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Research Article

Crataegus Species in Isparta Urban Forest

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Abstract

In this study, the growth and fruit characteristics of two species of maquis, one of the Mediterranean maquis, were determined. The average individual height of *Crataegus orientalis* Pall. ex M. Bieb. subsp. *orientalis* individuals was 2.99 m, the average crown diameter was 2.13 m, and the average number of branches was 2, the average individual height of the *Crataegus monogyna* Jacq. var. *monogyna* individuals was 3.17 m, the average crown diameter was 2.35 m, and the average number of branches was 2.8. While the number of fruits in *C. orientalis* species was 295.82 and fruit weight was 1.72-3.37 g, the number of fruits in *C. monogyna* species was 4274.5 and fruit weight was 0.33-0.90 g. As a result of the analysis of variance applied to compare the growth characteristics of the study according to the aspects, it was determined that there was no statistically significant ($p>0.05$) difference between the aspect groups in terms of height, crown diameter, and the number of branches in *C. orientalis*. In *C. monogyna*, while there was no statistically significant difference between the aspect groups in terms of height and crown diameter, there was a statistically significant difference in the number of branches. As a result of the analysis of variance applied to compare the aspects in terms of fruit characteristics, it was observed that there was a statistically significant difference ($p<0.05$) between the aspect groups in terms of fruit number and fruit weight in *C. orientalis*. At the same time, there was no significant difference in *C. monogyna*. According to the correlation analysis performed, it was determined that the relationship between the number of branches and the height character was insignificant for both species, and all other characters were statistically positively correlated with each other at the 0.01 significance level. Hawthorn species have an ethnobotanical feature used for various purposes such as food, medicinal, ornamental, etc. Local people also benefit from these features in the region where the study area is located. They use their fruits to make jam, marmalade, and vinegar, consume their leaves and flowers as tea, and use them for decorating their homes. It is thought that by studying the growth and fruit characteristics of hawthorn species, the necessary data will be provided for easy cultivation of this species, and a base for further studies will be formed by learning about their local uses.

Keywords: Crataegus, Fruit, Growth, Hawthorn, Isparta.

Isparta Kent Ormanında Bulunan *Crataegus* Türleri

Öz

Bu çalışmada, Akdeniz maki elemanlarından biri olan alıcın iki türüne ait büyüme ve meyve özellikleri belirlenmiştir. *Crataegus orientalis* Pall. ex M.Bieb. subsp. *orientalis* bireylerine ait ortalama birey boyu 2.99 m, ortalama tepe çapı 2.13 m ve ortalama dal sayısı 2 adet olarak, *Crataegus monogyna* Jacq. var. *monogyna* bireylerine ait ortalama birey boyu 3.17 m, ortalama tepe çapı 2.35 m ve ortalama dal sayısı 2.8 adet bulunmuştur. *C. orientalis* türünde meyve sayısı 295.82 adet ve meyve ağırlığı 1.72-3.37 g bulunurken, *C. monogyna* türünde meyve sayısı 4274.5 adet ve meyve ağırlığı 0.33- 0.90 g bulunmuştur. Bakılara göre çalışmaya konu büyüme özelliklerinin karşılaştırılması amacıyla uygulanan varyans analizi sonucunda *C. orientalis* türünde boy, tepe çapı ve dal sayısı bakımından bakı grupları arasında istatistiksel bakımdan anlamlı ($p>0.05$) fark olmadığı belirlenmiştir. *C. monogyna* türünde ise boy ve tepe çapı bakımından bakı grupları arasında istatistiksel bakımdan anlamlı fark bulunmazken dal sayısı bakımından istatistiksel bakımdan anlamlı bir fark olduğu belirlenmiştir. Bakıların meyve özellikleri bakımından karşılaştırılması amacıyla uygulanan varyans analizi sonucunda *C. orientalis* türünde meyve sayısı ve meyve ağırlığı bakımından bakı grupları arasında istatistiksel bakımdan anlamlı fark olduğu ($p<0.05$) ortaya çıkarken, *C. monogyna* türünde ise anlamlı bir fark olmadığı görülmüştür. Gerçekleştirilen

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korelasyon analizine göre, her iki tür için de dal sayısı ve boy karakteri arasındaki ilişkinin anlamsız olduğu, diğer tüm karakterlerin istatistiksel açıdan 0.01 önem düzeyinde birbirleri ile pozitif yönde ilişkili oldukları belirlenmiştir. Alıç türleri, gıda, tıbbi, süs vb. amaçlarla kullanımı bulunan etnobotaniksel özelliğe sahiptir. Çalışma alanının bulunduğu yörede de yöre halkı bu özelliklerinden faydalanmaktadır. Meyvelerini reçel, marmelat, sirke yapımında kullanmakta, yaprak ve çiçeklerini çay olarak tüketmekte ve evlerinde dekorasyon amaçlı kullanmaktadırlar. Alıç türlerinin büyüme ve meyve özelliklerinin çalışılması ile bu türün kültürünün kolay yapılması için gerekli olan verilerin sağlanacağı, yöresel kullanımlarının öğrenilmesi ile daha sonraki yapılacak çalışmalar için altlık oluşturulacağı düşünülmektedir.

Anahtar Kelimeler: Alıç, Büyüme, Crataegus, Meyve, Isparta.

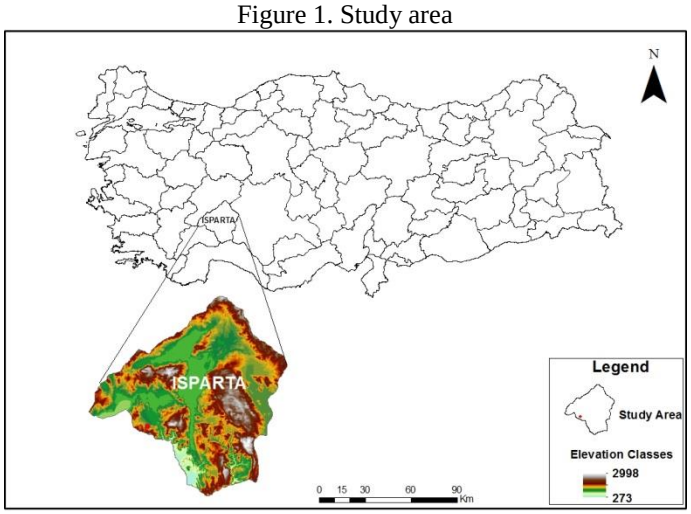
1. Introduction

People have tried to treat many diseases with herbs from the past to the present. Because the drugs produced with the developing medicine and technology have many side effects and benefits, some people try to treat their diseases primarily herbal. Some people also refer to plants as a supplementary source of supportive treatment in addition to the drugs they use. These orientations of people show that plants have a significant place today and in the past (Bulut, 2006). The Hawthorn plant is also an important species with ethnobotanical features that have been used for various purposes from past to present. However, this species is often undervalued. This species, which is not planted and planted much in our country, is mainly grafted and used as rootstock for fruits such as apples and pears (Gökbunar, 2007). Hawthorn fruits are one of the essential plants in the food industry because they contain minerals such as calcium, potassium, and magnesium and protein and oil values (Özcan et al., 2005). Besides being consumed as food, hawthorn fruits are also used for medicinal purposes (Venskutonis, 2018; Wang et al., 2015). Hawthorn fruits have antioxidant, antimicrobial, and antibacterial properties, and there are many studies on this subject (Guven et al., 2006; Ebrahimzadeh and Bahramian, 2009; Bahorun et al., 2003; Kirakosyan et al., 2003). It is also known to treat diseases such as anti-aging, Alzheimer's, diabetes, cancer, hyperglycemia, hypertension, and anxiety (Salehi et al., 2009; Nazhand et al., 2020). In addition, hawthorn grows in many regions of the world, such as North America, Europe, North Africa, and Australia, due to its high plasticity. It is known for its resistance to harsh climates and is one of the species we need and will need in the future regarding climate change due to global warming. Due to its widespread, it is possible to cultivate it quickly (Hobbs et al., 1990). Hawthorn is under the *Crataegus* genus of the *Rosaceae* family, and it is known that there are a total of 1060 species in the world. In our country, 21 of these species grow naturally, and only 2 of them are planted or planted (Dönmez, 2003). The most common hawthorn species in our country is *C. monogyna*, *C. oxyacantha*, *C. orientalis*, and *C. aronia* species are also common (Gökbunar, 2007). The growth and fruit characteristics of two of the most common hawthorn species in Turkey (*C. monogyna* and *C. orientalis*) were discussed in this study. In addition, it is aimed to raise awareness about the importance of these species by mentioning their ethnobotanical characteristics.

2. Materials and Methods

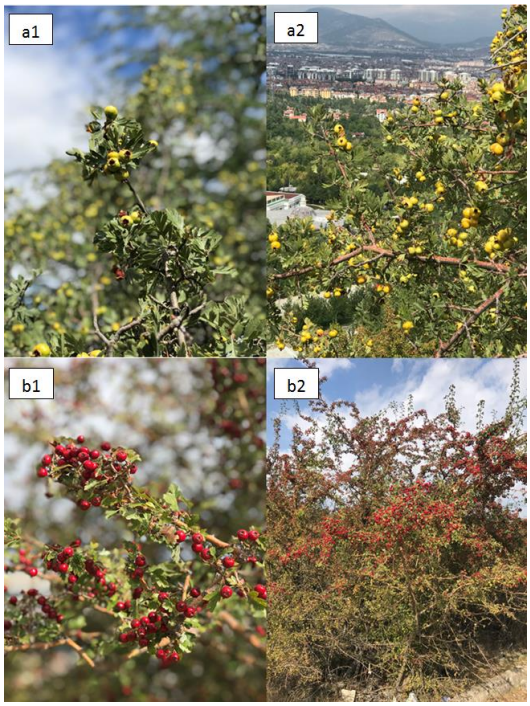
Isparta, the province where the study area is located 37° 45′ 53″ North, 30° 33′ 24″ East in the north of the Mediterranean Region in the Lakes region (Figure 1). Afyon in the northwest of Isparta, Burdur in the southwest, Antalya in the south, and Konya in the southeast. Its altitude is on average 1050 meters. Since Isparta is located in the transition zone between the Mediterranean and continental climates, the characteristics of both climates are seen in the region (Anonymous, 2021). The coldest months of the year are January-February, and the hottest months are July-August. The annual average precipitation in Isparta province is 569.4 mm, and the annual average temperature is 12.3°C (MGM, 2021). In the province of Isparta, there are forests consisting of trees such as red pine, black pine, cedar and, juniper, oak, together with the maquis elements unique to the Mediterranean.

Figure 1. Study area



The study area is located in the city center of Isparta, within the boundaries of the urban forest. In the study area, *Crataegus orientalis* Pall. Ex M. Bieb. subsp. *orientalis* and *Crataegus monogyna* Jacq. *monogyna* species were detected (Figure 2). *C. orientalis* Pall. ex M. Bieb. subsp. *orientalis* are shrubs or shrubs that can grow up to 3-5 m. The leaf margins are coarsely toothed; the fruits are spherical yellow and reddish-orange. Flowering occurs in May-June, while fruits ripen in September-October. *C. monogyna* Jacq. var. *monogyna* are thorny shrubs or trees that can grow up to 10 m tall. Its leaves are ovoid, divided into 3-5 lobes, and its fruits are spherical red. Flowering occurs in April-May, while fruits ripen in September-October. Within the scope of this study, tree height, crown diameter, the number of branches, fruit number, and fruit weight characteristics of individuals of these two *Crataegus* species were determined. The local view was taken as the basis for the view of individuals. As for the number of branches, the number of branches emerging from the main trunk is taken as a basis. The measured characters were first evaluated according to the aspect, and then the relations of all the characters with each other were examined. Analysis of variance was used to evaluate the characters according to the aspect, and correlation analysis was used to determine the relationship between the characters.

Figure 2. Individuals in the study area (a1-a2: *C. orientalis*, b1-b2: *C. monogyna*)



3. Results and Discussion

3.1. Growth characteristics of *C. orientalis* subsp. *orientalis* growth characteristics of individuals

It was observed that the measured height, crown diameter, and the number of branches were highest in the south and lowest in the individuals in the west (Table 1). The average individual height was 2.99 m, the average crown diameter was 2.13 m, and the average number of branches was 2. As a result of the analysis of variance applied to compare the growth characteristics of the study according to the aspects, it was determined that there was no statistically significant ($p>0.05$) difference between the aspect groups in terms of height, crown diameter, and the number of branches.

3.2. Fruit characteristics of *C. orientalis* subsp. *orientalis* individuals

In terms of fruit number and fruit weight characteristics, it was determined that individuals in the south aspect were the best (Table 2). It was determined that the lowest fruit number was in the individuals in the west and the lowest fruit weight in the individuals in the north. As a result of the analysis of variance applied to compare the aspects in terms of the characteristics that are the subject of the study, it was found that there was a statistically significant ($p<0.05$) difference between the aspect groups in terms of fruit number and fruit weight.

3.3. Growth characteristics of C. *monogyna* subsp. *monogyna* individuals

The measured height values were found in the highest individuals in the north and the lowest in the individuals in the east (Table 3). In terms of crown diameter, it was determined that the individuals with the largest diameter in the west, the individuals in the east had the least. Regarding the number of branches, it was determined that the individuals with the highest number of branches were found in the south, while the individuals with the least number of branches were found in the west. The average individual height was 3.17 m, the average crown diameter was 2.35 m, and an average number of branches was 2.8. As a result of the analysis of variance applied to compare the growth characteristics of the study according to the aspects, it was revealed that there was no statistically significant ($p>0.05$) difference between the looks in terms of height and crown diameter. However, it was determined that there was a statistically significant ($p<0.05$) difference between the view groups in terms of the number of branches.

3.4. Fruit characteristics of C. *monogyna* subsp. *monogyna* individuals

Regarding fruit number and fruit weight characteristics, the highest values were observed in individuals from the south aspect, while the lowest values were observed in individuals from the west (Table 4). As a result of the analysis of variance applied to compare the aspects in terms of the characteristics of the study, it was determined that there was no statistically significant ($p>0.05$) difference between the aspect groups in terms of fruit number and fruit weight.

3.5. Relationships between characters

According to the correlation analysis performed on *C. orientalis* individuals, it was determined that the relationship between the number of branches and the height character was insignificant. All other characters were statistically positively correlated at the 0.01 significance level (Table 5). According to the correlation analysis performed in *C. monogyna* individuals, it was determined that the relationship between the number of branches and the height character was insignificant. All other characters were statistically positively correlated at the 0.01 significance level (Table 6).

Table 1. Height (H), crown diameter (CD) and number of branches (BN) values according to aspects (*C. orientalis*)

	H				CD				BN			
Aspect	**E**	**W**	**N**	**S**	**E**	**W**	**N**	**S**	**E**	**W**	**N**	**S**
Average	3.01	2.49	3.03	3.44	2.06	1.61	2.30	2.54	1.80	1.80	2.00	2.40
Min.	2.60	1.50	2.20	2.05	0.90	0.60	0.90	0.70	1.00	1.00	1.00	1.00
Max.	3.60	6.00	4.20	6.40	4.00	5.00	3.50	3.80	3.00	3.00	3.00	5.00
Std. Dev.	0.32	1.33	0.54	1.24	1.12	1.36	0.94	1.00	0.79	0.92	0.82	1.17

Table 2. Number of fruits (FN) and fruit weight (FW) values by aspect (*C. orientalis*)

	FN				FW			
Aspect	**E**	**W**	**N**	**S**	**E**	**W**	**N**	**S**
Average	263.0	222.9	216.9	480.5	530.6	535.46	492.82	1244.72
Min.	105.0	67.0	75.0	90.0	180.31	167.03	145.67	182.64
Max.	595.0	695.0	435.0	1125.0	1092.39	1346.95	964.9	2769.18
Std. Dev.	145.59	194.07	110.99	342.95	306.05	402.11	263.0	916.02

Table 3. Height (H), crown diameter (CD) and number of branches (BN) values according to aspects (*C. monogyna*)

	H				CD				BN			
Aspect	**E**	**W**	**N**	**S**	**E**	**W**	**N**	**S**	**E**	**W**	**N**	**S**
Average	2.88	3.07	3.69	3.03	2.26	2.42	2.42	2.31	2.60	1.90	2.50	4.20
Min.	2.40	1.95	1.80	1.80	1.10	1.70	1.20	1.20	1.00	1.00	1.00	2.00
Max.	3.75	4.20	6.50	5.20	4.50	3.10	3.70	4.20	6.00	3.00	4.00	7.00
Std. Dev.	0.51	0.81	1.38	1.02	1.02	0.44	0.87	0.97	1.84	0.74	0.85	1.75

Table 4. Number of fruits (FN) and fruit weight (FW) values by aspect (*C. monogyna*)

	FN				FW			
Aspect	**E**	**W**	**N**	**S**	**E**	**W**	**N**	**S**
Average	4628.0	3269.0	4147.0	5054.0	2133.37	1967.13	2485.33	2595.21
Min.	1950.0	210.0	670.0	1750.0	1136.89	1020.60	545.57	972.86
Max.	11120.0	5120.0	8100.0	10760.0	3656.99	3145.14	5822.83	7581.00
Std. Dev.	2525.02	977.03	2260.48	3452.92	796.24	714.99	1552.35	2073.76

Table 5. Relationships between growth characteristics of *C. orientalis* Pall. ex M. Bieb. subsp. *orientalis* individuals and fruit yield

r	**H**	**CD**	**BN**	**FN**
CD	**	-		
BN	ns	**	-	
FN	**	**	**	-
FW	**	**	**	**

***** p <0.05, ** p <0.01

Table 6. Relationships between growth characteristics and fruit yield of *C. monogyna* Jacq. var. *monogyna* individuals

r	**H**	**CD**	**BN**	**FN**
CD	**	-		
BN	ns	**	-	
FN	**	**	**	-
FW	**	**	**	**

In a study performed on red hawthorn, the average height, crown diameter, and the number of branches in individuals were found to be 2.34 m, 1.79 m, and 2.7, respectively (Baloğlu and Bilir, 2020b). In this study, the average height, crown diameter, and number of branches were found to be 3.17 m, 2.35 m, and 2.8 in individuals, respectively, and showed similar results. Özderin (2014), in a study on *Crataegus* taxa, determined that flower and fruit yields were higher in the south aspect. In this study, flower and fruit yields of both species were found to be high in the south. A study conducted on *Rosa canina* L. species determined that there was a statistically significant and positive relationship between growth characteristics and fruit characteristics (Baloğlu and Bilir, 2020a). In this study, the relationships between growth and fruit characteristics in both species were positive and statistically significant. Bektas et al. (2017), in a study they carried out, determined that the number of branches emerging from the trunk of hawthorn genotypes varied between 1-3. This study determined that the average number of branches in *C. orientalis* species varied between 1-3, and in *C. monogyna* species 1-7. The fruit weight of *C. azarolus* L. species was between 0.81-2.14 g (Karadeniz and Kalkışım, 1996), fruit weight of hawthorn species was between 0.58-3.48 g in a study carried out in Erzincan (Gündoğdu et al., 2014). In the study, fruit weight in hawthorn genotypes was between 1.54-4.72 g (Balta et al., 2015), fruit weight was between 0.98-6.76 g in natural hawthorn populations in a study conducted in Malatya (Bektaş et al., 2017), in another study conducted in Malatya. It was determined that the fruit weight of hawthorn species varied between 0.76-4.27 g (Ercişli et al., 2015). Similar results were obtained in this study, and the fruit weight was found to be 1.72-3.37 g in *C. orientalis* species and 0.33-0.90 g in *C. monogyna* species.

4. Conclusions and Recommendations

As a result of the study, outputs on growth and fruit characteristics of two naturally grown *Crataegus* species were obtained. According to the result, it can be said that it is an ideal view for the cultivation of southern persimmon for both species in this and similar regions. If it is to be planted or planted, it is thought that choosing the southern view will be more advantageous in terms of both growth characteristics and fruit

yield. It was concluded that growth and fruit characteristics were positively related in both species. This shows that fruit yield estimation can be made by looking at the growth characteristics. In addition, knowing the growth and fruit characteristics and the interaction between growth and fruit yield is essential for cultivating this species. This study was carried out in a limited area and with a limited number of individuals. In the case of working in larger areas and with more individuals, more comprehensive results can be obtained. The accuracy of recommendations to be made can be made more precise. It is thought that this and similar studies to be carried out both in these two species and in other *Crataegus* species will reinforce the importance of the *Crataegus* species and form a basis for studies to investigate the use of *Crataegus* species for food and medicinal purposes. With its flora and fauna, Isparta city forest has particular importance to the people of Isparta. In addition to hawthorn species, the urban forest is also home to many plant species with ethnobotanical characteristics, such as rosehip, wild plum, wild apple, and wild pear. Hawthorn species are also found in large numbers in the area. According to the results of our study, hawthorn species in the area can be collected and consumed as food. According to the observations made in the area, it has been seen that the local people who know the hawthorn plant make jam, marmalade, and vinegar from the hawthorn individuals here and collect them for decorative purposes in their homes. They also stated that they boiled the leaves and drank them for upper respiratory tract ailments and cardiovascular health and boiled the flower to reduce blood pressure. However, as a result of the interviews, it has been seen that there are as many people who do not know as much as those who know this plant. The use of this plant can be increased by increasing the studies on hawthorn in these and similar regions and introducing it to the local people. In addition, by providing state incentives to the public to cultivate this plant, product supply can be provided for the pharmaceutical industry.

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