance group.

These differences in total performance scores indicate the presence of pronounced morphological variation among the Rhus genotypes. This finding suggests that natural populations are rich in genetic diversity and provide suitable material for selection studies. Similarly, previous studies have emphasized that Rhus species exhibit a wide range of morphological variation, which is influenced by both environmental conditions and genetic background (Dirr, 2009; Mabberley, 2017).

As a result of field studies and morphological observations, it was determined that genotypes G8, G9, and G10 exhibited marked superiority compared to the other genotypes with respect to the evaluated traits. The high branching capacity observed in these genotypes contributed to a dense and well-balanced plant form. High branching density is considered an important criterion in landscape applications, as it enhances the volumetric perception of plants (Ferrini and Fini, 2011).

**Table 2.** Genotype Performance Based on Total Scores

| Genotype | Geographical Coordinates | Total Morphological Score |
|---|---|---|
| G1 | 36°55'30.5"N 34°33'57.7"E | 82 |
| G2 | 36°56'34.7"N 34°35'55.4"E | 48.5 |
| G3 | 36°41'14.3"N 33°33'25.1"E | 53 |
| G4 | 36°40'32.5"N 33°36'05.5"E | 58 |
| G5 | 36°42'53.4"N 33°47'52.1"E | 61 |
| G6 | 37°51'07.0"N 36°38'49.4"E | 68 |
| G7 | 37°36'57.1"N 36°52'41.8"E | 76 |
| G8 | 36°39'53.8"N 34°13'25.6"E | 95 |
| G9 | 37°29'59.9"N 34°58'14.4"E | 95 |
| G10 | 36°29'03.6"N 33°58'30.4"E | 95 |

In addition, these genotypes were characterized by a high fruit density per cluster, with clusters displaying a compact and well-organized structure. Fruit density and cluster architecture are of particular importance in Rhus species in terms of both aesthetic value and functional use, and are especially preferred traits in genotypes evaluated for ornamental purposes (Dirr, 2009).

Evaluations of fruit color revealed that the G8, G9, and G10 genotypes produced fruits with dark red hues that were uniform and visually attractive. Dark and vivid fruit coloration contributes to creating color contrast in landscape designs during summer and autumn periods, thereby enhancing the suitability of Rhus species as accent plants (Nowak and Dwyer, 2007).

Measurements of cluster length and width indicated that high-performing genotypes developed long and wide clusters. This characteristic increases the overall aesthetic value of the plant and enhances visual impact, particularly in large-scale landscape areas. Previous studies on woody ornamental plants have also reported that cluster size and fruit density are directly associated with landscape value (Percival and Hitchmough, 2014).

Based on these findings, genotypes G8, G9, and G10 were distinguished not only by their high morphological performance scores but also by their superior aesthetic, structural, and color-related traits. These genotypes were considered to have a high potential for providing color, texture, and form diversity in landscape applications and were therefore recommended as suitable materials for use as ornamental plants.

## DISCUSSION

Although *Rhus coriaria* L. has a widespread distribution in the flora of Turkey, it has primarily been featured in academic literature for its food, spice, and medicinal properties. However, its morphological diversity and potential as an ornamental plant in landscape architecture have been largely overlooked. Morphological characterization studies conducted on local genotypes collected from Kahramanmaraş, Mersin, and Adana provinces within the scope of this study revealed that the species possesses not only functional economic value but also high aesthetic and landscape potential.

Based on performance evaluations primarily using ten morphological criteria, genotypes G8, G9, and G10 stood out with the highest scores. The high branching capacity, balanced plant form, broad cluster structure, and high fruit density exhibited by these genotypes fully meet the requirements for "enhancing spatial perception" and "being an accent plant" in landscape applications. In particular, the observed dark red fruit color and compact cluster structure demonstrate strong agreement with the visual quality criteria specified in international literature (Dirr, 2009; Gilman and Watson, 2014).

The ecological adaptability of the species constitutes another strategic outcome of the study. The resistance of these genotypes, which naturally occur in Mediterranean and transitional climate zones, to limited water availability, poor soil conditions, and environmental stressors offers a critical advantage for "sustainable landscape" practices in combating climate change. Low maintenance requirements and high drought tolerance make Rhus coriaria a prominent native alternative species in reducing increasing maintenance costs in urban green spaces.

Based on the findings of this study, which fills a gap in the literature regarding the ornamental plant potential of native sumac genotypes in Türkiye, the following recommendations are presented:

Propagation and breeding efforts should prioritize the inclusion of G8, G9, and G10 genotypes, which demonstrate high morphological performance, in rapid propagation programs (in vitro and ex vitro), as well as their utilization as parental material in breeding studies. In addition, the establishment of collection gardens and experimental plots for these superior genotypes is essential to enable long-term monitoring of their adaptation and performance under varying landscape conditions. Furthermore, the development of nursery production systems, together with the promotion of native plant use in landscape applications, will not only generate economic added value but also support the conservation of local biodiversity.

### Conclusion

In conclusion, beyond its conventional uses, Rhus coriaria demonstrates considerable potential as a native ornamental plant species for the Turkish landscape sector owing to its aesthetic qualities, ecological tolerance, and low maintenance demands. The superior genotypes identified in this study may serve as valuable genetic resources for sustainable landscape applications, while also supporting the

conservation, promotion, and wider utilization of native plant diversity in both scientific studies and commercial landscaping practices.

**Additional Declaration**

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***Conflicts of Interest***

The authors declare no conflicts of interest.

***Ethics Approval***

This study was conducted in accordance with the principles of Pen Academic Publishing Research Ethics Policy throughout all stages of the process.

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