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Some Morpho-Anatomical and Conservation Status Studies on Rare Endemic *Astragalus eskishehiricus* Podlech (sect. Onobrychoidei, Fabaceae) from Eskişehir (Turkey)

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***Abstract*—*Astragalus eskishehiricus* Podlech which distributes only one limited locality in the Eskişehir (Turkey) is one of the rare endemic of Turkey. In this study, first time anatomical properties are given of *A. eskishehiricus*. Transverse sections of the root, stem, leaf and surface sections of the leaves were investigated to identify the anatomical features. Its morphological characters have been checked and its conservations status is given for the first time.**

Keywords: anatomy, Astragalus eskishehiricus, conservation status, endemic, Fabaceae, morphology

I. Introduction

The Fabaceae family (Leguminosae) is the third largest family of flowering plants, with around 18,000 species in 650 genera in the world. It is divided into three subfamilies, Caesalpinioideae, Mimosoideae and Papilionoideae. Major tribes of the Papilionoideae include the Swartzieae, Sophoreae, Dalbergieae, Amorpheae, Thephrosieae, Robinieae, Indigofereae, Phaseoleae, Desmodieae, Psoraleae, Loteae, Galegeae, Trifolieae, Podalyrieae, Liparieae, Bossiaeae, Crotalarieae, Thermopsideae, and Genisteae (Polhill, 1994). In Turkey Flora, Fabaceae is represenred by 1013 species that belongs to 71 genera. 400 of these species are endemic for Turkey (Erik & Tarıkahya, 2004).

Astragalus L. is one of the important genus belongs to *Fabaceae* has approximately 3000 species. Thus, it is considered the richest genus among angiosperm (Podlech, 1986; Zarre & Podlech, 1997). This genus is distributed in the semi-arid steppe regions of Irano-Turanian. Comparing the number of species according to the world's flora, Turkey is the second diversity center of the genus *Astragalus* with 50% endemism ratio after Iran. In Turkey, the genus *Astragalus* is represented ca 425 species belonging to 62 sections (Chamberlain & Matthews, 1970; Davis, Mill & Tan, 1988; Maassoumi, 1998; Podlech, 1999, 2002; Aytaç, 2000; Aytaç, Ekici & Açık, 2001; Podlech & Sytin, 2002; Duman & Akan, 2003; Ekici & Ekim, 2004). But since these studies, many species of the genus *Astragalus* have been added to the Turkey flora. After adding new species, the total species number of the genus *Astragalus* is increasing to ca. 445 species of which 224 are endemic in 62 sections in Turkey Flora (Özhatay et al., 2011).

The genus *Astragalus* also has an economical value because of its chemical compounds (Yakovlev, 1996). It is used in several herbal formulas. Gum tragantha whose alkaloid has been used as an herbal remedy for such conditions as cough and diarrhea are obtained from species of Middle Eastern *Astragalus*, such as *A. microcephalus* (Doğan et al., 1985).

Astragalus eskishehiricus Podlech is a member of sections *Onobrychoidei* DC. (=A. sect. *Onobrychium* Bunge) which belongs to the subgenus *Cercidothrix.* The section *Onobrychoidei* DC. (=A. sect. *Onobrychium* Bunge) includes the plants which are distinctly caulescent, rarely shortly caulescent; covered with adpressed to spreading, bifurcate (slightly or strongly) to simple (often at the margins of stipules and bracts) hairs. Leaves are imparipinnat and stipules are small, membranous, free from the petiole (rarely shortly adnate, mostly distinctly and often high up vaginate connate) behind the stem. Peduncles are straight, mostly shorter than the stems. Bracteoles are absent and calyx is tubular or campanulate. Plants have glabrous or rarely hairy petals. Claw of wings and keel are adnate only at the base to the stamen-tube. Stamen-tube is mostly truncate at the mouth. Legumes are bilocular. The section is represented about 40 species in Turkey. Comparing the number of the section's species with the other countries' flora, so its infer that the gene center of the section is Turkey (Ekici et al., 2005).

In this study, some anatomical characteristics of rare endemic *A. eskishehiricus* Podlech sect. *Onobrychoidei* DC. which distributes in a restricted area in Eskişehir (Turkey) have been investigated.

Since the taxa were first introduced, there have not been any anatomical studies about the species. The aim of this study is investigating morpho-anatomical properties of *A. eskishehiricus* Podlech. First time, in anatomical studies, tranverse sections of the root, stem, leaves and surface sections of the leaves were investigated.

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II. Material and Method

A. eskishehiricus Podlech was collected from B3 Eskişehir, Çifteler, 1 km south of Hamidiye, at 930 m. in 1996. Locality of plant samples is given in Figure 1. During field trip for Eskişehir Flora Project in 2012, we collected plant samples. Samples are identifed taxonomically according to Davis (1988) and related article (Podlech, 1999). In order to ensure a systematic study of the material obtained, herbarium samples were prepared and these samples were protected as herbarium samples at the Eskişehir Osmangazi University Herbarium (OUFE) (Figure 1).



Fig. 1. Flower and fruits *Astragalus eskishehiricus* in habit.

In anatomical studies; the root, stem and leaves were fixed in 70% alcohol and then kept in the same solution until the acquisition of cross and superficial sections. For sectioning, samples were taken from the alcohol by hand and scalpel. A variety of foundation anatomical books and conducted studies were used as sources for identification of the plants (Esau, 1967; Fahn, 1967; Özörgücü et al. 1991; Özörgücü, 1993; Yentür, 1995).

III. Results and Discussion

A. Examinated plant sample

Astragalus eskishehiricus Podlech B3 Eskişehir: Çifteler district, Eskisehir-Ankara route, iter Emirdağ junction-Hamidiye district, 1. km, the left side of the road, wet fields, 39°35'45" N-30°54' 48" E, 920 m., 18 vi 2012, OUFE: 16476 (Figure 2).

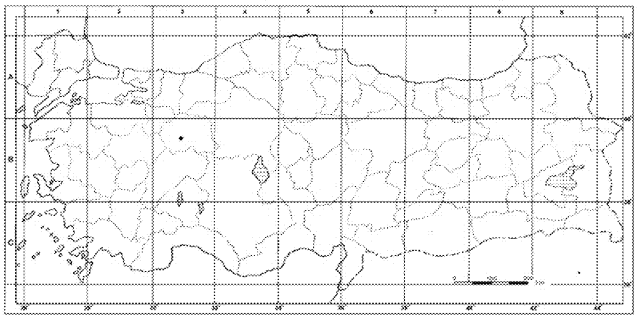

Fig. 2. Distribution map of *Astragalus eskishehiricus*.

B. Distribution and Ecology

Astragalus eskishehiricus Podlech is endemic to Turkey and grows in Central Anatolia and Irano-Turanian areas. The species is only known from the type locality. Its habitat is wet grass land, open damp places it grows along *with Iris orientalis, Phragmites australis, Galium verum, Achillea wilhemsii, Linum hirsutum, Juncus inflexus, Eleocharis palustris, Hordeum murinum, Avena barbata, Aleopecurus myosuroides, Dactylis glomerata* and *Setaria viridis* (Figure 2).

C. Recommended IUCN threat category listing

Astragalus eskishehiricus Podlech is known from one locality (criterion B2 a), with an estimated area of occupancy is less than 10 km^2 (criterion B2). The population is unhealthy with less than 200 individuals (criterion C). Therefore, it should be classified as "Critically Endangered (CR)" based on the criteria of the IUCN Red List Categories (IUCN 2001). In this study, conservations status were determined for the first time of *A. eskishehiricus* (Figure 2).

D. Description

Plants ca. 30 cm tall, covered with adpressed, symmetrically to slightly asymmetrically medifixed hairs 0.2-0.5 mm long. Stem up to 30 cm long, erect or at the base ascending, sparsely covered with white and black hairs. Stipules 2.5-3 mm long, triangular, scarcely adnate to the petiole, free from each other, at margins white and black ciliate. Leaves 7-10 cm. long, nearly sessile; rachis sparsely to loosely white and black hairy. Leaflets in 10-13 pairs, narrowly elliptic, 5-14 x 1.5-3, obtuse at the apex, on upper side glabrous, on underside loosely white hairy. Peduncles 7-12 cm long, hairy like the stem. Raceme short or elongated, densely 10-many flowered. Bracts whitish ovate, 0.5-1.5 mm long, black ciliate. Pedicels ca. 1 mm long. Calyx 4-5 mm long, campanulate, with slightly obliquely cut orifice, loosely white and black hairy; teeth subulate, unequal, the two upper ca. 1 mm long, the three lower up to 2 mm long, all white hairy on innerside. Petals glabrous, violet. Standard 14-15 mm long; blade ovate, ca. 6 mm wide, at the apex rounded, at the base shortly cuneately narrowed. Wings 10-11 mm long; blades narrowly oblong, at the apex slightly emerginate, 7 x 2 mm; auricle curved, ca. 0.8 mm long, blades obliquely elliptic, with widely curved lower edge and nearly straight upper edge, at the apex acutish, 4 x 2 mm, auricle minute. Ovary sessile, white hairy; style glabrous. Legumes

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(unripe) narrowly ovoid, densly subappressed white hairy (Podlech, 1999). In this study, plant samples were examined with type description no difference was observed (Figure 1).

E. Anatomical properties

1) Root anatomy

In the cross section of the root, it is seen that periderm is formed of multilayered of suberized cells on the exterior surface. Just under the periderm, cortex is situated. Cortex is composed of different cell types like parenchyma and sclerenchyma. Towards to the middle of cross section, xylem tissue is surrounded by phloem tissue. Between the phloem and xylem, few layered vascular cambium which gives secondary xylem and phloem is being in. Also supporting tissue members are distributed in the root section (especially sclerenchyma). Xylem is separated from pith by sclerenchyma bundle. Pith is composed of globoid parenchyma cells which have large intracellular space and thin cell walls (Figure 3).

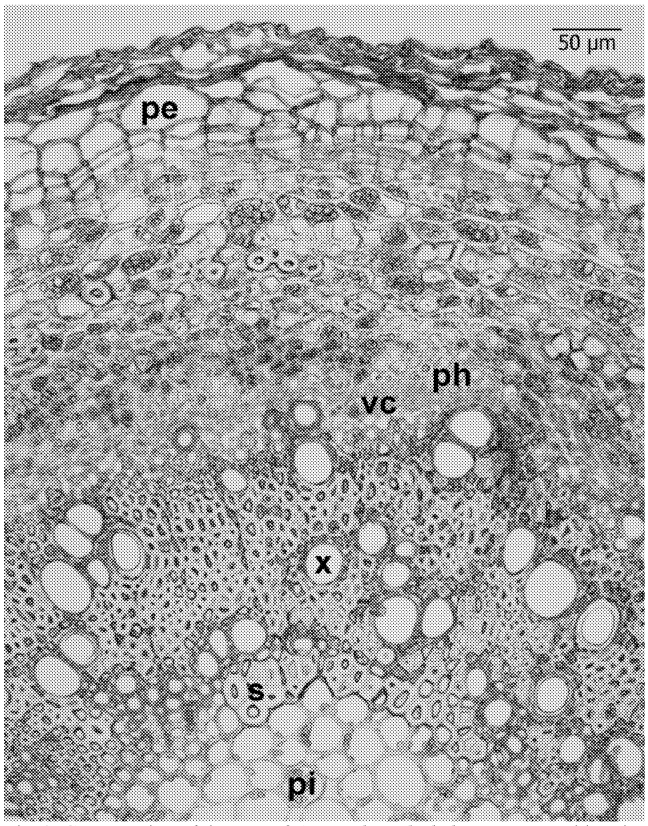

Fig. 3. Cross section of the root of *Astragalus eskishehiricus*. pe: peridermis, ph: phloem, vc: vascular cambium, x: xylem, s: sclerenchyma, pi: pith (20 x 10).

2) Stem anatomy

One layered epidermis cells are all covered with thin cuticle layer. The shapes of epidermis cells are similar and ± oval. Beneath the epidermis cells, 3-4 layered collenchyma cells are seen with thickened cell walls. Between the epidermis and vascular cambium, cortex which is comprised of 4-5 layered parenchyma cells are situated. Also sclerenchyma bundle is on the phloem part. Under the sclerenchyma bundle phloem is found which is composed of primer and seconder phloem. 1-2 layered cambium is between the phloem and xylem. Outer part of pith is composed of xylem which has ± globoid and thick walled cells. Under the xylem cylindrical pith cells which have properties of parenchyma tissue differ from the cortex cells due to have large and thin walled cells types. In addition to these properties, pith's cells of older stems are evanished and change to a hallow (Figure 4).

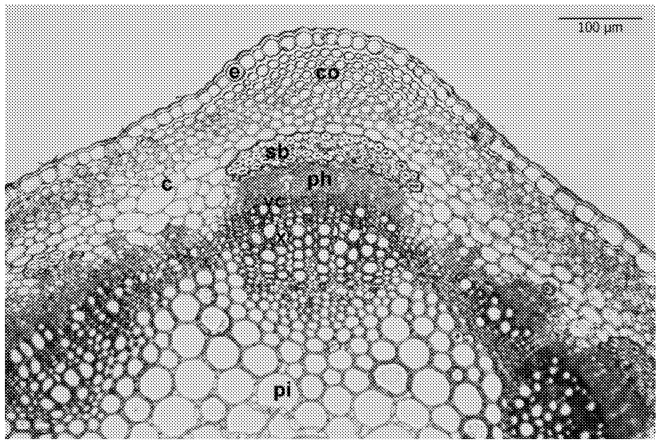

Fig. 4. Cross section of the stem of *Astragalus eskishehiricus*. e: epidermis, co: collenchyma, c: cortex, sb: sclerenchyma bundle, ph: phloem, vc: vascular cambium, x: xylem, pi: pith (10 x 10).

3) Leaf Anatomy

Upper and lower parts of epidermis are composed of one layered cells which have almost equal width and length. On the leaf surface, bi furcate hairs are seen abundantly and these hairs are characteristic for the section *Onobrychoidei* DC. (=A. sect. *Onobrychium* Bunge). Leaf is isobilateral and palisade parenchyma has one or two layered, long-cylindrical cells which have lots of chloroplasts. Collateral type vascular bundle is clearly distinguished between phloem and xylem. All vascular bundles are covered with one layered bundle sheaths.

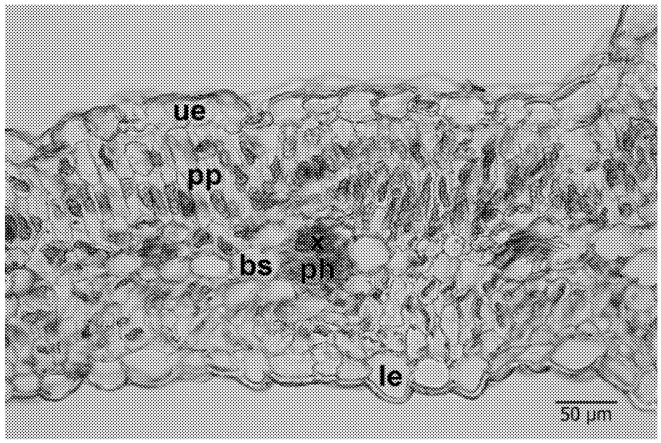

Figure 5. Transverse section of the leaf of *Astragalus eskishehiricus*. **ue:** upper epidermis, **pp:** palisade parenchyma, **bs**: bundle sheath, **x:** xylem, **ph:** phloem, **le**: lower epidermis, , (20 x 10).

The stomata were irregularly oriented and distributed on both surfaces of leaves. The guard cells are typically kidney-shape

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and amaryllis type. The stomata are slightly sunken related to the epidermal cells According to Metcalfe & Chalk's studies (1957), the type of stomata is anomocytic (Ranunculaceous), (Figure 5,6).

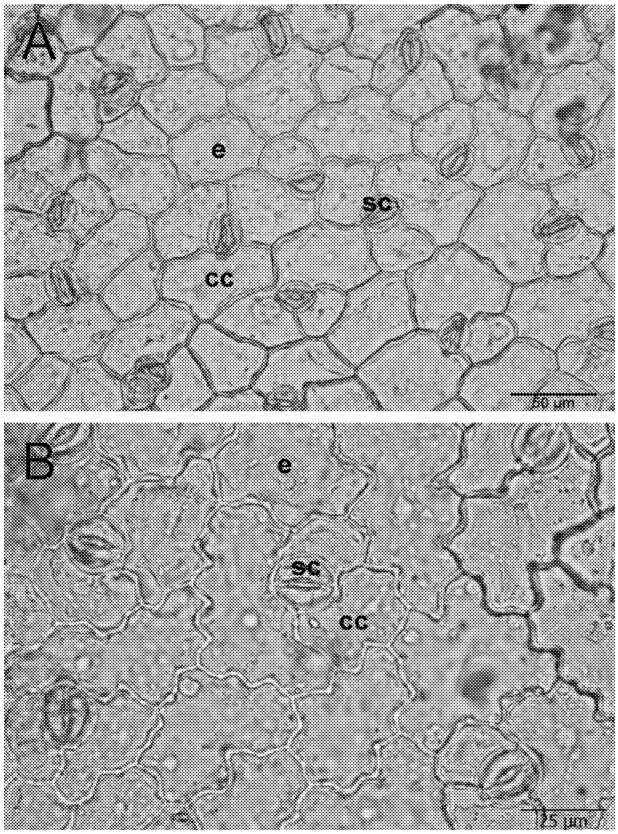

Fig. 6. Surface section of the leaf of *Astragalus eskishehiricus*. A, stomata from upper epidermis (20 x 10 x 1,5); B, Stomata from lower epidermis (60 x 10); sc: stomatal cell, cc: companion cell, e: epidermis

In this study, anatomical characteristics were determined for the first time of *A. eskishehiricus*. Thus we believe that contributed to the studies on plant systematics, plant anatomy, plant morfology and all relevant studies.

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