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» Focus and Scope
» Section Policies
» Peer Review Process
» Open Access Policy

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Anatomical studies and conservation status of rare endemic *Hypericum sechmenii* Ocak&Koyuncu (Sect: Adenosepalum) from Eskişehir-Turkey

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Abstract

Hypericaceae which contains 500 taxa and outspread all over the world is one of the largest families. *Hypericum* L. is biggest genus of Hypericaceae family. The genus *Hypericum* is represented by nearly 100 taxa in Turkey and its endemism ratio is more than 40%. This genus is very important because of its seconder metabolites and it also has an economical value. Taxonomical studies about this genus are very restricted. In this study anatomical property of rare endemic *Hypericum sechmenii* Ocak & Koyuncu which distribute naturally in Eskişehir-Turkey was firstly investigated. To research anatomical features, transverse sections of the roots, stem, leaves and surface sections of the leaves were studied. Observed anatomical properties of *H. sechmenii* were compared with some other species. In addition to, chrology of *H. sechmenii* was reviewed and conservation status is suggested for the first time.

Keywords: Anatomy; Conservation; Endemic; Eskişehir; *Hypericum*; Turkey

Introduction

According to Angiosperm Phylogeny Group (APG III), *Hypericum* L. which is the largest genus of family Hypericeae (Guttiferae) contains about 500 species in 9 genera (APG III, 2009; Nürk, 2011; Carine & Chirstenhusz, 2012). Additionally, this genus has been divided into 36 taxonomic sections that contains nearly 80% of the taxa within Hypericaceae (Nürk & Blattner, 2010; Robson, 2010a,b; Crockett & Robson, 2011; Nürk & Crockett, 2011). This genus has wide distribution all around the world except at the poles, desert and low altitude areas of tropical regions (Robson, 1977; Meseguer & Sanmartin, 2012).

Hypericaceae is known as a monophyletic group but recent taxonomical studies such as molecular approaches, chemotaxonomical, phylogenetic and palynological data shows that the genus *Hypericum* is not a monophyletic group (Meseguer & Sanmartin, 2012).

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Species of *Hypericum* has abundantly bioactive secondary metabolites which are used as painkillers, antidepressants, antioxidant and etc. Thus, the genus of *Hypericum* has been used in traditional medicine (Avato, 2005; Kaçar et al., 2008; Assadi et al., 2011; Şentürk et al., 2012). They also have an economical value as herbal products in the USA and Europe because of its phytochemical diversity (Crockett & Robson, 2011).

Turkey is one of the important gene centers for the *Hypericum* species with 41% endemism ratio (Tokur, 1988; Erik & Tarıkahya, 2004; Crockett & Robson, 2011; Nürk & Crockett, 2011, Meseguer & Sanmartin, 2012). The total number of *Hypericum* in Turkey is represented by 96 taxa in 21 sections. Those which, 40 taxa are endemic to Turkey (Özhatay et al., 2011).

Different Hypericaceae (Guttiferae) taxa has been studied according to their morphological, anatomical, palynological, secretional and pharmalogical features by different researchers until today (Noack, 1939; Robson, 1967; 1988; Çakırer, 1981; Tokur & Mısırdalı, 1989; Curtis & Lersten, 1990; Cicarelli et al., 2001; Erkara & Tokur, 2004; Łotocka & Osinska, 2010; Şentürk et al., 2012; Ocak et al., 2012). In addition to these, some Hypericaceae taxa, like *Hypericum sechmenii* Ocak & Koyuncu has not been studied previously and also such investigations on *Hypericum* species are rather limited (Curtis & Lersten, 1990; Cicarelli et al., 2001; Erkara & Tokur, 2004).

In this study, some anatomical characteristics of rare endemic *H. sechmenii* which is distributed in Central Anatolia have been investigated. Moreover, distribution of *H. sechmenii* was checked. Also conservation status was the first time determinated.

This study aims to investigate anatomical properties of *H. sechmenii*, to determinate distribution and conservation status and so evaluate the usefulness of these obtained data for systematic purposes. As seen in Figure 1-2, *H. sechmenii* distributes in very restricted area and investigated specimens are found in only two localities at Eskişehir-Turkey (Fig. 2). Therefore, we can consider that *H. sechmenii* is local endemic for Turkey. In anatomical studies, transverse sections of the roots, stem, leaves and surface sections of the leaves were investigated for the first time. Obtained anatomical characteristics of *H. sechmenii* were compared with some other closely related species (Erkara & Tokur, 2004).

Materials and Methods

Plant material

The samples of *Hypericum sechmenii* Ocak & Koyuncu were collected from two different localities in B3: Sivrihisar and Kaymaz (Eskişehir) for this study in 2011. Also a distribution map of plant samples is given in Figure 2. Fresh, fixed and dried plant samples were used for anatomical investigations. In order to contribute a systematic study of the material obtained, herbarium samples were prepared and these samples were stored as herbarium samples at the Eskişehir Osmangazi University Herbarium (OUFE).

Localities were collected plant samples:

1- B3 Eskişehir; Sivrihisar, Arayit Mountain, slopes, hilly, screes, steppe, 39°17′47.3″N, 31°45′07.3″E, 1682 m, OUFE: 16591, 07.07.2011.

2- B3 Eskişehir; Sivrihisar, Sivrihisar-Kaymaz, Kaymaz rocks, 31°13′56″N, 39°32′19.5″E, 1070 m, OUFE: 16592, 13.07.2011.



Figure 1. General appearance of *Hypericum sechmenii* in type locality.

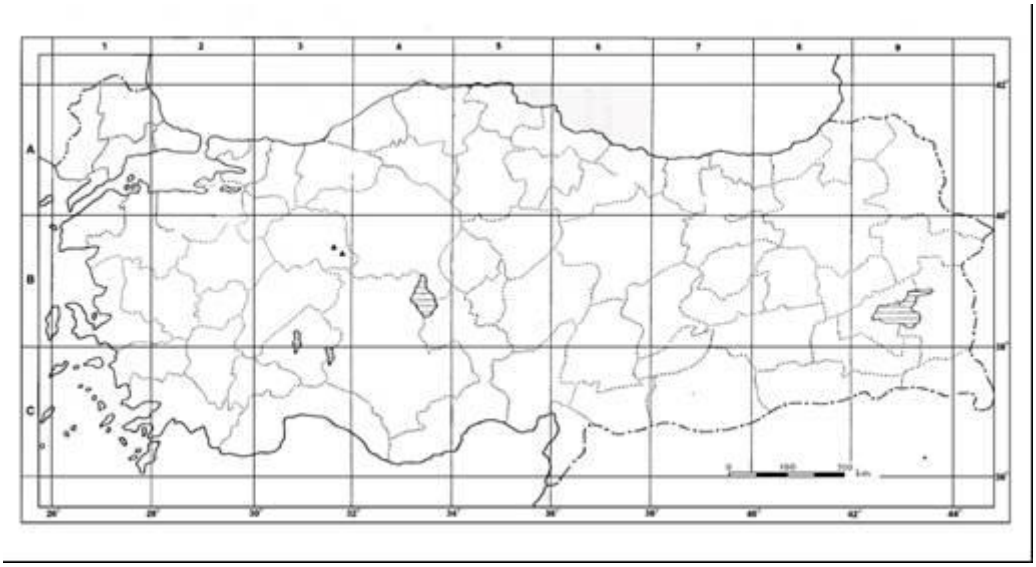


Figure 2. Distribution map of *Hypericum sechmenii* in Turkey.

Anatomical studies

In anatomical studies; the root, stem and leaves were fixed in 70% alcohol and then kept in the same solution until taking of cross and superficial sections. For sectioning, samples were taken from the alcohol by hand and scalpel. The sections were photographed by the Kameram™ digital camera and a Nikon 80i type microscope in our Department. A variety of foundation anatomical books and conducted studies were used as sources for identification of the plants (Esau, 1965; Fahn, 1967; Vardar, 1987; Curtis & Lersten, 1990; Özörgücü et al., 1991; Özörgücü, 1993; Yentür, 1995; Łotocka & Osinska, 2010).

Results and Discussion

Anatomical properties

Leaf anatomy

Epidermis is composed of a single layer of somewhat oblong epidermal cells in cross section. Upper and lower walls of epidermal cells are thicker than lateral. Typically width of epidermal cells is longer than length (Fig. 3). The outer surface of epidermis is covered with a thick cuticle. The leaf is amphistomatic and equifacial. Beneath both surfaces of the mesophyll is present 1-2 layered palisade parenchyma. Spongy parenchyma located between the palisades. Some hypodermal cells are includes

druse crystals. Central vascular bundle is clearly bigger than lateral ones and leaves have got a distinct midrib. *H. sechmenii* has xeromorphic stomata that are amaryllis type. Also, according to the shape of companion cells, type of the stomata is anomocytic (Fig. 4-5). Schizogenic secreting vesicles are abundantly being on the cross section of *H. sechmenii*.

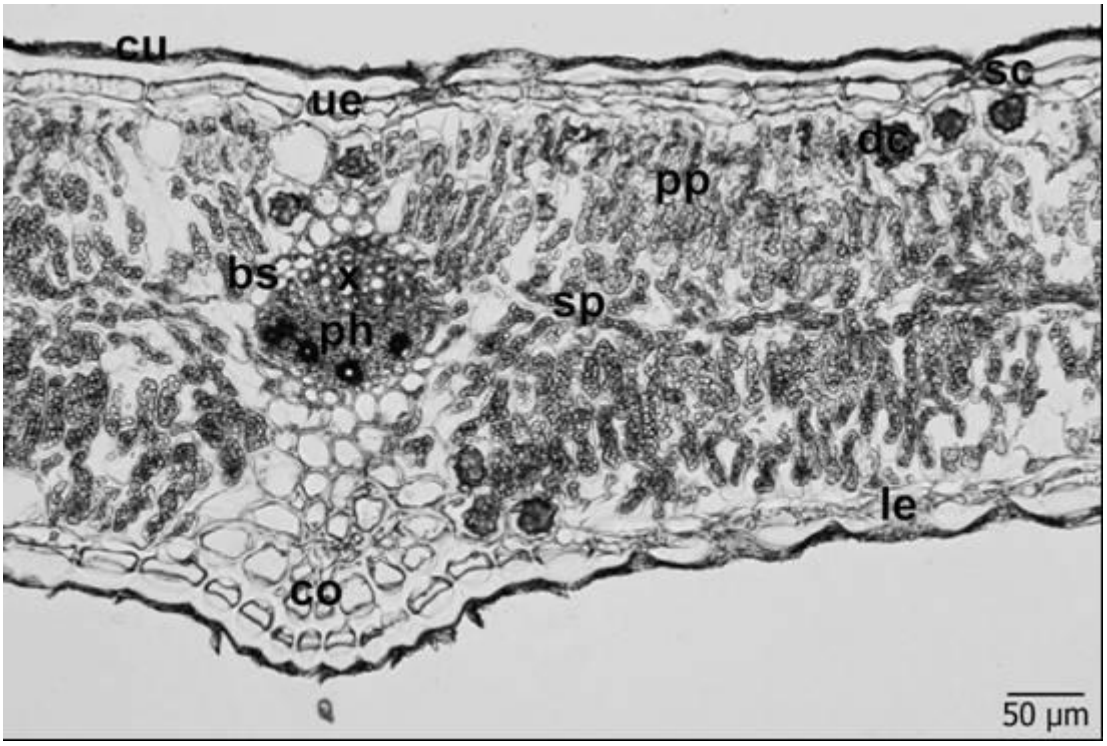


Figure 3. Transverse section of the leaf of *H. sechmenii*; **cu:** cuticle, **ue:** upper epidermis, **le:** lower epidermis, **sc:** stomata cell, **pp:** palisade parenchyma, **sp:** spongy parenchyma, **ph:** phloem, **x:** xylem, **bs**: bundle sheath, **co:** collenchyme, **dc:** druse crystal (1.5x10x10).

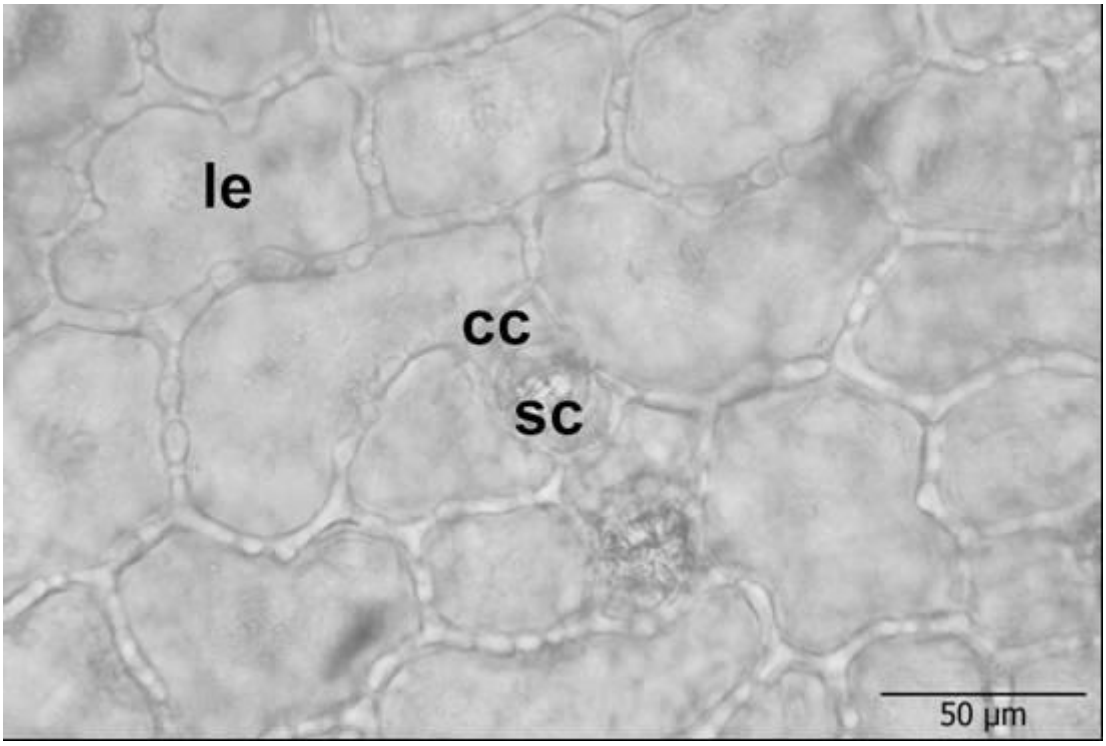


Figure 4. Lower surface section of the leaf of *H. sechmenii*. **le:** lower epidermis, **sc:** stomata cell, **cc:** companion cell (10x40).

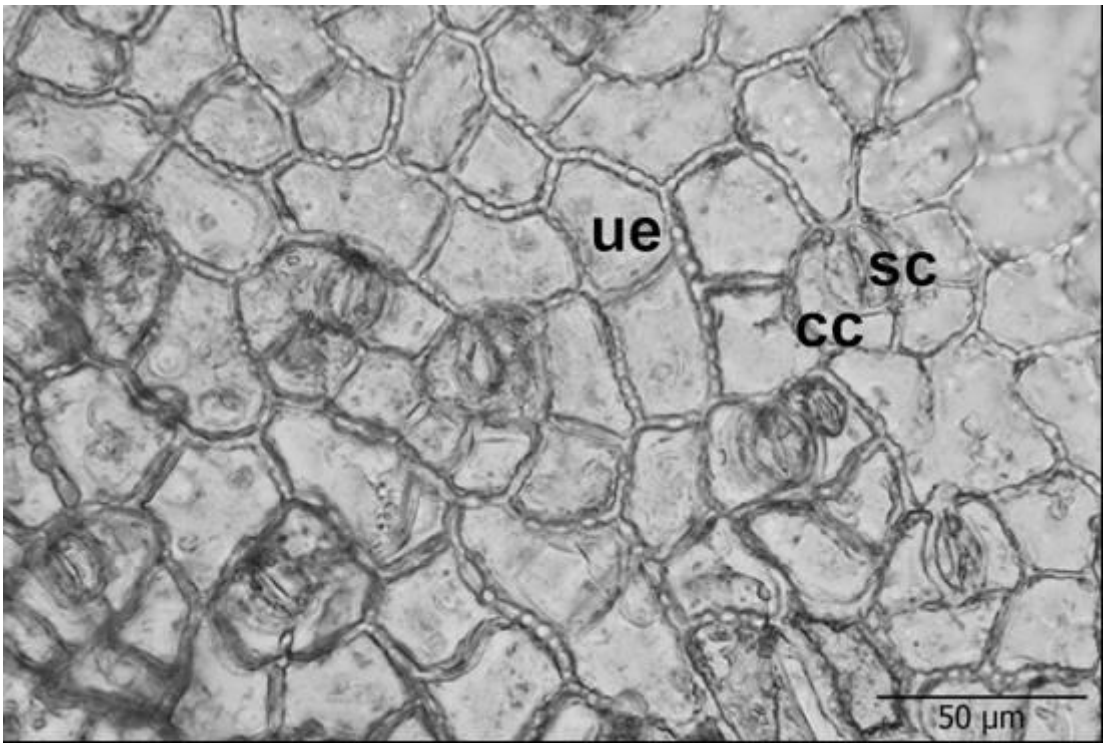


Figure 5. Upper surface section of the leaf of *H. sechmenii*. **ue:** upper epidermis, **sc:** stomata cell, **cc:** companion cell (2x10x20).

Stem anatomy

There is a cuticle in the outermost part and under this layer lies a single-layered epidermis. Periderm is composed of multilayer of dead cells. Peridermal cells are oblong shaped and suberized. Some peridermal cells also include druse crytals. Under the periderm, multilayered cortex which made up of nearly oblong parenchymatic cells is situated. Cortex cells are squeezing with growing of stem. Also, there lies a plate collenchyma with a few layers as well as a parenchymatic cortex under the epidermis. Following this, continuous vascular cambium is found between phloem and xylem. Pith is made of by xylem and any parenchymatic cells have not been observed (Fig. 6).

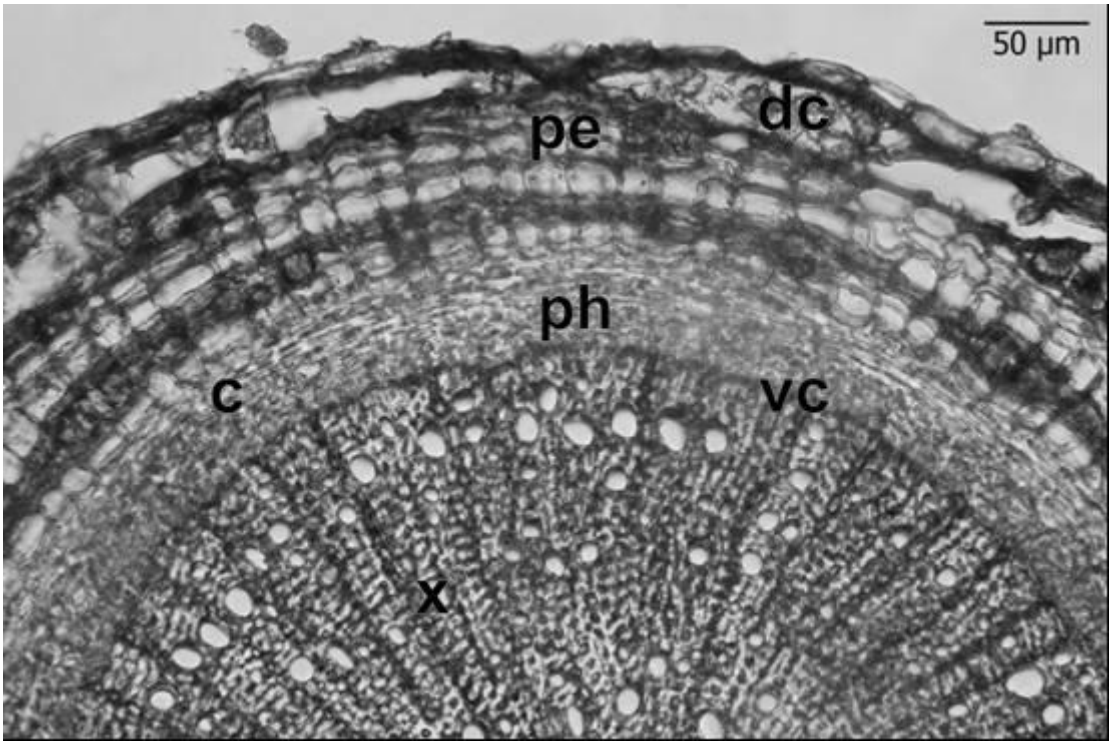


Figure 6. Transverse section of the stem of *H. sechmenii*. **pe:** periderm, **c:** cortex, **vc:** vascular cambium, **ph:** phloem, **x:** xylem, **dc:** druse crystal (1.5x10x10).

Root anatomy

There is a thick cuticle in the outermost part, under which there lies 1-2 layered periderm. The peridem is made up multilayered and nearly oblong cells on the outermost surface. Periderm is followed by a parenchymatic cortex with a few layers. There lies a single-layered flat pericycle beneath the single layer of endodermis. There

follow a narrow phloem with 2-3 layers, a cambium of 1-2 layers, apart from a widespread xylem. The pith of the root is entirely covered with xylem elements (Fig. 7).

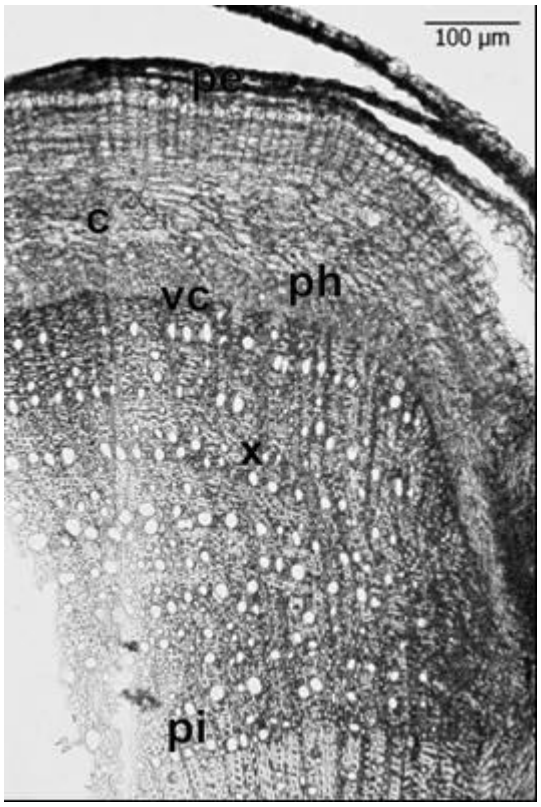


Figure 7. Transverse section of the root of *H. sechmenii*. **pe:** periderm, **c:** cortex, **vc:** vascular cambium, **ph:** phloem, **x:** xylem, **pi:** pith (1.25x10x10).

Findings of this study generally shows similarities with the other anatomical investigations (Erkara & Tokur, 2004; Łotocka & Osinska, 2010). Moreover, our findings will make contribution to systematic, morphological and anatomical studies.

Conservation status

The *H. sechmenii* is endemic to Central Anatolia and Irano-Turanian phytogeographic element. It was found only near the two localities by us. First locality is peak of Arayit Mountain (Sivrihisar-Eskişehir). It has very limited distribution in this locality. Population is composed of nearly 100 individuals and covers less than 2 km^2. Abundance of the population is decrease in time because of grazing and other biotic factors in this locality. Second locality is between Kaymaz and Sivrihisar (Sivrihisar-Eskişehir). It has very limited distribution in this locality too. Population is composed of about 50 individuals and covers less than 2 km^2. In this locality, population is very

small because of abiotic factors like climatic factors. Furthermore, populations are under treat here because of some anthropogenic factors. Especially, agricultural works and grazing have major effect on size and abundance of populations (Fig. 2).

According to these obtained data, *H. sechmenii* is known from only two localities and severely fragmented (criterion B2 a), with an estimated area of occupancy is less than 10 km^2 (criterion B2). The population is unhealthy with less than 250 individuals (criterion C). Therefore, it should be classified as "Critically Endangered (CR)" based on the criteria of the IUCN Red List Categories, and populations should be protected (Anonymous, 2001).

Acknowledgments

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