



SAKARYA ÜNİVERSİTESİ

# FEN BİLİMLERİ ENSTİTÜSÜ DERGİSİ

Sakarya University Journal of Science  
SAUJS

ISSN 1301-4048 e-ISSN 2147-835X Period Bimonthly Founded 1997 Publisher Sakarya University  
<http://www.saujs.sakarya.edu.tr/>

Title: A Research on the Anatomical and Ecological Characteristic of *Onosma mollis* DC.  
(Boraginaceae)

Authors: Sibel ULCAY

Received: 2023-02-02 00:00:00

Accepted: 2023-03-06 00:00:00

Article Type: Research Article

Volume: 27

Issue: 4

Month: August

Year: 2023

Pages: 813-821

How to cite

Sibel ULCAY; (2023), A Research on the Anatomical and Ecological Characteristic of *Onosma mollis* DC. (Boraginaceae). Sakarya University Journal of Science, 27(4), 813-821, DOI: 10.16984/saufenbilder.1209779

Access link

<https://dergipark.org.tr/en/pub/saufenbilder/issue/79486/1209779>

New submission to SAUJS

<http://dergipark.gov.tr/journal/1115/submission/start>

## A Research on the Anatomical and Ecological Characteristic of *Onosma mollis* DC. (Boraginaceae)

Sibel ULCAY\*<sup>1</sup> 

### Abstract

In this study, endemic *Onosma mollis* DC. it is aimed to examine the anatomical and ecological features of (Boraginaceae) plant in detail and to be compared with the other studies. According to the cross-sections, the root is secondary. Primary pith rays that 2-3 layered are observed. Epidermis is single-layered in stem transverse section. Eglanular hairs in the epidermis are simple, with one and two cells. Glandular hairs are capitate, digitate and with two cells. Just under the epidermis, 2-3 rows of collenchyma cells are formed. Both the upper and the lower surface of leaf is covered with numerous eglanular hairs. Eglanular hairs are 2-3 branched. Glandular hairs are of capitate, digitate and peltate type. The habitat of the *O. mollis* plant is mountain slopes, meadows, and prairies. The soil in which the species grows is clay and loamy. It is also classified as slightly alkaline, salty, calcareous, low phosphorus and high in potassium. According to its organic matter content, it is in the group of good humus soils.

**Keywords:** *Onosma*, *Onosma mollis*, Boraginaceae, anatomy, ecology

### 1. INTRODUCTION

Boraginaceae family is a big family containing approximately 154 genera and 2500 species, which is spread in the temperate and subtropical areas of the world and mainly in the Mediterranean region [1]. *Onosma* L. is a genus belonging to the Boraginaceae family and distributing 101 species of this genus in Türkiye. Among these species 50 of these are endemic [2 revised according to Firat and Binzet 2021 and add to references list]. The roots of the species belonging to the *Onosma* genus are used for purposes of treatment and as dye substance [3, 4]. It is used for cuts, swelling, wounds and ulcers in the continent of Asia and especially in India. Again, it is

mentioned that the dye obtained from the plant is used in religious ceremonies in the same region [5]. Some species belonging to the genus are used in Şanlıurfa and the surrounding region as chewing gum. It has been stated by Kahyaoğlu and Türkoğlu that *Onosma mollis* DC. species collected from Elazığ and its surrounding region had antimicrobial effect against bacteria and yeast [6]. The *O. mollis* around the region of Gürün (Sivas) -Tohma stream is valuable with respect to medical and aromatic aspects and it has been stated by Bozkurt that it has characteristics that can be used in planting studies [7].

\* Corresponding author: sibelulcay@gmail.com (S. ULCAY)

<sup>1</sup> Kırşehir Ahi Evran University, Faculty of Agriculture, Department of Field Crops, Kırşehir

ORCID: <https://orcid.org/0000-0002-2878-1721>



Y-linoleic acid is present in most members of the Boraginaceae family. Stearidonic acid is the other chemical component which has been determined in members of stearidonic acid family. These compounds bear nutritional value and medical importance [8]. Velasco and Goffman state that these chemical compounds bear importance for the Boraginaceae family taxonomically [8]. Metcalfe and Chalk and Watson and Dallwitz have defined the characteristic features of Boraginaceae family [9, 10]. Akçin, Binzet and Orcan, Kodal, Binzet and Akçin, Güven et al., Akçin et al., Akçin and Binzet, Selvi et al., have conducted various studies relating with species belonging to *Onosma* and distributing in Turkey [11-18]. In these studies, the morphological, anatomical, micromorphological, palynological characteristics of some species belonging to the *Onosma* genus have been determined.

Anatomical features of organs such as root, stem and leaf of species having similar morphological features may reveal significant differences. In accordance, anatomical characteristics are used in taxonomy in recent years [19]. *Onosma* is a genus that has systematic and taxonomic problems. Anatomical and micromorphological studies also constitute an important criterion in the differentiation of species [20]. In this study, it has been aimed to determine the anatomical features of *O. mollis*. and to eliminate some deficiencies it has got and to reveal the ecological characteristics that have not been investigated before. The results obtained will contribute to other studies on the *Onosma* genus.

## 2. MATERIALS AND METHODS

*O. mollis* constituting research subject has been collected In May 2019 in Yıldızeli (Sivas) at a height of 1600 m, at 26 km northwest of the district. The identification of plant samples was made according to the Flora of Turkey [21]. Some of the materials that were collected were turned into herbarium specimens (Voucher and

herbarium number: Sulcay60, 356), while some of them were made into stock samples having 70% alcohol (Stock number A94). Manual sections were taken to determine the anatomical features. Glycerin-gelatin was used as the examination medium in the sections. Preparations were made permanent by using the glycerin gelatin method [22]. Preparations have been examined with Nikon Eclipse Ni microscope and Nikon DS-F1 screening system and photographs have been taken. 25 measurements on average were made from tissues such as epiderma and parenchyma collenchyma that were seen in the sections being examined. As a result of these measurements, minimum, maximum, average values and standard error values of the anatomical characters have been calculated.

For ecological studies soil samples have been taken from the area where plant samples were collected. During the field work, after removing the upper surface of the soil, a section of approximately 1 kg was taken with depth and diameter in the range of 0-20 cm. After these samples were dried in air and passed through a 2 mm sieve, they were made ready for analysis [23]. Soil analyzes have been conducted in 2 replications. Saturation percentage was obtained by saturating the colloid surface areas with water [24]. The pH and total salinity determinations were made in the saturation sludge [25, 26]. Organic material has been classified by using modified Walkey-Black wet burning method [27]. Total lime was made with Scheibler calcimeter [28] and it was classified according to Ülgen and Yurtsever [29]. Useful phosphorus determination was made by extracting soils with sodium bicarbonate (pH: 8.5, 0.5 N NaHCO<sub>3</sub>) [30]. Changeable potassium was determined [31] by extracting it with ammonium acetate (pH: 7, 1 N NH<sub>4</sub>OAc). Among the elements passing into the solution phase, concentration of phosphorus was determined by using the UV-VIS Spectrometer device, while the concentration of potassium was determined by using the Flame Spectrometer device.

### 3. RESULTS

#### 3.1. Anatomical Results

In cross-sections taken from the root of the taxon, periderms cells are in 2-3 rows. Cortex parenchyma cells which are right at the bottom are polygonal in shape and have 10-15 rows. Phloem is circular in shape and form a large region. Cambium is in a crushed condition and it is not fully apparent. Endodermis is seen in the secondary root cross-section (Table 1). 2-3 layered primary pith arms are formed (Figure 1, A).

Epidermis cells are circular in shape and have a single row in the stem cross-section. Eglanular hairs on the epidermis are simple, having one and two cells (Figure 1, C). Short-stemmed capitate (Figure 1, D), digitate (Figure 1, D), peltate (Figure 1, E) are observed on the stem. Cuticle is observed on the epidermis cells of the stem. 2-3 rows of collenchyma cells surrounding the stem cross-section are observed right below the epidermis.

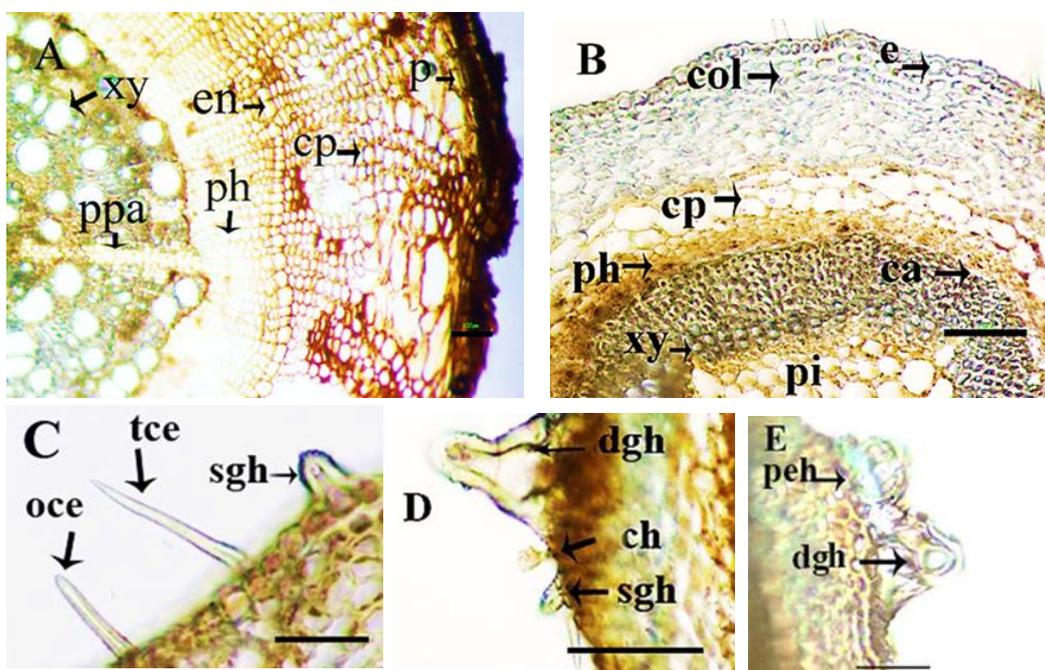


Figure 1 Cross-section of *O. mollis*. A root, B, C, D, E stem, ca; cambium, ch; capitate hair, col; collenchyma, cp; cortex parenchyma cell, dgh; digitate glandular hair, e; epidermis, en; endodermis, oce; one celled eglanular hair, tce; two celled eglanular hair, p; peridermis, peh; peltate hair, ph; phloem, ppa; primary pith arms, pi; pith, sch; short stalked capitate glandular hair, sgh; sesil glandular hair, tce; two celled hair, xy; xylem (Scale 100  $\mu$ m)

Cortex parenchyma cells at the parts which are close to the collenchyma cells have been crushed. Cortex is constituted of 8-10 rows of parenchyma cells. Phloem is crushed under the cortex and it consists of cells in 3-4 rows. Cambium is not apparent. Pith consists of parenchyma cells (Table 1). Cuticle is present on the leaf lower epidermis and the cells are polygonal in shape and they have a dense sequence, and they are quite different with

respect to size. At the lower epidermis, numerous simple eglanular hairs are observed (Figure 2, C, E) while digitate glandulars are also seen (Figure 2, C, F). On this surface, stomata cells with 3-5 neighboring cells are observed and stomata is anisocytic and anomocytic. Number of stomata is higher with respect to lower surface. On the upper surface stomata are anisocytic and anomocytic (Figure 2, D).

Table 1 Anatomical measurements of *O. mollis*

		Width ( $\mu\text{m}$ ) Mean $\pm$ Se	Length ( $\mu\text{m}$ )-Mean $\pm$ Se
Root	Periderm cells	19.57 $\pm$ 3.02	33.95 $\pm$ 4.80
	Trachea	48.97 $\pm$ 11.42	
	Cortex cells	23.054 $\pm$ 5.57	63.98 $\pm$ 8.56
	Phloem	15.62 $\pm$ 2.28	
	Endodermis	20.17 $\pm$ 3.42	28.37 $\pm$ 8.02
Stem	Epidermis cells	11.29 $\pm$ 2.53	24.54 $\pm$ 5.66
	Cortex cells	24.96 $\pm$ 6.18	36.88 $\pm$ 6.78
	Cuticle	4.88 $\pm$ 1.54	
	Trachea	21.95 $\pm$ 5.62	
	Pith parenchyma cells	35.16 $\pm$ 7.5	
Leaf	Cuticle	7.71 $\pm$ 1.58	
	Palisade parenchyma	20.46 $\pm$ 3.30	50.20 $\pm$ 7.27
	Spongy parenchyma	16.39 $\pm$ 4.05	39.57
	Lower epidermis	14.21 $\pm$ 3.96	23.18 $\pm$ 4.60
	Upper epidermis	20.54 $\pm$ 1.30	44.61 $\pm$ 1.94
	Phloem	3.90 $\pm$ 1.92	

Upper epidermis surface is having numerous, eglandular hairs, again. Eglandular hairs on the upper surface have 3-4 branched (Figure 2, H). Together with sessile capitate (Figure 2, I) and digitate glandular (Figure 2, G) hairs are also observed. In the leaf cross-section of the *O. mollis*, 2-3 rows of palisade parenchyma are observed at the bottom and top sections, while 2 rows of spongy parenchyma are seen in the middle, and the mesophyll is equifacial (Figure 2, B). 2-3 rows of collenchyma cells are present right below the lower epidermis cells. Phloem consists crushed cells in 3-4 rows (Figure 2, A).

### 3.2. Ecological Results

The habitat of the *O. mollis* plant is mountain slopes, meadows, and prairies. Saturation percentage of soil where the species grow is 62.7% and the soil is clayey and loam. It has a pH value of 8.01 and it is slightly alkaline. Total amount of water soluble salt of the soil is 26.4% and it is classified among saline soils. It is 1.46% in terms of lime and it is considered as calcareous soils. With respect

to chemical features, available phosphorus amount of the soil is 4.47 kg/da and it is classified among Low Phosphorus soils. Amount of potassium that can be obtained is 733.85 kg/ha and it is classified as high. Amount of organic matter is 3.52% and it is classified in the group of Good Humus soils (Table 2).

## 4. DISCUSSIONS

In this study, the anatomical and ecological features of *O. mollis* species have been examined in detail. The root of the species has secondary features. Periderm is multilayered. In the species of *Onosma auriculata* Aucher ex DC, multilayered peridermis and secondary root structure have been determined by Akçin and Binzet [17]. Endodermis can be clearly seen. While endodermis is clearly seen in the species of *Onosma nana* DC. endodermis can not be distinguished in *Onosma discedens* Hausskn. ex. Bornm. [32]. No information has been found in the literature regarding the 2-3 layered primary pith arms in the *O. mollis* species.

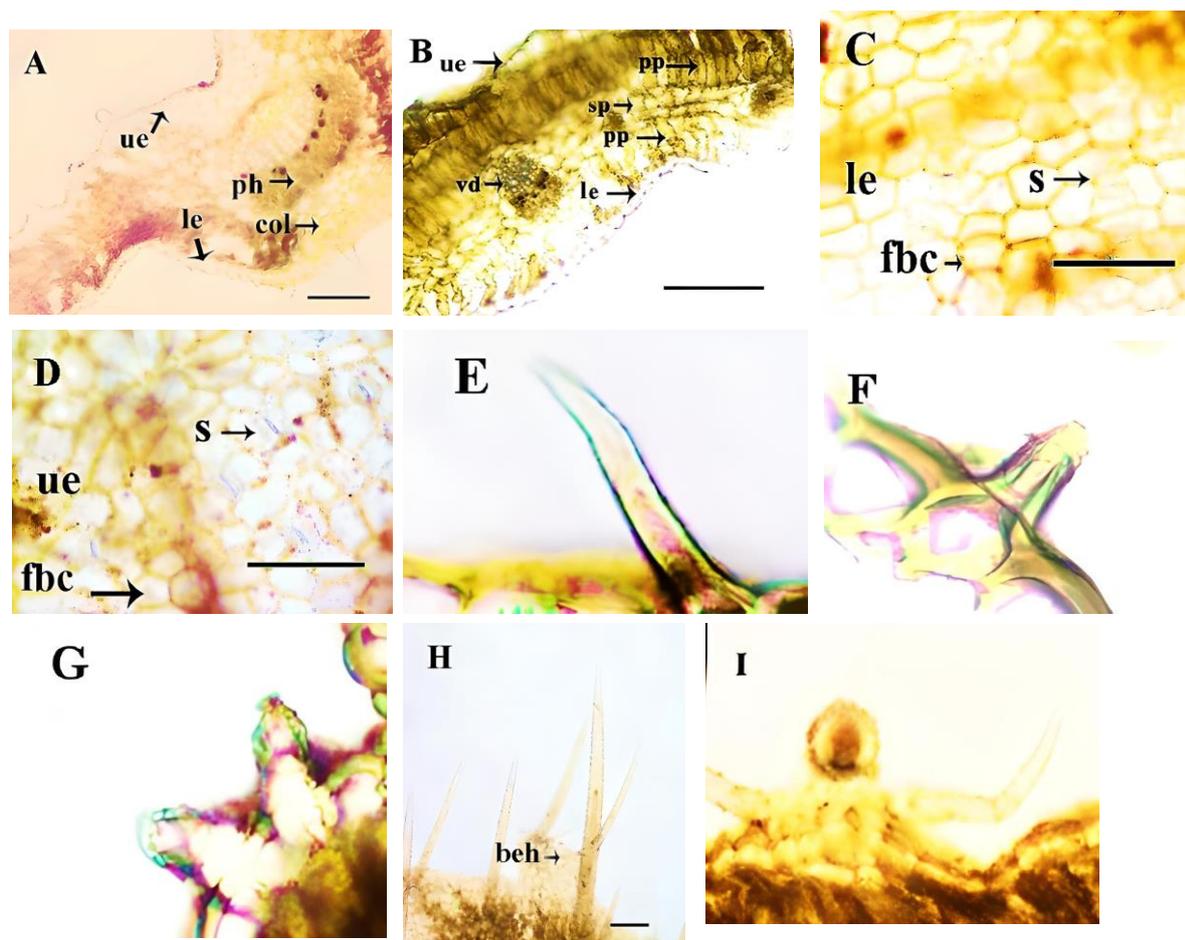


Figure 2 Cross section (A, B) and superficial section of leaf (C, D) *O. mollis*. F, G; digitate glandular hair, H: branched eglandular hair, I; capitulate glandular hair. beh; branched eglandular hair, ph; phloem, ue; upper epidermis, le; lower epidermis, pp; palisade parenchyma, sp; spongy parenchyma, col; collenchyma, vb; vascular bundles, s; stomata, ue; upper epidermis, le: lower epidermis, fbc; feather base cell, (Scale 100  $\mu$ m)

Table 2 Ecological characteristics of *O. mollis*

Physical properties					
Saturation (%)			Texture		
62.7			Clayey and loam		
Chemical properties					
Total Salt Soluble in Water (%)	pH	Lime (%)	Organic Matter (%)	Phosphorus (kg/da)	Potasyum (kg/da)
26.4	8.01	1.46	3.52	4.47	733.85

Stem epidermis cells of the *O. mollis* plant have single-row and they are hairy. In the species of *Onosma caucasica* Levin. ex M.Pop, stem epidermis cells have single-row and they are covered with characteristic hairs. These hairs are branched from the base and they have various types as being simple, unicellular, capitate and glandular [33]. Hairs

of the *O. mollis* species are observed as being simple, unicellular, double-branched and capitate glandular hairs. A thin cuticle layer covers the stem as in the case with *O. caucasica* species [33]. Binzet and Akçin state that there is a thick cuticle in the species of *Onosma frutescens* Lam as well and 2-3 rows of collenchyma cells surround the stem

right below the epidermis [34]. It has been stated by Güven et al (2013) that in the species of *Onosma aucheriana* DC. and *Onosma roussaei* DC., there is collenchyma present in 1-6 rows at the sections close to the epidermis [16]. The cortex parenchyma cells in the section under the collenchyma cells are crushed in the species of *O. mollis* and parenchyma cells in parts close to the phloem are apparent. Teke and Binzet have stated that some of the cortex parenchyma cells are crushed in the plant of *Onosma nana* DC. as well [32]. In the stem cross-section of the plant that constitutes this study, 3-4 rows of prominent phloem cells and 1-2 rows of cambium are observed. In *O. angustissimum*, xylem, phloem and cambium are in distinguishable situation [35].

In the leaf cross section of the taxon, the palisade parenchyma consists of 2-3 rows of cells at the bottom and top, while the spongy parenchyma in the middle part consists of 2 rows of cells. In *O. papillosa* Riedl species, palisade parenchyma has 2-3 layers, while spongy parenchyma has 3-4 layers [17]. It was reported by Selvi et al. that the leaves are equifacial in *O. argentata* Hub. -Mor., *O. sericea* Willd. and *O. rechingeri* in Riedl taxa [18]. It was reported by Binzet and Teke that the leaves of *O. mollis* DC. and *O. halophyllum* Boiss. & Heldr plants were also equifacial [36]. According to Daironas et al. only the upper epidermis side of *O. caucasica* plant has palisade parenchyma in the form of two layers [33]. In the plant of *O. rutila* Hub. -Mor. anomocytic and starocytic stomata is observed on the lower and upper leaf surface [17]. In the *O. mollis* plant, anomocytic and anisocytic stomata have been determined. Metcalfe and Chalk have stated that Boraginaceae family had anomocytic and anisocytic stomata on both of the leaf surfaces [9].

*O. bracteosum* Hausskn. & Bornm is sandy-loamy, sandy-clayey, loamy and slightly alkaline, and its salt concentration is low [37]. The soil of the *O. mollis* plant is clayey and loamy and slightly alkaline. The soil of the

plant that constitutes the subject of our research is classified in the group of salty, calcareous, low phosphorus and good humus soils.

## 5. CONCLUSION

As a conclusion, in this study anatomical and ecological characteristics of *O. mollis* have been examined in detail. The existence of primary pith arms in the root, the types of hair present on the stem and leaf, the presence of collenchyma and the ecological characteristics of the species have been revealed by us for the first time. The findings will contribute to a better understanding of the species and to clear the deficiencies.

### *Acknowledgments*

The abstract of the article was presented as an oral presentation at the 6th International Applied Sciences Congress.

### *Funding*

The author (s) has no received any financial support for the research, authorship or publication of this study.

### *Authors' Contribution*

The authors contributed equally to the study.

### *The Declaration of Conflict of Interest/ Common Interest*

No conflict of interest or common interest has been declared by the authors.

### *The Declaration of Ethics Committee Approval*

This study does not require ethics committee permission or any special permission.

### *The Declaration of Research and Publication Ethics*

The authors of the paper declare that they comply with the scientific, ethical and quotation rules of SAUJS in all processes of the paper and that they do not make any falsification on the data collected. In addition, they declare that Sakarya University Journal of Science and its editorial board have no

responsibility for any ethical violations that may be encountered, and that this study has not been evaluated in any academic publication environment other than Sakarya University Journal of Science.

### REFERENCES

- [1] D. J. Mabberley, "The plant-book: a portable dictionary of the vascular plants" Cambridge university press", 1997.
- [2] A. Güner, S. Aslan, T. Ekim, M. Vural, M. Babaç, "Turkey Plant List (Vascular Plants)," Istanbul: Nezahat Gökyiğit Flora Botanic Garden and Research Association Publications, 2012.
- [3] J. Tsering, B. J. Gogoi, P. K. Hui, N. Tam, H. Tag, "Ethnobotanical appraisal on wild edible plants used by the Monpa community of Arunachal Pradesh," Indian Journal of Traditional Knowledge, vol.16, no. 4, pp. 626-637, 2017.
- [4] W. Younis, H. Asif, A. Sharif, H. Riaz, I. A. Bukhari, A. M. Assiri, "Traditional medicinal plants used for respiratory disorders in Pakistan: a review of the ethno-medicinal and pharmacological evidence," Chinese Medicine, vol.13(, no. 1, pp. 1-29, 2018.
- [5] P. K. Rana, P. Kumar, V. K. Singhal, J. C. Rana, "Uses of local plant biodiversity among the tribal communities of Pangi Valley of district Chamba in cold desert Himalaya, India," The Scientific World Journal, vol. 2014, pp. 1-15, 2014.
- [6] M. Kahyaoğlu, İ. Türkoğlu, "Antimicrobial activities of some plants collected in Elazığ region," Journal of Science and Technology of Dumlupınar University, vol. 015, 1-8, 2008. J. O. Williams, "Narrow-band analyzer," Ph.D. dissertation, Dept. Elect. Eng., Harvard Univ., Cambridge, MA, USA, 1993.
- [7] S. G. Bozkurt, "Determining the possibilities of use in landscape architecture of some medicinal and aromatic plants grown in the valley of Gürün (Sivas)-Tohma Stream," Bartın Faculty of Forestry Journal, vol. 21, no. 1, pp. 66-80, 2019.
- [8] L. Velasco, F. D. Goffman, "Chemotaxonomic significance of fatty acids and tocopherols in Boraginaceae," Phytochemistry, vol. 52, no. 3, pp. 423-426, 1999.
- [9] C. R. Metcalfe, L. Chalk, 1979. Anatomy of Dicotyledons I. Oxford University Press, London, England. 279 p.
- [10] L. Watson, M. J. Dallwitz, "Australian The families of angiosperms: Automated descriptions, with interactive identification and information retrieval," Systematic Botany vol. 4, no. 4 pp. 681 – 695, 1991.
- [11] Ö. E. Akçin, "The morphological and anatomical properties of endemic *Onosma armenum* DC.(Boraginaceae) species," International Journal of Natural and Engineering Sciences, vol. 1, no. 2, pp. 37-43, 2007.
- [12] Ö. E. Akçin, G. Şenel, Y. Akçin, "Leaf epidermis morphology of some *Onosma* (Boraginaceae) species from Turkey," Turkish Journal of Botany, vol. 37, no. 1, pp. 55-64, 2013.
- [13] G. Kodal, "Bazı *Onosma* L.(Boraginaceae) Türlerinin Anatomik Yönden İncelenmesi", Yüksek Lisans Tezi, Karadeniz Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Trabzon, Türkiye, 2007.

- [14] R. Binzet, Ö. E. Akçin, "The morphological and anatomical properties of two endemic *Onosma* species (*O. intertextum* and *O. sieheanum*)," *Acta Botanica Hungarica*, vol. 51, no. 1-2, pp. 1-9, 2009.
- [15] R. Binzet, N. Orcan, "A new species of *Onosma* (Boraginaceae) from southern Turkey," *Novon: A Journal for Botanical Nomenclature*, vol. 17, no. 1, pp. 8-10, 2007.
- [16] S. Guven, O. Beyazoglu, S. Makbul, Z. Turkmen, A. Kandemir, "Anatomical features of six *Onosma* L.(Boraginaceae) species from Turkey," *The Iranian Journal of Botany*, vol. 19, no. 1, pp. 95-103, 2013.
- [17] O. E. Akcin, R. Binzet, "Anatomy of three *Onosma* species from Turkey," *Bangladesh Journal of Botany*, vol. 48, no. 2, pp. 329-337, 2019.
- [18] S. Selvi, R. Polat, E. Y. Babacan, M. O. Rahman, U. Çakılcıoğlu, "Micromorphological and anatomical investigation on six species of *Onosma* L. (Boraginaceae) from Turkey," *Bangladesh Journal of Plant Taxonomy*, vol. 26, no. 1, pp. 69-81, 2019.
- [19] N. Kharazian, "The taxonomy and variation of leaf anatomical characters in the genus *Aegilops* L.(Poaceae) in Iran," *Turkish Journal of Botany*, vol. 31, no. 1, pp. 1-9, 2007.
- [20] R. Binzet, O. E. Akcin, "Pollen morphology of some *Onosma* species (Boraginaceae) from Turkey," *Pakistan Journal of Botany*, vol. 43, no. 2, pp. 731-741, 2011.
- [21] P. H. Davis, "Flora of Turkey and the East Aegean Islands," *Edinburgh University Press*. vol 6, no. 15, pp. 326-336-24, 1978.
- [22] Y. Vardar, "Preparation in Botany Techniques," *Ege University Faculty of Science Printing Works*, Izmir, no 1, 1987.
- [23] M. C. Jackson, "Soil Chemical Analysis," *Prentice Hall of India Private Limited*, New Delhi. pp. 183, 1962.
- [24] I. Demiralay, "Soil physical analysis," *Atatürk University, Faculty of Agriculture Publications*, Erzurum, no. 143, pp. 131, 1993.
- [25] C. A. Black, "Methods of soil analysis, Agronomy," *The University of Wisconsin-Madison College of Agricultural and Life Sciences*, no. 9, Part: 1 and 2. pp. 1572, 1965.
- [26] A. Tüzüner, "Soil and water analysis laboratories handbook," *T.C. Ministry of Agriculture, Forestry and Rural Affairs General Directorate of Rural Services*, pp. 21-27, 1990.
- [27] D. W. Nelson, L. E. Sommers, "Total carbon, organic carbon, and organic matter," P: 9611011. In D.L. Sparks (ed) *Method of Soil Analysis: Chemical Methods. Part 3. SSSA, Madison, WI.*, 1996.
- [28] F. Gülçur, "Physical and chemical analysis methods of soil," *Istanbul University Faculty of Forestry Publications*, İ. Ü.
- [29] N. Ülgen, N. Yurtsever, "Turkey Fertilizer and Manure Guide," *Soil and Fertilizer Research Institute publications. General Publication no. 209, Technical Publications no. T.66. Ankara*, 1995.
- [30] S. R. Olsen, V. Cole, F. S. Watanabe, and L. A. Dean, "Estimation of available phosphorus in soils by extraction with sodium bicarbonate,"

- Washington, DC: US Department of Agriculture, vol. 939, p. 19, 1954.
- [31] P. A. Helmke, D. L. Sparks, "Lithium, sodium, potassium, rubidium, and calcium, in Sparks, D.L., (Ed) Methods of Soil Analysis," Part 3, Chemical Methods, SSSA Book Series Number 5, SSSA., Madison, WI, s. 551-574, 1996.
- [32] H. I. Teke, R. Binzet, "Anatomical, morphological and palynological studies of some *Onosma* L. (Boraginaceae) taxa endemic to Anatolia," Pakistan Journal of Botany, vol. 49, no. 2, pp. 579-588, 2017.
- [33] J. V. Daironas, F. K. Serebryanaya and I. N. Zilfikarov, "Comparative Morphological and Anatomical Study of *Onosma caucasica* Levin. ex M. Pop. and *Onosma sericea* Willd.(Boraginaceae Juss.)," Pharmacognosy Journal, vol. 6, no. 5. 2014.
- [34] R. Binzet, Ö. E. Akçin, "The anatomical properties of two *Onosma* L. (Boraginaceae) species from Turkey," Journal of Medicinal Plants Research, vol. 6, no. 17, pp. 3288-3294, 2012.
- [35] Ö. E. Akçin, R. Binzet, "The micromorphological and anatomical properties of *Onosma angustissimum* Hausskn. & Bornm. and *O. cassium* Boiss.(Boraginaceae)," Bangladesh Journal of Plant Taxonomy, vol. 17, no. 1, pp. 1-8, 2010.
- [36] R. Binzet, H. I. Teke, "The anatomical properties of *Onosma mollis* DC. and *Onosma halophila* Boiss. & Heldr.(Boraginaceae) from Turkey," Pakistan Journal of Botany, vol. 46, no. 5, pp. 1663-1668, 2014.
- [37] Ö. E. Akçin, A. Engin, "The morphological, anatomical and ecological properties of endemic *Onosma bracteosum* Hausskn. & Bornm.(Boraginaceae) species," Turkish Journal of Botany, vol. 29, no. 4, pp. 317-325, 2005.