Growth and fruit characteristics in *Rosa canina* L.

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Abstract: This study was conducted to determine the morphological and pomological variation within natural populations of *Rosa canina* L. in the Sarıveliler district of Karaman Province, Turkey. A total of 150 randomly selected individuals were evaluated for plant height (PH), crown diameter (CD), fruit length (FL), fruit width (FWi), and fruit weight (FWe). The collected data were analyzed using analysis of variance and phenotypic correlation analysis. The results revealed significant differences both among plants and within individuals in terms of fruit characteristics. Plant height (207.41 cm) and crown diameter (130.62 cm) exhibited high coefficients of variation (39.6% and 42.6%, respectively), while fruit weight showed 26.7% variation. Strong positive correlations were observed between flower length and fruit width (r = 0.750) as well as fruit weight (r = 0.878). In addition, significant correlations were identified between plant height and flower length (r = 0.375), and between plant height and fruit weight (r = 0.256). These findings demonstrate strong relationships between morphological and pomological traits in *R. canina*, and indicate substantial phenotypic diversity within natural populations. The results provide important insights for the conservation of the species as a genetic resource and its potential use in agricultural applications.
Keywords: *Rosa canina*, Morphological variation, Phenotypic correlation, Fruit quality, Sarıveliler (Karaman)

Rosa canina L.'de büyüme ve meyve özellikleri

Özet: Bu çalışma, *Rosa canina* L. türünün doğal popülasyonlarında görülen morfolojik ve pomolojik varyasyonları belirlemek amacıyla, Karaman ili Sarıveliler ilçesinde yürütülmüştür. Araştırmada, rastgele seçilen 150 bireyde bitki boyu (BB), taç çapı (TÇ), meyve uzunluğu (MU), meyve genişliği (MG) ve meyve ağırlığı (MA) gibi karakterler ölçülmüştür. Elde edilen veriler varyans analizi ve fenotipik korelasyon analizleriyle değerlendirilmiştir. Sonuçlar, hem bitkiler arası hem de birey içi meyve özelliklerinde anlamlı düzeyde farklılıklar olduğunu göstermiştir. Bitki boyu (207.41 cm) ve taç çapı (130.62 cm) yüksek varyasyon katsayıları (%39.6 ve %42.6) ile dikkat çekerken; meyve ağırlığında %26.7 oranında varyasyon belirlenmiştir. Çiçek uzunluğu ile meyve genişliği (r = 0.750) ve meyve ağırlığı (r = 0.878) arasında yüksek düzeyde pozitif korelasyonlar tespit edilmiştir. Ayrıca, bitki boyu ile çiçek uzunluğu (r = 0.375) ve meyve ağırlığı (r = 0.256) arasında da anlamlı ilişkiler bulunmuştur. Bulgular, *R. canina* türünün morfolojik ve pomolojik özellikleri arasında güçlü ilişkiler bulunduğunu ve doğal popülasyonlarda önemli düzeyde fenotipik çeşitlilik sergilediğini ortaya koymaktadır. Bu sonuçlar, türün genetik kaynak olarak korunması ve tarımsal potansiyelinin değerlendirilmesi açısından önem arz etmektedir.
Anahtar kelimeler: *Rosa canina*, Morfolojik varyasyon, Fenotipik korelasyon, Meyve kalitesi, Sarıveliler (Karaman)

1. Introduction

Rosa canina L., commonly known as dog rose, is a perennial shrub species belonging to the Rosaceae family. It is widely distributed across diverse habitats with broad ecological tolerance, particularly in Europe, Western Asia, and North Africa (Rehder 1940; Wissemann 2003). In Türkiye, *R. canina* holds a significant place in the native flora and is commonly found in many regions, especially in rural areas (Davis 1972). Among the species of the genus Rosa, R. canina is notable for its bioactive compounds, which are valuable to the pharmaceutical and food industries, attracting attention both economically and ecologically (Ercişli 2007).

The fruits of the plant, commonly known as "kuşburnu" (rose hips), are regarded as functional foods due to their high content of ascorbic acid (vitamin C), phenolic compounds, and antioxidant capacity (Chrubasik et al. 2008). Recent studies have highlighted both the nutritional and pharmacological importance of *R. canina* fruits. Its scientifically validated anti-inflammatory, antioxidant,

and antimicrobial properties (Nazaruk and Borzym-Kluczyk 2015) have stimulated increased research interest in fruit yield and quality. In terms of fruit morphology and composition, rose hips are distinguished by their high levels of ascorbic acid, phenolic compounds, and carotenoids. These constituents confer significant functional benefits for human health and underscore the need for phytochemical studies of the species (Ercişli 2007; Demir and Özcan 2001).

In Turkey, where *R. canina* is commonly known as "kuşburnu," the plant has long been utilised in traditional medicine owing to its antioxidant, anti-inflammatory, and immune-supportive properties (Orhan et al. 2007; Chrubasik et al. 2008). The fruits, in particular, are rich in vitamin C and are traditionally consumed as tea or marmalade for the treatment of colds, gastrointestinal ailments, and urinary tract infections (Yeşşilada et al. 1995).

Ethnobotanical studies conducted in various regions of Turkey indicate that *R. canina* is not only valued for medicinal purposes but also used in nutrition, dye

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production, and cultural practices. This diversity highlights the multifunctional importance of the plant among local communities and demonstrates the need to document it as part of biocultural heritage. Naturally growing in almost every region of Turkey, this shrubby species has become a focal point of scientific research due to its ecological flexibility and high biological value (Orhan et al. 2007; Güner et al. 2012).

R. canina is recognized as a resilient species with high drought tolerance and the ability to adapt to varying altitudes and climatic conditions. The growth dynamics of this species particularly in terms of shrub development, shoot elongation, and fruit formation can show significant variations, which are attributed to genetic diversity and environmental interactions (Demir and Özcan 2001).

Morphological characteristics such as fruit size, color development, seed ratio, and flesh thickness vary depending on ecological conditions, the characteristics of the habitat, and genetic differences among populations. Moreover, fruit morphology and biochemical composition are significantly influenced by both environmental and genetic factors (Baytop 1999). In this context, detailed morphological and phenological observations on *R. canina* are crucial for determining its agricultural production potential and planning for its sustainable utilization.

The objectives of this study are to evaluate the morphological growth characteristics and fruit quality parameters of *R. canina* in Türkiye. By analyzing the relationship between growth performance and fruit traits in individuals collected from natural populations, this research aims to provide a foundation for both the conservation of the species as a genetic resource and its potential economic exploitation.

2. Materials and methods

2.1. Study area and data collection

The plant samples used in this study were collected from the Sarıveliler district, located in the southern part of Karaman Province within the Central Anatolia Region of Türkiye (Figure 1). arıveliler lies on the southern slopes of the Central Taurus Mountains, specifically on the Taşeli Plateau. It is bordered by the Taşkent district to the north, Başyayla to the northeast, Ermenek to the east, Gazipaşa to the south, and Alanya to the southwest (Bağcı et al. 2016).

Plant height (PH) and canopy diameter (CD) were measured on 150 randomly selected individuals within the species' natural distribution area. From each individual, 100 harvested fruits were used to collect data on fruit length (FL), fruit width (FW), and fruit weight (FWt).

2.2. Data analysis

The plants were compared for fruit characteristics by following linear model of analysis of variance to at SPSS (SPSS 2011).

$$Y_{ij} = \mu + P_j + e_{ij} \tag{1}$$

Where Y_{ij} is the observation from the jth fruit of the ith plant, μ is overall mean, P_j is the random effect of the ith plant, and e_{ij} is random error.

Phenotypic correlations (r_p) among the characteristics were estimated as (Falconer 1989):

$$r_p = \frac{COV_{f(x,y)}}{\sqrt{\sigma^2_{f(x)}}\sqrt{\sigma^2_{f(y)}}} \tag{2}$$

Where $COV_{f(xy)}$ is the phenotypic covariance between characteristics x and y, $\sigma^2_{f(x)}$ and $\sigma^2_{f(y)}$ are the phenotypic variances for characteristics x and y, respectively.
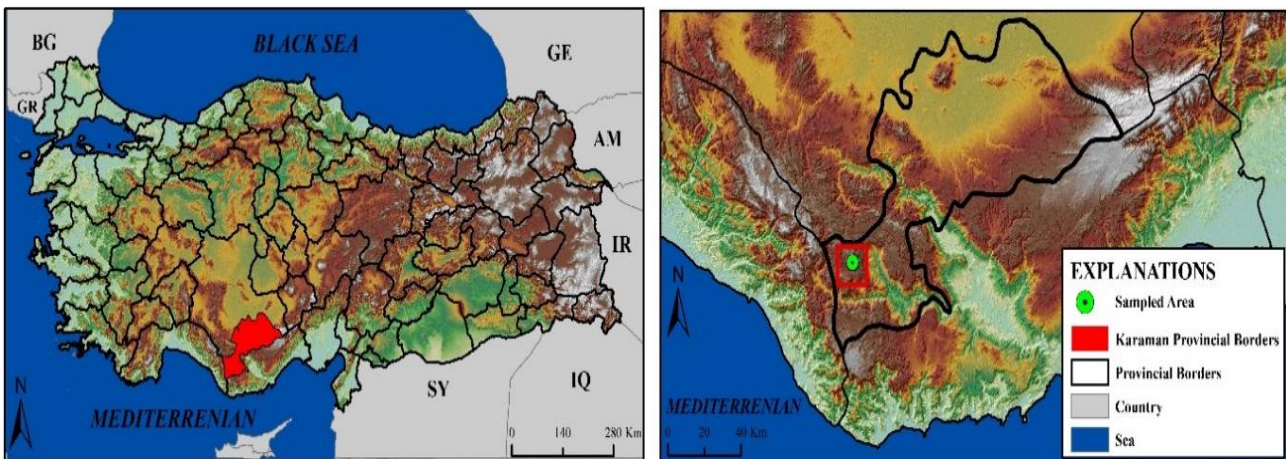

Figure 1. Location of the study area

3. Results

3.1. Characteristics

Averages, range and coefficient of variation (CV%) were given in Table 1. Large differences were found among the plants for growth characteristics, and also among plants and among fruits within plant. Growth characteristics showed higher variation than fruit characteristics based on coefficient of variation (Table 1).
Significant differences ($p<0.05$) were found for the fruit characteristics according to results analysis of variance.

3.2. Relations among the characteristics

Phenotypic correlations among the characteristics were presented in Table 2. There were positive and significant ($p<0.05$) relations among fruit characteristics, while, results of correlation analysis showed that plant height was better indicator than crown diameter for estimation of fruit characteristics (Table 2).

Table 1. Averages ($\overline{X}$), range and coefficient of variation (CV%) of the characteristics

	PH (cm)	CD (cm)	FL (mm)	FWi (mm)	FWe (g)
$\overline{X}$	207.41	130.62	10.80	15.65	1.16
Range	50.0-427.0	37.0-320.0	8.66-13.23	10.72-20.52	0.53-2.23
CV%	39.6	42.6	9.70	11.6	26.7

Table 2. Phenotypic correlations among the characteristics

(r)*	PH	CD	FL	FWi	FWe
CD	.484**	-			
FL	.375**	.215*	-		
FWi	.222*	.062^{NS}	.750**	-	
FWe	.256*	.156^{NS}	.878**	.865**	-

*; correlation was significant at $p<0.05$ level, **; correlation was significant at $p<0.01$, ^{NS}; correlation was not significant ($p >0.05$).

4. Discussions

In this study, variations in certain morphological traits (plant height, stem diameter, flower length) and pomological characteristics (fruit width, fruit weight) of *R. canina* were assessed, revealing significant differences within the population. The wide range of variation and high coefficients of variation observed in vegetative traits such as plant height (207.41 cm) and stem diameter (130.62 cm), with coefficients of 39.6% and 42.6% respectively, indicate that both environmental conditions and genetic factors play a decisive role in this species.
The mean flower length (FL) of 10.80 mm observed here aligns with values reported for various *Rosa* species by Ercişli (2007). However, the relatively low coefficient of variation (9.70%) suggests that this trait is predominantly genetically controlled and less affected by environmental influences. Regarding pomological traits, notable variation was recorded in fruit width (15.65 mm) and fruit weight (1.16 g). In particular, the coefficient of variation for fruit weight (26.7%) implies that this characteristic is influenced by both genetic and environmental factors, making it a valuable criterion for selection programmes.
The results of this study demonstrate considerable morphological and pomological diversity among individuals in natural populations of *R. canina*. This diversity may arise not only from natural selection processes but also from the microclimatic conditions prevailing in different ecological regions. Wissemann (2003) observed that *Rosa* species exhibit high phenotypic plasticity, which contributes to their intraspecific variation.
Correlations among selected morphological and pomological traits of *R. canina* were examined using Pearson's correlation analysis, and the findings were compared with similar studies in the literature. A positive and significant correlation was identified between plant height (PH) and stem diameter (SD) (r = 0.484, p < 0.01). This suggests that flower size changes proportionally with overall plant size, indicating a coordinated growth pattern in the morphological structure of *R. canina*. Ercişli (2007) similarly reported that flower size in *Rosa* species varies according to plant age and growth capacity, which aligns closely with the present findings.
A strong positive correlation was observed between fruit width (FWi) and flower length (r = 0.750, p < 0.01), as well as between fruit weight (FWe) and both flower length (r = 0.878, p < 0.01) and fruit width (r = 0.865, p < 0.01). These findings indicate that flower morphology can directly influence fruit yield characteristics. Similar significant relationships between flower size and fruit size or content in *R. canina* were also reported by Chrubasik et al. (2008).
Correlations between plant height and fruit traits (FWi and FWe) were weaker but nonetheless statistically significant (r = 0.222 and r = 0.256, respectively; p < 0.05), suggesting an indirect yet meaningful association between vegetative growth and reproductive traits. However, the absence of statistically significant correlations between stem diameter and fruit traits implies that stem diameter may have limited influence on the development of reproductive structures.
Overall, the correlations identified in this study suggest that morphological traits particularly flower length are important predictors of fruit quality and yield in *R. canina*. Consequently, readily observable morphological features such as flower length could be utilized as indirect selection criteria in breeding and selection programmes.

5. Conclusions

Several recommendations have been proposed regarding strategies to be adopted in the breeding and domestication of *Rosa canina* L. In particular, prioritising the selection of individuals that demonstrate strong correlations between morphological traits, such as flower length, and fruit yield and quality is of great importance for breeding programmes. The clonal propagation of individuals exhibiting large fruit size and weight could help strengthen the genetic base of new *R. canina* cultivars intended for domestication.

Furthermore, supporting the phenotypic relationships identified in this study with molecular genetic markers would facilitate the development of faster and more efficient selection strategies. Similar studies conducted across different altitudinal gradients, soil types, and climatic conditions would aid in clarifying the effects of environmental factors on morphological and pomological traits.

Finally, analysing functional compounds such as ascorbic acid, phenolic compounds, and antioxidant capacity which are directly associated with fruit size would provide valuable insights into the potential applications of *R. canina* in the food industry.

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