

# Some Botanical Properties of Hawthorn (*Crataegus* L. spp.) Taxa Natural Distributed in the Western Anatolia Part of Turkey

Sevgin ÖZDERİN

Muğla Sıtkı Koçman University,  
Truffle Application and Research Center, 48000, Muğla/Turkey  
Email: sevginozderin@mu.edu.tr

Hüseyin FAKİR

Süleyman Demirel University, Faculty of Forestry,  
Department of Forest Engineering, 32260 Isparta/Turkey

**Abstract** – In this study, some botanical properties of Hawthorn (*Crataegus* L. spp.) taxa which natural spread in the western Anatolia, were determined. Data were obtained from 13 experimental sites that situated İzmit, Sakarya, Balıkesir, İzmir, Kütahya, Muğla and Isparta province where most distribution are exist of hawthorn in the western Anatolia. Length, width, stalk and lobe number of leaves; flowering periods and width, length, fruit seed weight and number of fruits were calculated and results were given. According to results, the largest taxon for leaf and petiole is *Crataegus pentagyna* (7 cm length, 3,8 cm width and stalk is 3 cm). The smallest taxon for leaf is *C. monogyna* var. *lasiocarpa* (0,8 cm length and 1,1 cm width). *C. pentagyna* subsp. *pentagyna* is producing a maximum of flowers in a flower taxa installation up to 50 and *C. azarolus* has at least the third. Most early blooming taxa are *C. monogyna* var. *monogyna* and *C. pentagyna* subsp. *pentagyna* by in April, and also flowers of *C. tanacetifolia* opened by July at the latest. *C. orientalis* subsp. *orientalis* has the biggest fruit (2,8 cm length and 2,5 cm width). *C. tanacetifolia* has the heaviest fruit (6,78 g) and the lightest is *C. monogyna* var. *monogyna* (0,26 g).

It is determined that hawthorn is spreading in sparse, opening in forest, steep, rocky slopes and edge of fields. Productivity of flower and fruit occur in South and southwest aspects in experimental sites. The slopes of selected experimental sites vary between 5% and 35 %. It determined example areas that hawthorn spread between 250 and 2131 meters altitude. Example areas become significant difference in elevation and also depending on the difference in elevation; the some botanical characteristics of taxa are varied.

**Keywords** – *Crataegus*, Botanical Properties, Western Anatolia, Turkey.

## I. INTRODUCTION

Turkey is very rich in wild plant species. It has a substantial amount of flora with around 11.000 plant species compared to the rest of the World [1-4]. Although the continental Europe is nearly 12 times larger than Turkey, the biological diversity of Turkey is remarkable considering that it accommodates around 11.000 species [5]. Furthermore, the flora of Turkey is interesting not only due to the high number of species but also because it has so many endemic species [6]. The reasons why Turkey's flora is so rich include its geological and geomorphological structure and thus several different microclimates as well as so many diverse soil types. Turkey is a bridge between Europe and Asia due to its geographical location. The number of plant species has

increased owing to the two-way migration of plants between the two continents. On the other hand, Turkey has such a rich plant cover as it is located within the European-Siberian Phytogeographical Zone in the Northern Anatolia Region; Mediterranean Zone in the Western and Southern Anatolia Region; and Iran-Turanian Zone in the Central, Eastern and Southern Anatolia Regions [7].

The genus *Crataegus* L. which is one of the most important genera of *Rosaceae* family has around 200 species on the earth. Some features of this genus including the leaf and seed morphology, seed number and fruit colour are polymorphic. Polymorphism and hybridization are the reasons why *Crataegus* species have so many synonyms. The number of hawthorn taxa in Turkey is currently twenty eight [8]. The rate of endemism is 37%. It is an extremely complex species in terms of systematic botanics. Many species in this genus are polyploid. Several factors such as climate, latitude, elevation, habitat variety, life cycle, reproduction system, hybridization, cell size, chromosome size, chromosome structure, sex chromosome mechanism and genotype have been demonstrated to be associated with polyploidy character. There are many different habitats in different regions across Turkey with respect to climate, latitude and elevation.

Hawthorn is a winter-deciduous woody species belonging to the genus *Crataegus* L. in the form of semi-evergreen shrub or small tree. It usually has thorns [9,10]. It is characterized by dark red fruits and greenish calyx. Another distinctive feature is its hairy cover, leaf shape and thorns on the leaves [11]. Leaves are multiple row coils, simple, lobed, or virtually (telex), leaf edge is straight or toothed. Flower board is pseudo-umbrellu. Each flower has 5 calyxes and petals. Flowers do not have upper calyx. Hypanthium is attached to the fruit flowers. Petals are white and pinkish, and usually longer than the calyxes. It has 5-25 anthers. There are 1-5 fruit leaves. The fruit of hawthorn looks similar to plum, and it's yellowish, reddish, blackish purple or black, and usually fleshy. Each fruit has 1-5 seeds and the seeds are hard [8,11,12].

Since the existence of humankind, they have been using the natural plants to meet their needs (especially as food, and for disease treatment etc.). Information relating to various properties of plants, their medicinal use and their use as edible foods has been transferred to the next generations [13]. Hawthorn is such a plant and its different parts (leaves, flowers, fruits, stems) were traditionally used for the treatment of various diseases. Dried flowers

and fruits of hawthorn are brewed as tea and consumed for the treatment of throat infection, cough, poor cardiac activity, cardiac pain, tachycardia, renal diseases, atherosclerosis and hepatic pain, haemorrhoid, cancer and diabetes [14-16]. Although it has been used most commonly for cardiovascular diseases, it has also been traditionally used for the treatment of pulmonary diseases and diarrhoea in China, renal calculi in Czechoslovakia, jaundice in Hungary, and gout in France. In all European countries and China; therapeutic drugs are gradually becoming more important and serious steps are taken to produce drugs. These countries produce pharmaceutical preparations and medicinal herbal teas that contain hawthorn extracts [17].

Hawthorn is mainly used in the food industry whereas it can also be used for landscaping purposes. The bark colour, canopy form, flowers and fruits are have a very aesthetic appearance; therefore, it has an important place in the landscape arrangements. As it can grow in shallow, dry, sandy and stony soils; it can contribute to the erosion control efforts, it can be used as rootstock for some stone fruit species; moreover, it is one of the important bonsai materials due to its long life, ability to develop under scarce conditions, and flower and trunk properties [18].

## II. MATERIAL AND METHODS

In order to determine the botanical characteristics of the hawthorn taxa distributed in the Western Anatolia; field studies were conducted in İzmit, Sakarya, Balıkesir, Kütahya, Muğla, İzmir and Isparta provinces from 2012 to 2014 (Table 1, Figure 1). Thirteen sampling plots of 20 x 20 with an area of 400 m<sup>2</sup> were created in areas where the hawthorn taxa widely distributed in the Western Anatolia are most densely distributed. Field studies were conducted in these sampling areas during the blooming period (May-June) and fruit ripening period (September- October) of *Crataegus* taxa that were research materials; three herbarium samples were taken from each hawthorn taxon and from the accompanying species of these hawthorn taxa. The plant samples that were recorded and collected were stored at the forest Botanic Laboratory of Forestry Faculty of Süleyman Demirel University (SDU) to be dried and preserved according to the herbarium techniques. The plants were diagnosed in the herbarium of SDU Forestry Faculty, SDU Faculty of Science Letters, Department of Biology and in the herbarium of Hacettepe University's Faculty of Science. The latitude and longitude of the sampling areas were identified via GPS, while the elevation was measured using altimeter and aspect compass, and the inclination was measured by abney level. Besides, the slope position, stone percentage of the land surface, the land type of the sampling area were determined.

In order to determine the morphological features of the concerned taxa in the sampling areas we identified on the land; leave, flower and fruit samples were collected. For the purpose of measuring the morphological features of the taxa *C. pentagyna* Waldst. & Kit. ex Willd. subsp. *pentagyna*, *C. orientalis* Pall. ex M.Bieb. subsp. *orientalis*,

*C. orientalis* Pall. ex M.Bieb. subsp. *szovitsii* (Pojark.) K.I.Chr., *C. tanacetifolia* (Lam.)Pers., *C. monogyna* var. *lasiocarpa* (Lange) K.I.Christ, , *C. monogyna* Jacq. var. *monogyna*, *C. azarolus* L. var. *aronia* that are distributed in the Western Anatolia, 50 fruit measurements were performed for each taxon with the help of a digital calibre gauge; while 50 fruit measurements were performed for each taxon with a digital scale to determine the stoned and stoneless fruit weights. The width and height of 50 leave samples from each taxon were measured, while the leaf stalk length, number of lobes on the leaves were determined. Then, the arithmetic average of the measurements was calculated.

Table 1: Location and elevation values of the plant taxa research materials

Plant Taxa	Location and elevation
<i>C. pentagyna</i> subsp. <i>pentagyna</i>	İzmit-Taş Köprü forest depot province, 456 m.
<i>C. orientalis</i> subsp. <i>orientalis</i>	Sakarya-Taraklı; Karagöl Uğurlu yaylası province, 1385 m. Balıkesir-Dursunbeyli, Aktuzla province, 1510m. İzmir-Kemal Paşa, Ayrancı province, 820 m. İzmir-Ödemiş, Gölcük province 1120 m. Kütahya-Emet, Tahtalı province, 1120 m.
<i>C. orientalis</i> subsp. <i>szovitsii</i>	Kütahya- Emet, Alıç province, 1450 m
<i>C. tanacetifolia</i>	Kütahya-Emet, Çomar province, 1450 m. Sakarya-Taraklı, Esenyurt Yaylası, 1227 m.
<i>C. azarolus</i> var. <i>aronia</i>	Muğla-Yaraş village, Akyaka province, 812 m. Isparta Kovada Lake province, 933 m.
<i>C. monogyna</i> var. <i>lasiocarpa</i>	Balıkesir-Dursunbeyli, Aktuzla province, 1510 m.
<i>C. monogyna</i> var. <i>monogyna</i>	Muğla-Ula, Çiçekli province, 250m.

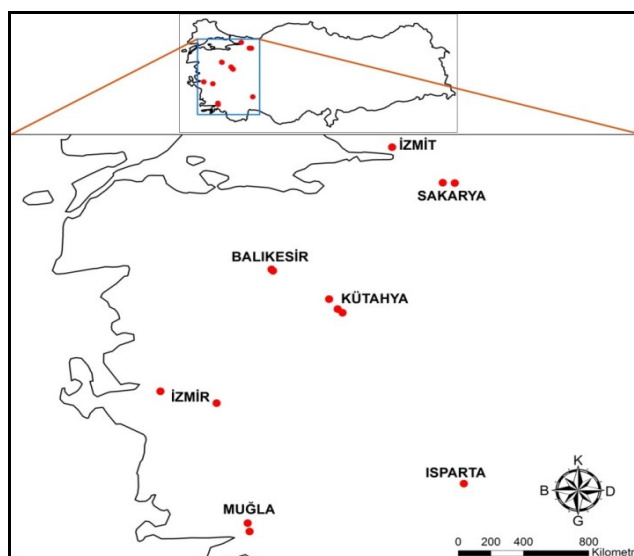


Fig.1. Map of research area location

### III. RESULTS

In our study, the leave and fruit measurements relating to 7 hawthorn taxa distributed in the Western Anatolia are presented in Tables 2 and 3. *C. pentagyna* subsp. *pentagyna* was found in the northern aspect with an inclination of 5% at margin of the sampling area where it is collected. In the sampling area, other species such as *Buxus sempervirens*, *Ulmus glabra*, *Quercus petraea* subsp. *iberica*, *Cornus mas*, *Robinia pseudoacacia*, *Carpinus betulus*, *Acer trautvetteri*, *Mespilus germanica*, *Cistus salviifolius*, *Thymus* sp., *Taraxacum* sp. were also found. It was observed that

*C. orientalis* subsp. *orientalis* was distributed in the northern, southern, southwest aspects in open forest and field margins and at an inclination of 5-35%. In the sampling areas, *Pinus nigra* subsp. *pallasiana*, *Rosa canina*, *C. monogyna* var. *lasiocarpa*, *Crocus cancellatus* subsp. *mazziiaricus*, *Ornithogalum* sp., *Verbascum* sp., *Carex* sp., *Campanula* sp., *Cochicum variegatum*, *Marrubium* sp., *C. monogyna* var. *monogyna*, *Pinus nigra* subsp. *pallasiana*, *Juniperus excelsa*, *Quercus frainetto*, *Quercus cerris*, *Rosa canina*, *Verbascum* sp. *Anthemis* sp., *Eryngium* sp., *Pinus nigra* subsp. *pallasiana*, *Cydonia vulgaris*, *C. monogyna* var. *monogyna*, *Prunus domestica*, *Quercus infectoria*, *Verbascum* sp. *Onopordum* sp., *Dryopteris pallida*, *Cydonia vulgaris*, *Quercus infectoria*, *Juniperus oxycedrus* subsp. *oxycedrus*, *Verbascum* spp., *Dactylis glomerata* subsp. *glomerata*, *Anthemis cretica*, *Cornus mas*, *Quercus frainetto*, *Thymus* sp., *Potentilla reptans*, *Rosa canina*, *Thymus longicoulis* subsp. *longicoulis* var. *subisophyllus*, *Trifolium repens*, *Euphorbia* sp., *Quercus petraea* subsp. *iberica* were identified.

In the sampling areas, *C. tanacetifolia* was found to be distributed in the southwest aspect in open forest and field margins at an inclination of 5-15%. *Pinus nigra* subsp. *pallasiana*, *Rosa canina*, *Crataegus monogyna* var. *monogyna*, *Achillea nobilis*, *Verbascum luciliae*, *Juniperus oxycedrus* subsp. *oxycedrus*, *Nepeta* sp., *Crataegus orientalis* var. *orientalis*, *Trifolium arvense*, *Buxus sempervirens*, *Abies nordmanniana* subsp. *bornmulleriana*, *Thymus* sp., *Verbascum* sp. *Juniperus oxycedrus* subsp. *oxycedrus*, *Crocus* sp. were also found in the sampling areas.

*C. azarolus* var. *aronia* was found to be distributed in the northern and southwest aspects of the sampling areas at an inclination of 15-25% in open forest. Species such as *Pinus brutia*, *Arbutus andrachne*, *Salvia tomentosa*, *Quercus coccifera*, *Orchis anatolica*, *Tordylium* sp., *Origanum onites*, *Cephalanthera rubra*, *Gladiolus anatolicus*, *Epipactis helleborine*, *Iris* sp., *Styrax officinalis*, *Phillyrea latifolia*, *Fontanesia philliraeoides*, *Scutellaria orientalis*, *Quercus coccifera*, *Quercus cerris*, *Lysimachia atropurpurea*, *Onopordum carduchorum*, *Reseda lutea*, *Anchusa undulata*, *Vicia cracca* subsp. *stenophylla*, *Coronilla varia* subsp. *varia*, *Senecio vernalis*, *Rosa canina* were also identified in the sampling areas.

Table 2: Measurement values of Hawthorn leaf taxa.

Species	Values	The Smallest	The Biggest	Average
<i>C. pentagyna</i> subsp. <i>pentagyna</i>	LL (cm)	2,0	7,0	4,68
	LW (cm)	1,7	3,8	2,82
	LNL	3,0	5,0	4,62
	LS	0,9	3,0	1,70
<i>C. orientalis</i> subsp. <i>orientalis</i>	LL (cm)	1,8	7,1	3,71
	LW (cm)	1,0	5,4	2,51
	LNL	-	7,0	4,00
	LS	0,3	2,3	0,66
<i>C. orientalis</i> subsp. <i>szovitsii</i>	LL (cm)	2,7	4,8	3,49
	LW (cm)	1,4	4,0	2,33
	LNL	-	6,0	3,04
	LS	0,2	1,2	0,39
<i>C. tanacetifolia</i>	LL (cm)	1,8	4,0	3,08
	LW (cm)	1,1	2,9	1,80
	LNL	2,0	7,0	4,68
	LS	0,1	0,9	0,42
<i>C. azarolus</i> var. <i>aronia</i>	LL (cm)	1,5	5,9	2,92
	LW (cm)	0,7	3,8	1,85
	LNL	-	5,0	3,67
	LS	0,1	1,2	0,65
<i>C. monogyna</i> var. <i>lasiocarpa</i>	LL (cm)	1,8	3,7	2,99
	LW (cm)	0,9	3,0	1,57
	LNL	-	5,0	5,00
	LS	0,3	2,5	1,10
<i>C. monogyna</i> var. <i>monogyna</i>	LL (cm)	1,9	4,7	2,96
	LW (cm)	1,0	3,5	1,98
	LNL	3,0	5,0	3,32
	LS	0,4	1,3	0,83

LL : leaf length, LW :leaf width, LNL: lobe number of leaf, LS : leaf stalk

*C. monogyna* var. *lasiocarpa* was found to be distributed in the northern aspects of open forest at an inclination of 5%. Such species as *Pinus nigra* subsp. *pallasiana*, *Rosa canina*, *Crataegus orientalis* var. *orientalis*, *Crocus cancellatus* subsp. *mazziiaricus*, *Ornithogalum* sp., *Verbascum* sp., *Carex* sp., *Campanula* sp., *Cochicum variegatum*, *Marrubium* sp., *Crocus cancellatus* subsp. *mazziiaricus* were also found in the sampling area.

*C. monogyna* var. *monogyna* was distributed at field margins in the southwest aspect at an inclination of 5%. In the sampling area, species such as *Vitex agnus-castus*, *Rosa canina*, *Pyrus amygdaliformis* var. *amygdaliformis*, *Pinus brutia*, *Salvia tomentosa* were also observed.

Table 3: Measurement values of Hawthorn taxa fruit.

Species	Values	The smallest	The biggest	Average
<i>C. pentagyna</i> subsp. <i>pentagyna</i>	FW (cm)	0,70	0,90	0,78
	FL (cm)	0,70	0,90	0,80
	FWS (g)	0,50	1,05	0,78
	SW (g)	0,19	0,38	0,26
	NS	3,00	5,00	4,52
<i>C. orientalis</i> subsp. <i>orientalis</i>	FW (cm)	0,80	2,50	1,72
	FL (cm)	0,70	2,80	1,62
	FWS (g)	1,15	5,19	3,04

	SW (g)	0,23	3,92	1,16
	NS	2,00	5,00	3,22
<i>C. orientalis</i> subsp. <i>szovitsii</i>	FW (cm)	0,90	1,50	1,27
	FL (cm)	0,90	1,50	1,11
	FWS (g)	1,13	2,45	1,73
	SW (g)	0,24	0,69	0,42
	NS	3,00	5,00	4,34
<i>C. tanacetifolia</i>	FW (cm)	1,30	2,60	1,96
	FL (cm)	0,90	2,40	1,48
	FWS (g)	1,50	6,78	3,88
	SW (g)	0,23	1,81	0,69
	NS	4,00	6,00	5,00
<i>C. azarolus</i> var. <i>aronia</i>	FW (cm)	1,00	1,80	1,39
	FL (cm)	0,80	1,60	1,20
	FWS (g)	1,02	3,49	1,96
	SW (g)	0,14	1,55	0,44
	NS	2,00	4,00	2,60
<i>C. monogyna</i> var. <i>lasiocarpa</i>	FW (cm)	0,80	1,00	0,85
	FL (cm)	0,80	1,10	0,98
	FWS (g)	0,69	1,18	1,01
	SW (g)	0,12	0,26	0,17
	NS	1,00	1,00	1,00
<i>C. monogyna</i> var. <i>monogyna</i>	FW (cm)	0,70	1,00	0,83
	FL (cm)	0,80	1,00	0,90
	FWS (g)	0,26	0,89	0,45
	SW (g)	0,05	0,19	0,13
	NS	1,00	1,00	1,00

FW:fruit width, FL:Fruit length, FWS: fruit weight with seed, SW:seed weight, NS. :number of seed

Hawthorn is an important source that is used as a nutritional source, drug and cosmetic raw material, an element in the field of rural landscaping for erosion control, urban forestation and alternative medicine. The increased orientation towards the natural products that are beneficial for human health requires the protection of wild fruits in their natural environments and culturing them for commercial purpose. For these reasons, the botanical characteristics of hawthorn taxa distributed in the Western Anatolia were identified in this study.

#### IV. DISCUSSION AND CONCLUSION

The leaves, flowers and fruits of hawthorn are rich in several substances that are beneficial for human health; therefore, it is considered as an important medicinal plant. Some botanical and habitat features of the taxa of this very important medicinal plant that are distributed in the Western Anatolia were identified in this study.

The measurements performed during this research revealed that the fruit diameter of *C. pentagyna* subsp. *pentagyna* ranged from 0,7 to 0,9 cm and the average fruit diameter was 0,78 cm, the fruit height varied from 0,7 to 0,9 cm and the average fruit height was 0,80 cm, stoned fruit weight ranged from 0,5 to 1,05 g and the average stoned fruit weight was 0,78 g, the stone weight was 0,19-0,38 g and the average stone weight was 0,26 g, while the number of stones ranged from 3 to 5 and the average number of stones was 4,52. The findings of our study

showed that the fruit size of *C. pentagyna* subsp. *pentagyna* was 5–9x5–9 mm, which is consistent with the findings of Dönmez et. al. [19-20].

It was found in this study that the fruit diameter of *C. azarolus* var. *aronia* ranged from 1 to 1,8 cm and the average fruit diameter was 1,39 cm, the fruit height ranged from 0,8 to 1,6 cm and the average fruit height was 1,20 cm, stoned fruit weight ranged from 1,02 to 3,49 g and the average stoned fruit weight was 1,96 g, the stone weight was 0,14-1,55 g and the average stone weight was 0,44 g, while the number of stones ranged from 2 to 4 and the average number of stones was 2,6. Koyuncu et al., (2007) reported that the fruit diameter of *C. azarolus* L. they collected in Malatya province was 19.12 mm, fruit height was 19.83 mm, fruit diameter was 25 mm, fruit weight ranged from 2.16 to 7.58 g, the stoneless fruit weight was 0.77–1.16 g. whereas Balta et al. (2006) found that the fruit weight of *C. aronia* was 2,63 g. [21]. This shows that the findings of our study were different from the others.

In this research, the fruit diameter of *C. tanacetifolia* was found to range from 1,3 to 2,5 cm while the average fruit diameter was 2,72 cm; fruit height ranged from 0,9 to 2,4 cm while the average fruit height was 1,48 cm, stoned fruit weight ranged from 1,5 to 6,78 while the average stoned fruit weight was 3,88 g, the stone weight ranged from 0,23 to 1,81 g while the average stone weight was 0,69 g; and the number of stones ranged from 4 to 6 while the average number of stones was 5. Balta et al. (2006) found in their study on hawthorn taxa that the highest fruit weight of *C. tanacetifolia* was 4.99 g. In the study, the fruit weight was found to be higher.

The fruit diameter of *C. orientalis* subsp. *orientalis* ranged from 0,8 to 2,5 cm while the average diameter was 1,72 cm; fruit height ranged from 0,7 to 2,8 cm while the average height was 1,62 cm, stoned fruit weight ranged from 1,15 to 5,19 g while the average weight was 3,04 g, stone weight ranged from 0,23 to 3,92 g while the average stone weight was 1,16 g; the number of stones ranged from 2 to 5 while the average number of stones was 3,22, the fruit diameter of *C. orientalis* subsp. *szovitsii* ranged from 0,9 to 1,5 cm while the average diameter was 1,27 cm, fruit height ranged from 0,9 to 1,5 cm while the average height was 1,11 cm, stoned fruit height ranged from 1,13 to 2,45 g while the average stoned fruit height was 1,73 g; the stone weight ranged from 0,24 to 0,69 g while the average stone weight was 0,42 g, the number of stones ranged from 3 to 5 while the average number of stones was 4,34. Balta et al. (2006) found that the highest weight of *C. orientalis* was 3.48 g whereas the weight of *C. orientalis* subsp. *orientalis* and *C. orientalis* subsp. *szovitsii* was higher in our study.

The distribution of tree and shrub species is influenced by the habitat features (elevation, climate, soil, aspect). In this study, similarities and differences between the sampling pairs were revealed with respect to the association between plant cover and habitat. Thirteen sampling areas where the hawthorn is widely distributed in the Western Anatolia were identified in this research. The sampling areas where hawthorn was distributed was identified in close canopy, open forest, slopes of steep

cliffs and margins of fields. The aspect was found to have a significant impact on the distribution of hawthorn taxa within the sampling areas. Accordingly, it was observed that *C. pentagyna* subsp. *pentagyna* was distributed on the northern aspect, *C. orientalis* subsp. *orientalis* on the northern, southern and southwest aspects, *C. orientalis* subsp. *szovitsii* on southwest aspect, *Crataegus tanacetifolia* on southwest aspect, *C. azarolus* var. *aronia* on northern and southwest aspects; *C. monogyna* var. *lasiocarpa* on northern aspect, *C. monogyna* var. *monogyna* on southwest aspect. Hawthorn taxa were found to vary depending on the aspect, the occurrence rate of taxa also varied while the aspect was observed to have a significant impact on the flower and fruit yield of the taxa. Accordingly, flower and fruit yield was observed to be higher on southern and southwest aspects. The inclination of the land increases the effect of sun on southwest aspect while it decreases the effect of sun on northern aspect. The inclination of the sampling areas was found to range from 5% to 35%.

Elevation is another factor that determines the habitat feature. It was observed that *C. pentagyna* subsp. *pentagyna* was distributed at an elevation of 250 m, *C. orientalis* subsp. *orientalis* at 820-1510 m, *C. orientalis* subsp. *szovitsii* at 1450 m, *C. tanacetifolia* at 1227-1450 m, *C. azarolus* var. *aronia* at 812-930 m, *C. monogyna* var. *lasiocarpa* at 1510 m, *C. monogyna* var. *monogyna* at 250 m in open forest, on rocky and steep lands and margins of fields. Accordingly, hawthorn in the sampling areas was found to be distributed at an elevation of minimum 250 m and maximum 1510 m. As the elevation difference between the sampling areas increases, the morphological features of hawthorn taxa depending on the elevation difference were also found to vary. Mediterranean climate (hot and dry in summer, mild and rainy in winter), Black Sea climate (cool in winter and rainy nearly in all seasons) and Continental climate (hot in summer, cold and often less rainy in winter) were dominant in the research area. The hawthorn trees were found to be widely distributed on humid, sandy, dry, clayey and heavy clay soils in the sampling areas. In the sampling areas where the hawthorn taxa are widely distributed in the Western Anatolia, *Rosa canina* and *Verbascum* spp. were the most common species. Furthermore, other species such as *Buxus sempervirens* and *Ulmus glabra*, *Quercus petraea* subsp. *iberica*, *Cornus mas*, *Carpinus betulus*, *Acer trautvetteri*, *Mespilus germanica*, *Cistus salviifolius*, *Pinus nigra* subsp. *pallasiana*, *Rosa canina*, *Crocus cancellatus* subsp. *mazziaricus*, *Cochicum variegatum*, *Juniperus excelsa*, *Quercus frainetto*, *Quercus cerris*, *Quercus infectoria*, *Quercus infectoria*, *Juniperus oxycedrus* subsp. *oxycedrus*, *Dactylis glomerata* subsp. *glomerata*, *Achillea nobilis*, *Verbascum lucilia*, *Trifolium arvense*, *Abies nordmanniana* subsp. *bornmulleriana*, *Pinus brutia*, *Styrax officinalis*, *Phillyrea latifolia*, *Scutellaria orientalis*, *Quercus coccifera*, *Lysimachia atropurpurea*, *Onopordum carduchorum*, *Vicia cracca* subsp. *stenophylla*, *Coronilla varia* subsp. *varia*, *Crocus cancellatus* subsp. *mazziaricus*, *Vitex agnus-castus*, *Pyrus*

*amygdaliformis* var. *amygdaliformis*, *Salvia tomentosa* were also found in the sampling areas.

The wide surface area, climate of Turkey and its location at the intersection of an important germplasm increase its plant diversity. Wild plants are used as food, drugs and cosmetics; therefore, they have a substantial impact on human life. The increased orientation towards the natural products that are beneficial for human health requires the protection of wild fruits in their natural environments and culturing them for commercial purpose [18]. Despite the scientifically verified benefits of hawthorn that is widely distributed in Turkey, they cannot be utilized adequately. Due to this reason and other similar reasons, the botanical characteristics of the important taxa of hawthorn that are widely distributed in the Western Anatolia were identified. It can be suggested that this study would contribute to the future scientific studies on hawthorn.

### ACKNOWLEDGMENT

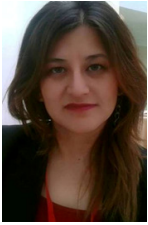
This study was a part of PhD thesis of first author Sevgin ÖZDERİN. We express our sincere appreciation to Suleyman Demirel University, Coordinatorship of Scientific Research Projects for their financial support by project which numbered as 3211-D2-12.

### REFERENCES

- [1] Davis, P. H., 1965-1985, Flora of Turkey and the East Aegean Island Vol. I-IX and Supplement, Edinburgh.
- [2] Davis, P.H., Mill, R.R., Tan, K. 1988. Flora of Turkey and East Aegean Islands. Vol. 10, Edinburgh Univ. Press, Edinburgh.
- [3] Güner, A., Özhatay, N., Ekim, T., Başer, K.H.C. (eds) 2000. Flora of Turkey and the East Aegean Islands. Suppl. II, Edinburgh Üniversitesi. Press, Edinburgh.
- [4] Erik, S., Tarıkahya, B., 2004. About Flora of Turkey, Kebikeç, 17, 139-163.
- [5] Tutin, G.T., Heywood, V.H. 1964-1981. Flora Europaea, Volume. I-V, Cambridge Univ. Press.
- [6] Ekim, T., Koyuncu, M., Erik, S., İlarıslan, R. 1989, List of Rare, Threatened and Endemic Plants of Turkey. Turkish Association for the Conservation of Nature and Natural Resources, no: 18, Ankara, 227pp.
- [7] Koyuncu, T., Y. Pinar ve F. Lüle 2007. "Convective Drying Characteristics of Azarole Red (*Crataegus monogyna* Jacq.) and Yellow (*Crataegus aronia* Bosc.) Fruits", Journal of Food Engineering, 78, 1471-1475.
- [8] Dönmez A.A. 2007. Taxonomic note on the genus *Crataegus* (Rosaceae) in Turkey. Bot. J. Linnean Soc., 155: 231-240.
- [9] Seçmen, Ö., Gemici, Y., Leblebici, Y., Görk, G., Bekat, L. 1989. Seed Plant Systematics E.Ü. Science Faculty. İzmir, No:116, 2. Baskı, 396 pp.
- [10] Pamay, B., 1992. Trees and shrubs I Plant Material II, İstanbul.
- [11] Dönmez, A.A., 2004. The Genus *Crataegus* L. (Rosaceae) with Special Reference to Hybridisation and Biodiversity in Turkey, Turk. J. Bot. ,28, 29-37.
- [12] Browicz PH (1972). *Crataegus* In: Davis PH (ed), Flora of Turkey and the East Aegean Islands. Edinburgh Univ. Press, No: 22, Edinburgh.
- [13] Lev, E. ve Amar, Z., 2000. Ethnopharmacological Survey of Traditional Drugs Sold in Israel at the end of the 20th Century, Journal of Ethnopharmacology, 72, 191-205.
- [14] Karadeniz, T.; Kalkışım, Ö 1996. Selection of Important Forms And The Fruit Characteristics of Azarole (*Crataegus azarolus* L.) Forms Grown in Edremit and Gevaş.

- [15] A. H. Meriçli and K. Ergezen 1994. Flavonoids of *Crataegus tanacetifolia* (Lam.) Pers. (Rosaceae) an endemic species from Turkey, *Sci Pharm.* 62, 277-281.
- [16] P. Ljubuncic, I. Partnaya, U. Cogan, H. Azaizeh and A. Bomzon (2005). Antioxidant activity of *Crataegus aronia* aqueous extract used traditional Arab medicine in Israel, *J. Ethnopharmacol.* 101, 153- 161.
- [17] Çelebi Koçyıldız Z., Birman H. , Akgün Dar K., Melikoğlu G., Meriçli A.H., "Crataegus tanacetifolia Leaf Extract Prevents L-Name-Induced Hypertension In Rats: A Morphological Study", *Phytotherapy Research*, vol.20, pp.66-70, 2006.
- [18] Gültekin, H. C., 2005. Bozkırın Yalnız Ağaçları Alıçlar, *Bilim ve Teknik*, Şubat Sayısı, 76–78.
- [19] Dönmez A.A. 2005. A new species of *Crataegus* (Rosaceae) from Turkey. *Botanical Journal of the Linnean Society* 148:245–249.
- [20] Dönmez A.A. Oybak Dönmez E. 2005. *Crataegus turcicus* (Rosaceae), a new species from NE Turkey. *Annales Botanici Fennici* 42: 61–65.
- [21] Balta MF, Celik F, Turkoglu N, Ozrenk K, Ozgokce F (2006). Some fruit traits of hawthorn (*Crataegus* spp.) genetic resources from Malatya, Turkey. *Res. J. Agric. Biol. Sci.*, 2(6): 531-536.

### AUTHOR'S PROFILE



#### **Dr. Sevgin ÖZDERİN**

has completed his PhD studies from Suleyman Demirel University, Faculty of Forestry in 2014 on Forest Botany. She became Specialist in Truffle Application and Research Center, Muğla/Turkey in 2015.

#### **Assoc. Prof. Dr. Hüseyin FAKİR**

has completed his PhD studies from Istanbul University, Faculty of Forestry in 1995 on Forest Botany. He became Associate Professor in 2011.