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Anatomical study on *Origanum vulgare* subsp. *viridulum* (Lamiaceae)

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Abstract – *Origanum* L. includes several species commonly used as spices, teas and for medicinal purposes, and is one of the most commercially important genera within the Lamiaceae family. The *Origanum* is found primarily in the Northern Hemisphere of the Old World, with 90% of the taxa occurring in the Mediterranean region. Turkey is an important center of the *Origanum* diversity with 21 species (24 taxa, 13 endemic) and 13 hybrids (12 endemic). The main purpose of this study is to investigate the anatomical features of *Origanum vulgare* subsp. *viridulum* to contribute to the systematics of *Origanum*. In this study, the plant specimens were collected from their natural distribution areas. The plant samples were preserved in 70% alcohol during field studies. Then, the paraffin method was used for cross sections of root, stem, and leaf. The sections were taken by microtome and stained with safranin and fast-green. In the root cross-section, there is the outermost fragmented rhizoderm, 6-7 row cortex, single-row endodermis, 7-8 row phloem, well-developed xylem layer and the pith region in the central part, respectively. Stem anatomical features are compatible with the general anatomical structure of the Lamiaceae. The leaf type is bifacial and mesophyll tissue consists of elongated palisade and spongy parenchyma cells.

Keywords – Anatomy, Lamiaceae, Mentheae, Origanum, Systematic.

I. INTRODUCTION

Lamiaceae (Labiatae) is the sixth largest family of angiosperms and the largest family within Lamiales [1]. The family Lamiaceae encompasses some 35,509 scientific plant names, including synonyms and unplaced ones, in addition to accepted species [2]. Lamiaceae is the third most used family in ethnobotanical terms, with 25 species at the taxon level, after Astraceae (52) and Fabaceae (30) [3].

Origanum L. (family: Lamiaceae, subfamily: Nepetoideae, tribe: Mentheae, subtribe Menthinae) includes several species commonly used as spices, teas and for medicinal purposes, and is one of the most commercially important genera within the Lamiaceae family. *Origanum* is found primarily in the Northern Hemisphere of the Old World, with 90% of the taxa occurring in the Mediterranean region [4]. Although members of the genus are distributed predominantly in the Mediterranean region, there are also species distributed from the Azores to Taiwan and much of Eurasia [5]. It includes approximately 42 species (49 taxa) and 22 hybrids worldwide. Turkey is an important center of *Origanum* diversity with 21 species (24 taxa, 13 endemic) and 13 hybrids (12 endemic) [6]. Its species are generally used as spices and are known as "kekik" in our country.

The revision of the genus *Origanum* was made by Ietswaart, and Lamarck, Briquet, El-Gazzar and Watson count Kintzios among the authors who examined the genus in a broad sense before him [7]. Later, the latest developments were compiled under the editorship of Dirmenci [8].

The *Origanum* species are perennial herbaceous or semi-shrub-like plants that are erect, cluster-like, or have flowers at the ends of the stems and have many stems [9]. These medium-sized perennial plants generally like hot climates and grow well in

arid, nutrient-rich, mostly calcareous, low-nitrogen soils [10].

In this study, *Origanum vulgare* subsp. *viridulum*, which grows naturally in Turkey, was examined in terms of root, stem and leaf anatomy.

II. Materials and Method

The plant specimens were collected from their natural distribution areas: - C4 Konya; Meram-Botsa, steppe, 1940 m, 15.07.2022, *B. Atasagun-1118* (Fig. 1).

For anatomical studies, plant samples were preserved in 70% alcohol during field studies. Then, the roots, stems and leaves of these samples were cut into small pieces and cross-sections with a thickness of 10-15 µm were taken using a microtome using the paraffin method [11]. The sections taken were stained according to the safranin-fast green method. The sections, which were made into fixed preparations, were photographed and examined with a Leica DM750 light microscope.

Fig. 1 General view of *O. vulgare* subsp. *viridulum*

III. Results

Root

In cross-sections of the root, there is an outermost layer called the rhizodermis layer, which appears fragmented, lignified, and appears to merge with the cortex layer. Below the rhizodermis layer, there is a cortex layer consisting of 6-7 rows. Following the cortex layer, there is a single-layered endodermis layer. Below the endodermis layer, there is a phloem tissue consisting of 7-8 rows. Beneath the phloem tissue, there is an extensive xylem layer. In the central region, there is parenchymatous pith (Fig. 2).

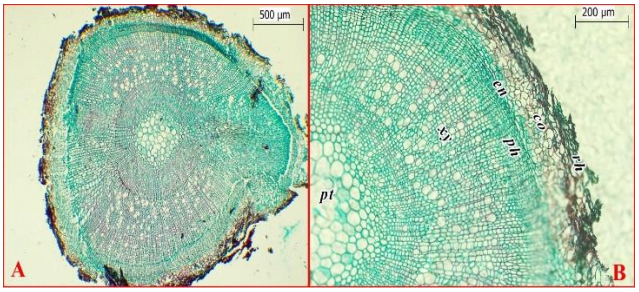

Fig. 2. Cross-section of *O. vulgare* subsp. *viridulum* root (rh: rhiozoderm, co: cortex, en: endodermis, ph: phloem, x: xylem, pt: pith).

Stem

The stem is distinctly quadrangular. The outermost layer has a wavy cuticle. The epidermis is composed of a single layer of rectangular cells. Below the epidermis, in the corners, there is a collenchyma layer consisting of 6-7 rows. The endodermis is single-layered and made up of relatively large, shapeless cells. Below the endodermis, there is a phloem layer with 6-7 rows. The cambium is composed of several layers of cells. In the xylem, vessels and tracheids are distinct. Medullary rays towards the pith are in a single row originating from the cambium. The pith region consists of large, starch-grain-containing parenchymatous cells with somewhat thickened walls (Fig. 3).

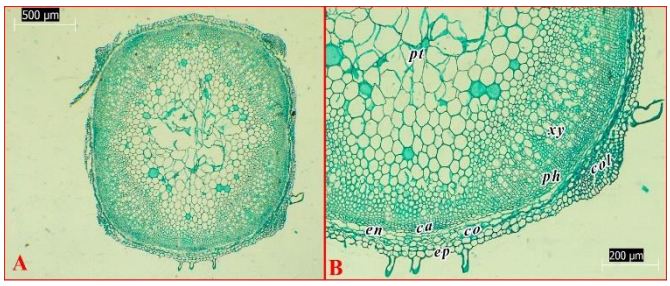

Fig. 3. Cross-section of *O. vulgare* subsp. *viridulum* stem (ep: epidermis, co: cortex, col: collenchyma, en: endodermis,ca: cambium, ph: phloem, x: xylem, p: pith).

Leaf

In a cross-section of the leaf, the outermost layer consists of a single row of cells forming the upper epidermis. There is a thin cuticle layer present on the epidermis. The leaf is dorsiventral in type. Below the upper epidermis, there is palisade parenchyma made up of single-rowed, cylindrical-shaped cells. Beneath the palisade parenchyma, there is a spongy parenchyma consisting of 2-3 rows of irregularly shaped cells. Below the spongy parenchyma, there is a lower epidermis made up of

single-rowed cells, smaller than those of the upper epidermis. The leaves are amphistomatic.

In a cross-section passing through the midrib, below the upper epidermis, there are 2-3 rows of collenchyma cells. Above the lower epidermis, there are 5-6 rows of collenchyma cells, and above this, there are 3-4 rows of sclerenchyma cells. The vascular bundles are surrounded by 1-2 rows of parenchymatous sheath (Fig. 4).

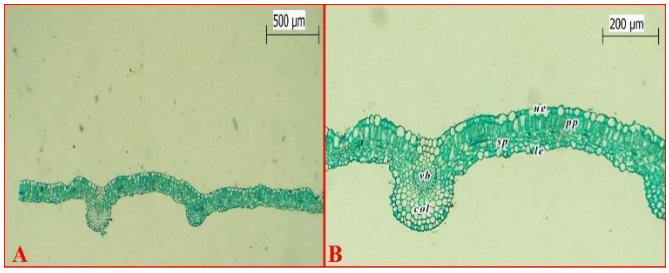

Fig. 4. Cross-section of *O. vulgare* subsp. *viridulum* leaf (ue: upper epidermis, le: lower epidermis, col: collenchyma, pp: palisade parenchyma, sp: spongy parenchyma, vb: vascular bundle)

IV. DISCUSSION

There are various anatomical studies related to the *Origanum* genus. Anatomical studies have been conducted on the widely distributed *Origanum vulgare* species by Anisimova and Demyanova [12], Bosabalidis and Kokkini [13], Gabriela et al. [14], Kofidis et al. [15], and Tanker [16], and no significant differences were observed among the findings of these taxonomic studies.

The anatomical features of *O. vulgare* subsp. *viridulum* align with the anatomical structure of the Lamiaceae family as described by Metcalfe and Chalk [17].

Sadıkoğlu and Efe established a key to distinguish between *Origanum* taxa found in Turkey based on identified characters related to stem and leaf anatomical structure, considering the differences they exhibited [18].

Temel & Tokur, investigated the anatomical characteristics of two *Origanum* L. species (*Origanum onites* L., *O. majorana* L.) [19]. Differences were observed in the mycorrhized tissues in root anatomy, and trichomes were present in the stem of *O. majorana*. Both species showed similarities in terms of single-layered epidermal cells, angular collenchyma, 1-2 layers of endodermis, open collateral vascular bundles, and medullary rays. The leaves of both species were dorsiventral and had a single-layered epidermal structure.

Comparing the anatomical features of *O. vulgare* subsp. *viridulum* with the aforementioned species, it was observed that the root and stem structures were quite similar, while in terms of leaf type, some species exhibited bifacial leaves, while others were isolateral.

CONCLUSION

In this study, root, stem, and leaf anatomy *O. vulgare* subsp. *viridulum* are given in detail. The results obtained will shed light on future anatomical studies on the *Origanum*, and the characters determined as a result of the examinations will contribute to systematic studies on the genus.

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