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MORPHOLOGICAL AND ANATOMICAL INVESTIGATIONS ON *THALICTRUM ORIENTALE* Boiss.

THALICTRUM ORIENTALE Boiss. ÜZERİNDE MORFOLOJİK VE ANATOMİK ARAŞTIRMALAR

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The genus Thalictrum L. (Ranunculaceae) is represented by nine species, three varieties and eleven taxa in the Flora of Turkey. T.orientale Boiss. was collected from different localities. In this study, morphological and anatomical features of the plant are described.

Thalictrum L. (Ranunculaceae) cinsi Türkiye Flora'sında dokuz tür, üç varyete ve onbir takson ile temsil edilmektedir. Bu çalışmada, farklı lokalitelerden toplanan T.orientale Boiss. Morfolojik ve anatomik özellikleri bakımından incelenmiştir.

Keywords: *Ranunculaceae, Thalictrum orientale, Morphology, Anatomy.*

Anahtar Kelimeler: *Ranunculaceae, Thalictrum orientale, Morfoloji, Anatomi.*

Introduction

The Ranunculaceae is a large family containing a number of well-known wild flowers and garden ornamentals such as buttercups, anemones and hellebores and some very poisonous plants, such as *Aconitum* (1). *Thalictrum* L. is one of the large genera in Ranunculaceae with 150 species spread in the Northern Hemisphere, tropical S.America and S.Africa (2).

The first comprehensive taxonomic monograph concerning *Thalictrum* species was published by Lecoyer in 1885. It includes 69 species grown in the world (3). On the other hand, Flora Orientalis (4) is the first source of information for *Thalictrum* species growing in Turkey. Davis recorded 11 taxa, 9 species and 3 varieties of with Mediterranean, four Euro-Sibirian and two Irano-Turanian elements in the Flora of Turkey (5). Comparative anatomical properties of three *Thalictrum* species were studied by G.Filipescu in 1969 (6).

T.orientale is a lilac-pink or white flowered East Mediterranean element with 26-55 cm height. It grows rocky slopes and crevices (600-1200 m). Its flowering time is from April to July (5). The plant is known as "kaya otu" in Niğde, Turkey.

Members of the family have diverse chemical constituents. Numerous alkaloids have been identified from this genus, some with pharmacologic potential and ethnomedical usage. In a previous work, we reported the isolation of alkaloids from *T. orientale* and fangchinoline was characterised as one of the major alkaloids known to have antitumor activity (7).

The present study reports the morphological and anatomical features of *T. orientale.*

Material and Method:

T. orientale was collected in May and July from different localities of Turkey (Adana, Antalya, Balıkesir, Isparta and Niğde). Voucher specimens are deposited in the Herbarium of the Faculty of Pharmacy of Anadolu University, in Eskisehir, Turkey (Acronym: ESSE). Morphological features were determined on herbarium materials. According to Flora of Turkey and ESSE records, distribution of *T. orientale* is given in figure 2. Transverse sections and surface preparations of stem, leaves and fruit were made manually for anatomical studies. Wild M5 Stereomicroscope with drawing tube and Leitz SM-LUX binocular microscope with drowing tube were used in morphological and anatomical studies. For SEM study, the specimens were mounted onto SEM stubs using double-sided adhesive tape and coated with gold. Photographs were taken with Cam Scan S4.

***Thalictrum orientale* Boiss:**

Perennial, diffuse, 26-55 cm high, glandular and pubescent or absent, shortly rhizomatous with fibrous roots. Leaves mostly cauline, sheating, stipulate, bi-triternate with long flexuous petioles, 0.6-7 cm, membranous, the leaflets elliptic-ovate to orbicular, 4-38 x 3.5-48 mm, rather deeply trilobed, crenate, glandular and pubescent or absent. Bracts like leaves, segments 0.3-4.5 x 0.3-8.5 mm, petiole 0.5-2.5 cm. Inflorescence a panicle, lax, the flowers solitary, perianth uniseriate, segments persistent 4-5 (6), much exceeding stamens, lilac-pink or white, 4-12 x 2.5-8 mm, elliptic-oblanceolate to oblong-obovate. Pedicel 0.5-13.5 cm, very slender, much exceeding bracts. Stamens numerous (10-28) and free, conspicuous, anthers 0.9-1.6 mm, yellow, linear, filaments 0.6-3.1 mm filiform, white. Pistils 2-8, linear, oblong, 0.8-2.5 mm. Achene sessile, straight, glabrous, oblong-acuminate, 8-ribbed, beak present, green to pale brown, 4-8.5 x 1-2 mm (Fig.1).

Study materials:

B1: Balıkesir, Edremit Kazdağı, 550 m, 26.6.1981, K.H.C. Başer, N. Kırımer, ESSE 1266!, C3: Isparta, Eğirdir, Yaka village 2 km, 12.6.1981, K.H.C. Başer, H.Malyer, M.Poyraz, ESSE 1213!, C4: Antalya, Alanya, Mahmutlar-Hadim road, from Alanya 13 km, 1020 m, 17.7.1995, K.H.C. Başer 1158, H.Duman, A.Altıntaş, ESSE 11519!, C5: Niğde, Ulukışla, 17.5.1999, Z.Erdemgil, ESSE 13167!, Horoz village, rocky, 1000 m, 28.5.1994, Z.Erdemgil ESSE 11111!, Horoz village, 1000 m, 4.6.1994, Z.and H.Erdemgil ESSE 11109!, 800-1200 m, 21.5.1995, Z.and H.Erdemgil ESSE 11750!, Adana, Gülek pass (Çamlı pass) 880 m, 29.5.1993, H.Malyer, M.Öğütveren ESSE 3129!, 28.5.1994, Z.and H.Erdemgil ESSE 11113!, Gülek pass, from oil station 3 km, 950 m, 26.5.1983, H.Malyer, M.Öğütveren ESSE 3120!,

Stem

Transverse sections taken from the middle part of the stem were observed as follows (Fig 3);

The epidermis is composed of a single layer of almost square compactly arranged cells. Upper surface is covered with a thin cuticle. Covering trichomes consists of glandular (head and stalk unicellular) and non-glandular type (simple, unicellular) or absent. If present, glandular hairs are more frequent. Stomata is observed. The collenchyma tissue which is located under the epidermis and between the parenchymatous cells. The shape of collenchymatous cells is ovoid. The parenchyma tissue which is 4-5 layered in between the epidermis and sclerenchymatous tissue and composed of usually oval forming. A ring of pericyclic sclerenchyma is 3-5 layered. Vascular bundles are arranged in a circle (with V-shaped xylem) under the pericycle. It is colleteral, typically with the xylem concave on the side towards the phloem, so that the latter is often partly surrounded by xylem. Cambium is usually squashed and several layered. Rays are all multiseriate, usually up to 7 cells wide and sometimes many more (8-9 cells). Pith consists of large orbicular or polyhedral parenchymatous cells, often with abundant intercellular spaces.

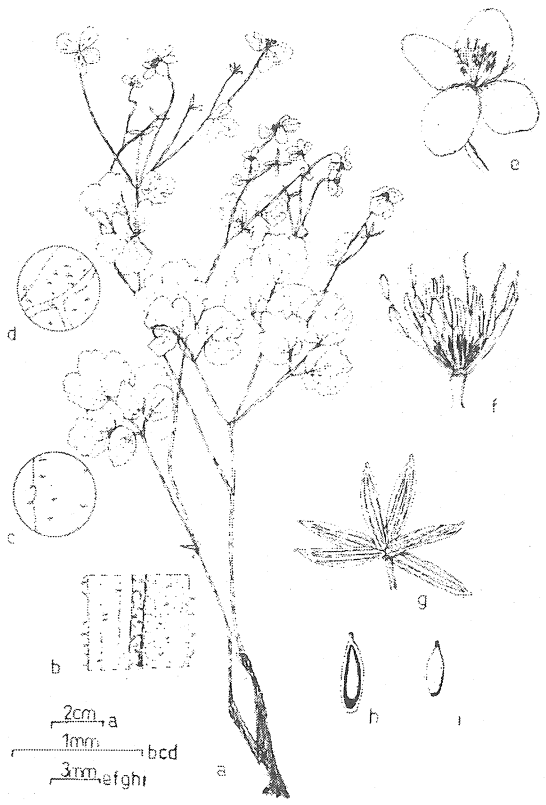

Fig. 1. *Thalictrum orientale* ESSE 13167, a-habit b-stem c-leaf upper surface d-leaf lower surface e-flower f-stamens & pistils g-achenes h-carpel cut vertically ı-seed.

Leaf

Transverse sections of the lamina and the midrib and surface preparations of both epidermi revealed the following elements (Fig.4-5);

In transverse sections, upper and lower epidermi comprise uniseriate ovoid, square and rectangular cells. Upper walls are thicker than lower and lateral walls. Both epidermi are covered with a thin cuticle and with sinuous anticlinal walls. Covering trichomes are like stem. Stomata type is anomocytic and occurs on the surfaces of both epidermi being more abundant on the lower surface. They are located on the same level with epidermal cells or slightly higher. Leaf is bifacial. Mesophyll is differentiated into 2-seriate palisade tissue and 1, sometimes 2-seriate spongy tissue (arm-pallisade). The shape of pallisade tissue is elongated in first layer and almost orbicular in second layer. Vascular bundles occur in a narrow area and is surrounded by bundle sheath. Central vessel is less developed. Xylem faces towards the upper surface while phloem faces the lower epidermis. In the midrib region, collenchymatous cells are located under the upper and lower epidermis.

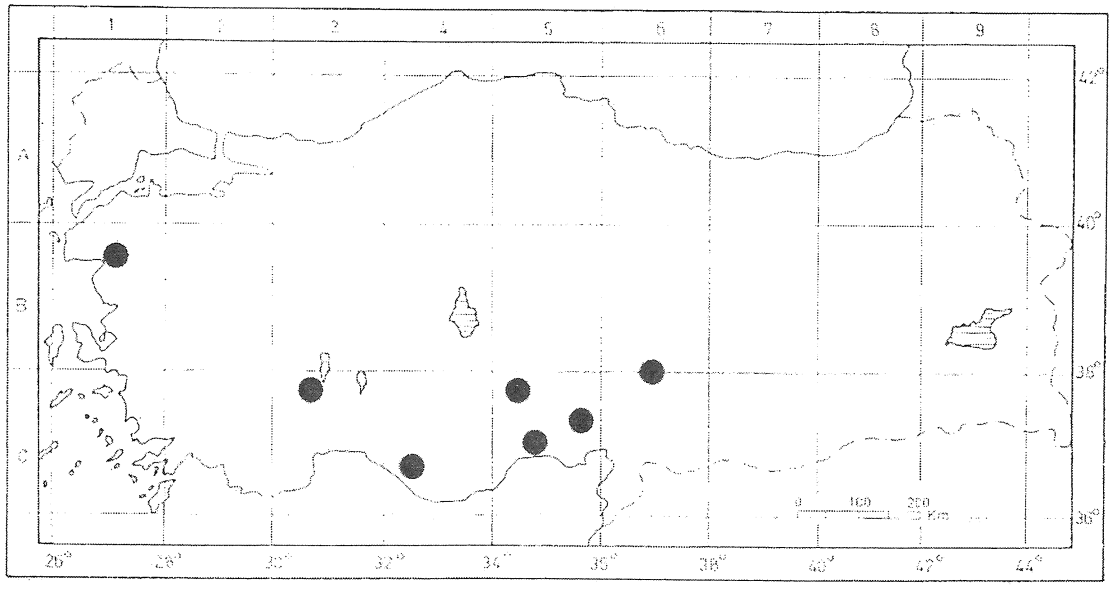

Fig. 2. Distribition of *Thalictrum orientale.*

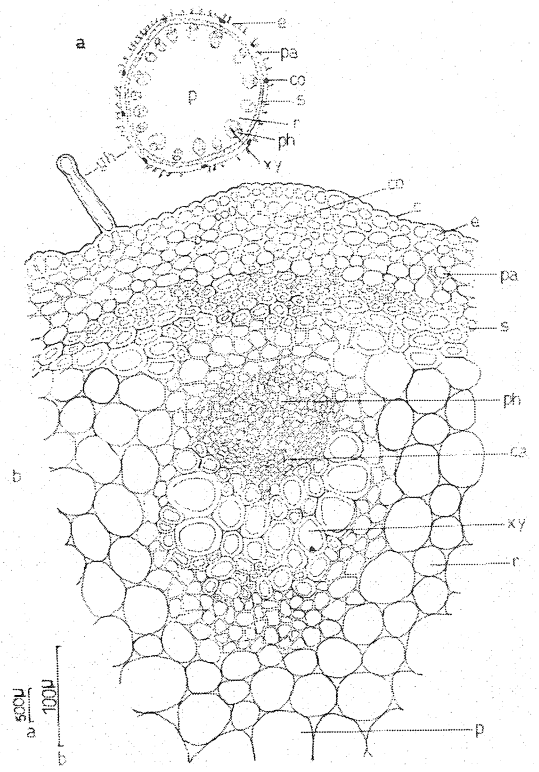

Fig. 3. *Thalictrum orientale* ESSE 13167, Stem cross-section a-schematic b-anatomic; c-cuticle ca-cambium co-collenchyma e-epidermis gh-glandular hair p-pith pa-parenchyma ph-phloem r-rays s-sclerenchyma xy-xylem.

Fruit

Transverse sections taken from the middle part of the fruit were observed as follows (Fig 6-7);

Achenes 8-ribbed. Exocarp (the outer epidermis) is composed of a single layer of square and rectangular arranged which contains rare glandular hairs. Mesocarp consists of thin walled parenchymatous cells. All parenchymatous cells usually contain some metobolites except for those located between the endocarp and the vascular bundle. Poorly developed vascular bundle is surrounded by much-developed sclerenchymatous cells. Endocarp (the inner epidermis) consists of a single layer of narrow-elongated cells which are thick-walled.

Results and Discussion

T. orientale Boiss. samples collected from 5 different localities in grids B1, C3-C5 were investigated and compared. Some morphological variations were determined in indumentum, habit, leaflets, pedicel, perianth segment and achene length characteristics.

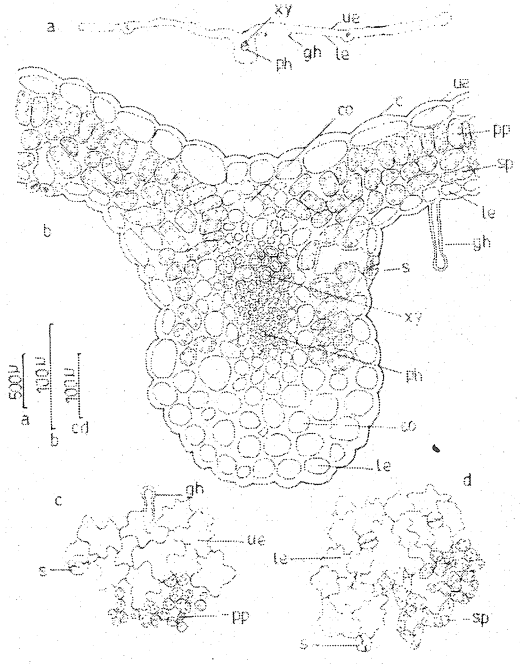

Fig. 4. *Thalictrum orientale* ESSE 13167, Leaf cross-section a-schematic b-anatomic c-surface preparations of upper epidermis d-surface preparations of lower epidermis; c-cutiçle co-collenchyma gh-glandular hair le-lower epidermis pp-palisade parenchyma ph-phloem s-stomata sp-spongy parencyhma (arm-palisade) up-upper epidermis xy-xylem.

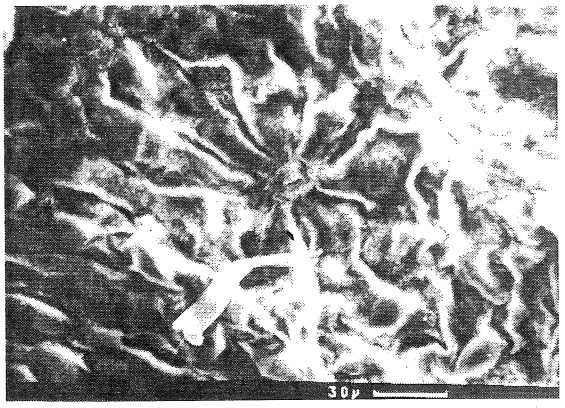

Fig. 5. *Thalictrum orientale* ESSE 13167, SEM of leaf.

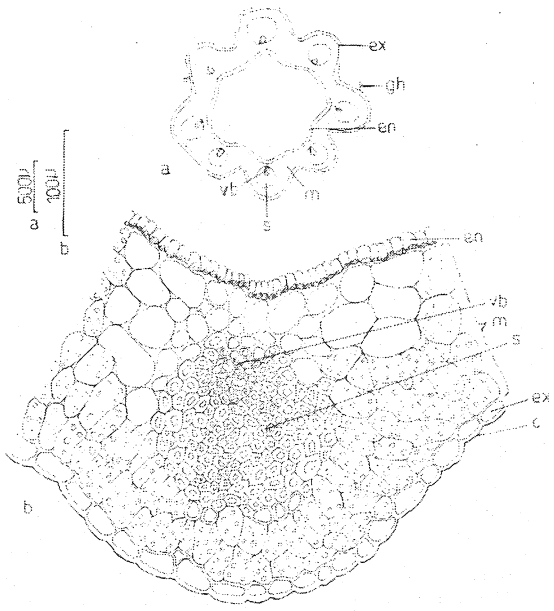

Fig. 6. *Thalictrum orientale* ESSE 13167, Fruit cross-section a-schematic b-anatomic; c-cuticle en-endocarp ex-exocarp gh-glandular hair m-mezocarp s-sclerenchyma vb-vascular bundle.

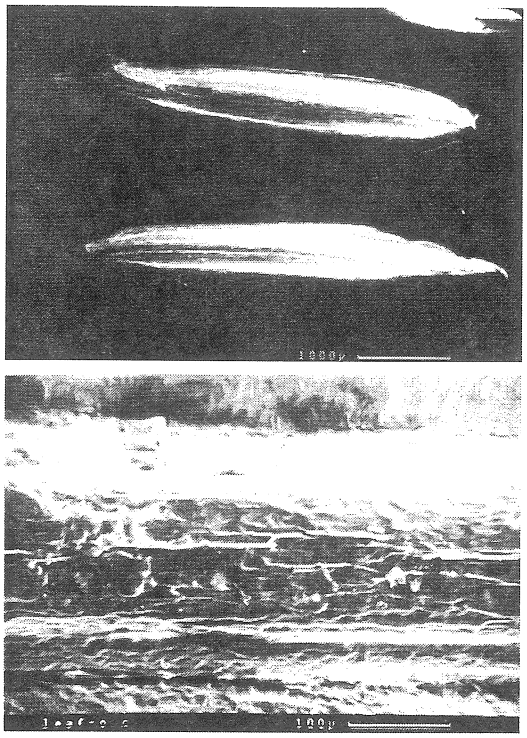

Fig. 7. *Thalictrum orientale* ESSE 13167, a-SEM of fruit and-fruit surfaces.

While Isparta, Adana and Balıkesir samples were glabrous, Niğde and Antalya samples were glandular and non-glandular. Plant heights of Niğde materials were longer (up to 55 cm) than those collected from other localities (up to 42 cm). As leaflets of Antalya samples (38x48 mm) were the largest, achene length of Adana samples (to 8.5 mm) and pedicel length of Isparta samples (to 13.5 mm) were the longest. Perianth segments were usually 4-5. However, 6-segments were also observed in Antalya materials. Nevertheless, segments lengths of Antalya materials were the smallest (7x3 mm) among all.

Our morphological results usually agree with those reported in the literature (3,4,5). However, this study revealed wider limits than those observed by Lecoyer, Boissier and Davis.

Some anatomical differences were observed in the stem materials. While the epidermis and parenchyma tissues consist usually of irregular rectangular cells in Adana and Antalya samples, they are more regular in Isparta and Niğde samples. While covering trichomes are not observed in Adana and Isparta, glandular hairs are present in Antalya and Niğde samples. Eglandular hairs were observed rarely in Antalya materials. Cambium is usually squashed and several layered in all samples. Narrow or large spaces in phloem were seen only in Adana and Isparta samples.

It has been reported that, in stem transverse sections, vascular bundles are arranged in several circles (8) and Filipescu reported the occurrence of two circles (6). However, they form a single circle in our materials. Filipescu reported that the leaf anatomy of *T.minus* var. *flexuosum* (Bernh.) S.et K. and *T.lucidum* var. *stenophyllum* (Wimm. Et

Grab.) f. *hirtostenophyllum* Nyar. was isobilateral and dorsiventral in *T.aquilegiifolium* L. (6). It was also dorsiventral in *T.orientale.* While *T.minus* is hipostomatic, like *T.aquilegiifolium and T.lucidum*, *T.orientale* was amphistomatic.

Thalictrum is regarded as a very difficult genus taxonomically (5) and this research was carried out to provide additional evidence to help taxonomists. During this study, *T. orientale* was collected for the first time from the following provinces (and grid square): Balıkesir (B1) and Niğde (C5). Its occurrence in Isparta (C3) was previously reported (9).

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