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Research Note

Morphological, Anatomical and Palynological Investigation on *Sonchus erzincanicus* Matthews (Asteraceae)

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Abstract: In this study, *Sonchus erzincanicus* Matthews (Asteraceae) collected from Erzincan (Turkey) has been investigated by its leaf and stem anatomical features, pollen grain characteristics and ecological features.

It is an endemic perennial herbs growing in slightly basic with low organic content soil. Stem cortex seen transparently is composed of parenchyma cells. The leaves are bifacial and have stomata cells that are anomocytic. The pollen type of the species is trizonocolporate. All anatomical studies including transverse sections of the stems and leaves and surface section of leaves are illustrated for the firs time.

Key Words: Anatomy, ecology, palynology, *Sonchus erzincanicus*, Turkey

Sonchus erzincanicus Matthews (Asteraceae)'un Anatomik, Morfolojik ve Palinolojik Özellikleri

Özet: Bu çalışmada, Erzincan (Türkiye)'dan toplanan *Sonchus erzincanicus* Matthews (Asteraceae) gövde ve yaprak anatomik özellikleri ile, polen karakterleri ve ekolojik özellikleri yönünden incelenmiştir.

S. erzincanicus hafif bazik ve düşük organik madde içerikli topraklarda yetişen çok yıllık ve endemik bir bitkidir. Saydam görünen gövde korteksi parenkima hücrelerinden oluşur. Yapraklar bifasial özellikte ve anomositik stoma hücrelerine sahiptir. Türün polen tipi trizonokolporattır. Gövdeden enine kesitler ile yapraktan enine ve yüzeysel kesitleri içeren tüm anatomik çalışmalar ilk defa gösterilmiştir.

Anahtar Sözcükler: Anatomi, ekoloji, palinoloji, *Sonchus erzincanicus*, Türkiye

Introduction

The genus *Sonchus* L. (Asteraceae) has a world wide distribution except for Central and South America (Heywood, 1978). It is commonly considered to be related to *Aetheorhiza* Cass., *Reichardia* Roth and *Launaea* Cass. (Stebbins 1953; Sell 1975), but it is a more isolated and distinct genus (Jeffrey, 1966; Sell, 1975). In recent years, this genus has been the subject of chemical studies (Shimizu et al., 1989; Mahmoud et al., 1983; Mahmoud et al., 1984; Giner et al., 1993; Manez et al., 1994). *Sonchus* is represented with seven taxa in Turkey (Davis, 1975, 1988) some of which are used as a food in Turkey (Akartürk, 2001). Flowers are perfect and generally self-incompatible. Perennial sowthistle can reproduce by seed and vegetatively is pollinated by insects including honeybees and other bees, hover flies, and blister beetles (Derscheid & Schultz, 1960; Stevens, 1924). *S. erzincanicus* Matthews, a very rare endemic species restricted to B7 Erzincan. It has been included in the Red Data Book of Turkish Plant (Ekim et al., 2000) as an endangered species, but very little is known about its detailed distribution and ecology. Thus the main object

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of this study is to explore morphological, anatomical structures and ecological properties of *S. erzincanicus* with wide perspectives.

Pollen grains of *Asteraceae* may be resolved into two major groups i.e., lophate and non-lophate grains (Qureshi et al., 2002). Within the genus *Sonchus*, probably rising from *Launaea* (Saad 1961, Boulos 1974), the most primitive taxa, included in the subg. *Origosonchus* Boulos, show pollen characters very similar to those of *Launaea* (Saad 1961; Pons & Boulos, 1972). It is seen that pollen morphology of some genera in the *Asteraceae* can be useful in supporting taxonomic suggestions (Clark et. al, 1980).

Materials and Methods

S. erzincanicus Matthews samples were collected during the field studies of the project titled "Important Plant Areas along the BTC pipeline" from B7 square (Erzincan: Ekşisu, 39° 43′ 98″ N, 39° 37′ 55″ E, 1154 m, 20.08.2004) in Turkey. Specimens for morphological studies were dried according to standard herbarium techniques and stored in the Herbarium of ISTE and Erzincan Education Faculty (Kandemir, 5845). Also these specimens were used for pollen studies. Anatomic observations were performed on the cross-sections of stem and leaves, and surface sections of leaves taken by free-hand. Staining was carried out with safranin–fast green dyes for 24 hour and mounted with glycerine-gelatine in order to get permanent slides (Vardar, 1987). The well-staining sections were photographed on camera Olympus BX51 from permanent slide. All measurement and observations were determined on three or four staining sections.

The pollen slides were prepared according to the Wodehouse (1935) technique. Pollen grains were dissected from herbarium specimens and placed on a clean microscope slides and added 2-3 drops of 96% ethanol to melt the resin and oil. Glycerin-jelly added basic fuchsine was placed on pollens and allowed to melt and mixed by a clean pin to get scattered pollen grains. The pollens were photographed on camera Olympus BX51 from permanent slide. All measurements were determined on thirty pollen grains. Also ornamentation of this species and number of spine rows were determined (Punt et al., 1994).

The chemical and physical properties of soil samples were also determined. Soil samples were air-dried, ground and sieved through a 2 mm-mesh-sized sieve (Gülçür, 1974). Field capacity, wilting point and available water content of samples were determined following the procedures described by Gülçür (1974). Organic matter content was determined by wet digestion (modified Walkley-Black Procedure) method (Kalra & Maynard, 1991; Gülçür, 1974). Soil pH was determined by a combination of glass-electrode in H_2O (soil-solution ratio 1:2.5). Cation exchange capacity (CEC) was determined by saturating soil samples with NH4 by leaching buffered NH_4OAc solution. Phosphorus determined according to Bray-Kurtz (Dilute acid-fluoride) and Olsen procedure (Kalra & Maynard, 1991). Exchangeable cat ions (Na, Ca, Mg, K, Zn, Fe, Cu) were extracted from the neutral ammonium acetate solution and measured by atomic absorption spectrophotometer (Kalra & Maynard, 1991). Salinity was determined by following the procedure described by Gülçür (1974). Total N of soil samples was determined using the published dry-burn method (Kalra & Maynard, 1991) with a Leco 420 N designation apparatus.

Results

I-Morphological Properties (Figure 1, 4)

Tuberoses, erect perennial with glabrous stems c. 130 cm, sparsely glandular-hairy above. Basal leaves in a rosette, oblong-elliptic, pinnatifid, denticulate, cauline leaves ± entire; auricles absent: capitula 1.5-2 cm broad. Involucres cylindrical, sparsely glandular-hairy. Ligules bright yellow. Achenes 3-4 mm, outher slightly curved, dorsal face 2, ventral face 1 ribbed, inner compressed, each face 1 ribbed. Pappus 7-8 mm.

II-Anatomical Properties

Stem (Figure 5, 6)

A transverse section taken from the middle part of the stem was observed as follows. The epidermis consists of a single layer, flattened, rectangular or orbicular cells and it is surrounded by a cuticle layer that is 5-6 µm in thickness. Underneath the epidermis, there is collenchyma with single layered cell, but 2-3 layers of collenchyma can be seen below the epidermis at the stem ridges. A long the stem radius, cortex (220-270 µ)

Figure1. General appearance of *S. erzincanicus*

consist of 6-7 layers of usually oval cells and makes up 16 to 18 % of the tissue in *S. erzincanicus*. Parenchyma cells containing latex are seen transparently in cortex. There is an amylum sheath on the phloem part. Cambium is undistinguishable. Vascular bundles are chollateral type and are surrounded by scleranchyma fibers filtrate into the vascular bundles and expanding outside of the phloem. Phloem and xylem members are clear. Number of row of trachea can change among 4-8 and each row contains 3-6 tracheas. Pith parenchyma cells situated centre of the stem are polygon shaped with schizogen cavity and are bigger than those in cortex. Measurements about stem anatomy are presented Table 1.

Leaf (Figure 7, 11)

The transverse section of the lamina, mid-rib and surface preparations of both epidermises revealed the following elements. Mid-rib is triangle shaped and has1-2 layered collenchyma located below the both epidermal cells. Vascular bundles surrounded with parenchymatous

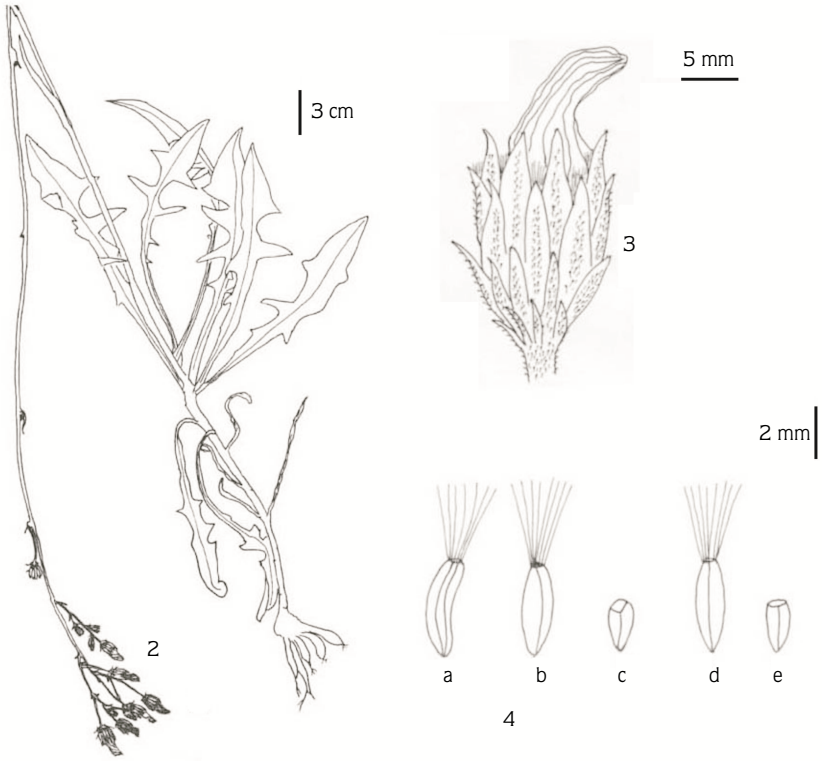

Figure 2–4. 2) General appearance of *S. erzincanicus*; 3) Phyllaries; 4) a- Dorsal appearance outer achene, b-Ventral appearance outer achene, c-Cross section from outer achene, d- Dorsal appearance of inner achene, e-Cross section from inner achene

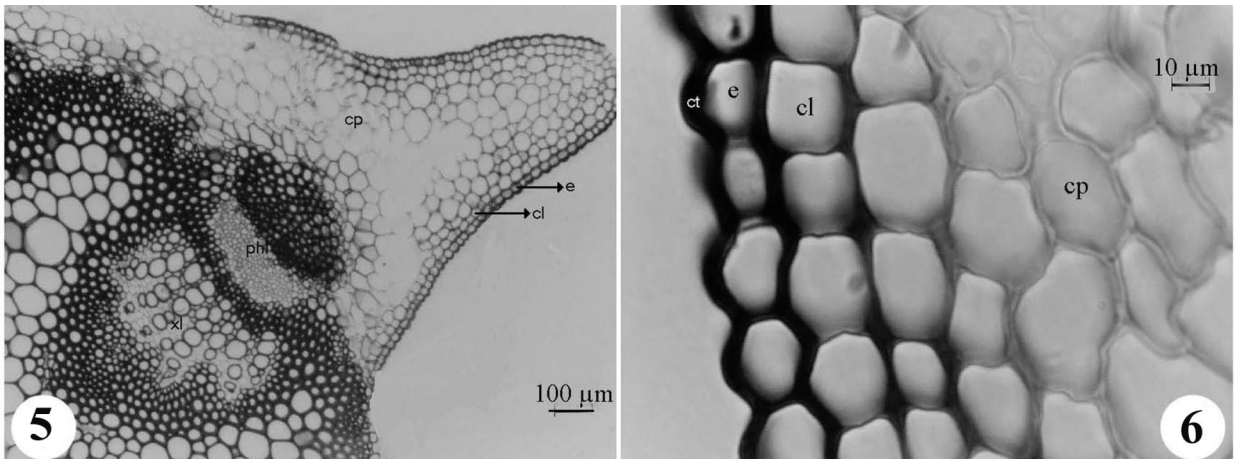

Figure 5–6. *S. erzincanicus.* Transection of the stem, e:epidermis, cp: cortex parenchyma, cl: collenchyma, phl:phloem, xl: xylem.

Table 1. Anatomical measurements of *S. erzincanicus*

	Min	Max
Thickness of cuticle (stem) µm	5	6
Thickness of mesophyll µm	220	240
Thickness of cortex µm	220	270
Bigness of vascular bundle (Width/length) µm	400/700	550/800
Diameter of trache µm	40	45
Diameter of pith parenchyma cell µm	110	120

and orbicular shaped cells are collateral type with a clearly visible cambium and are arranged as crescent-shape in cortex. Scleranchyma cells in bundles are dense. One layered collenchyma tissue is seen inside of the upper and lower epidermis in the midribs.

Palisade and spongy parenchyma are not distinct, that is, mesophyll tissue (220-240 µ) is homogeny. There is one-lined hypodermis underneath the upper epidermis. Number of stomata and their size are different for upper and lower surfaces and cell walls of lower epidermis are more undulate than upper ones. Stomata cells occur on the both surfaces at the same level with neighboring cells are anomocytic type. Some measurements about upper and lower surface are presented in Table 2.

III-Ecological Properties

Chemical and physical properties of the soil samples were studied. Measurements about soil are seen in Table 3. At the same time, habitats of the plant were determined and it is seen that *S. erzincanicus* shares its habitat with some herbaceous plants are presented in the following.

Orchis papilionacea L. var. *papilionacea* L., *Iris orientalis* Mill., *Schoenus nigricans* L., *Thesium stellerioides* Jaub.& Spach, *Thesium compressum* Boiss. & Heldr., *Allium flavum* L. ssp. *flavum* var. *flavum*, *Triglochin bulbosa* L. ssp. *barrelieri* (Loisel.) Rouy., *Triglochin palustris* L., *Veronica anagallis-aquatica* L., *Mentha spicata* L.var. *spicata*, *Plantago major* L. subsp. *intermedia* (Gilib.) Lange, *Plantago maritima* L., *Gladiolus atroviolaceus* Boiss., *Juncus* cf. *subnodulosus* Schrank, *Lycopus europaeus* L., *Silene kotschyi* Boiss. var. *kotschyi*, *Juncus maritimus* Lam. *Polygonum persicaria* L., *Verbascum blattaria* L., *Teucrium scordium* L. subsp. *scordioides* (Schreber) Maire & Petitmengin, *Gypsophila perfoliata* L., *Marrubium vulgare* L., *Verbena officinalis* L., *Solanum nigrum* L. subsp. *nigrum*, *Limonium gmelinii* (Willd.) O. Kuntze.

IV-Palynological Properties (Figure 12,13)

The pollens of *S. erzincanicus* are radially symmetric, 3- zonocolporate, echinolophate. Polar axis (P) is between 28-31 µ, equatorial axis (E) 30-34 µ and P/E rate 0.91-0.93 µ. Shape of pollen grain in equatorial view

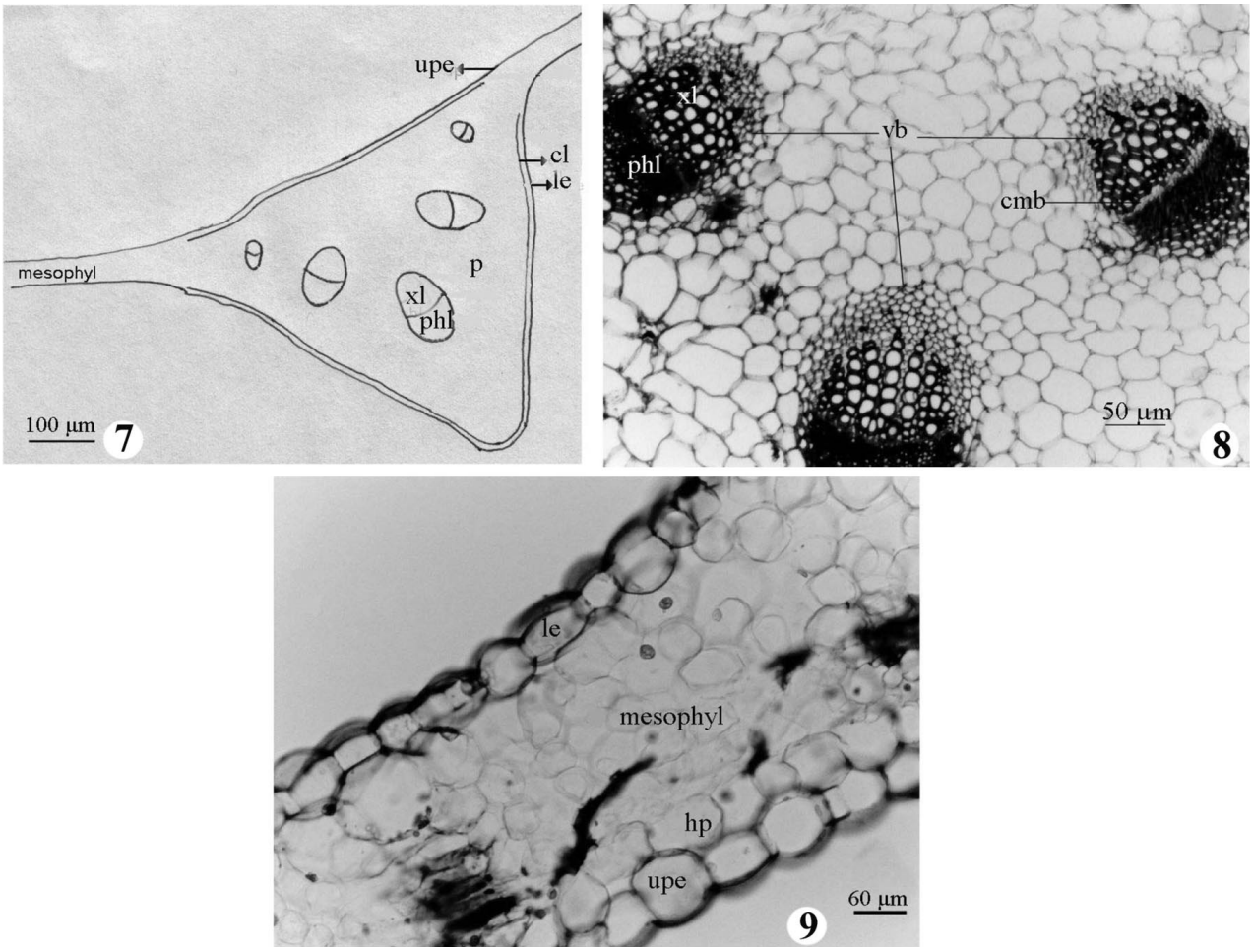

Figure 7–9. *S. erzincanicus.* Transection of the leaf. upe: upper epidermis, cl: collenchyma, le: lower epidermis, p: parenchyma, phl: phloem, xl: xylem, cmb: cambium, vb: vascular bundle, hp: hypodermis.

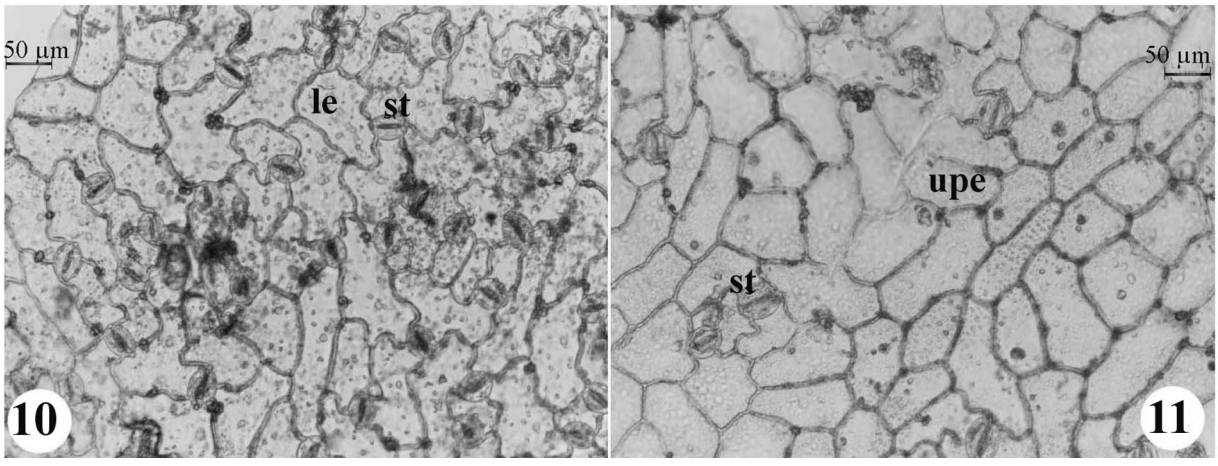

Figure 10–11. Surface section of leaf. upe: upper epidermis, le:lower epidermis, st:stomata

Table 2. Stoma features upper and lower surface of *S. erzincanicus*

Characters	Lower surface	Upper surface
Stomata width (µm)	12.9	15.2
Stomata length (µm)	16.4	20
Number of stomata (for the 1 mm^2)	489	244
Epidermis width (µm)	22	25
Epidermis length (µm)	50.3	45
Number of epidermis (for the1 mm^2)	734	816
Stomata index	39.9	23

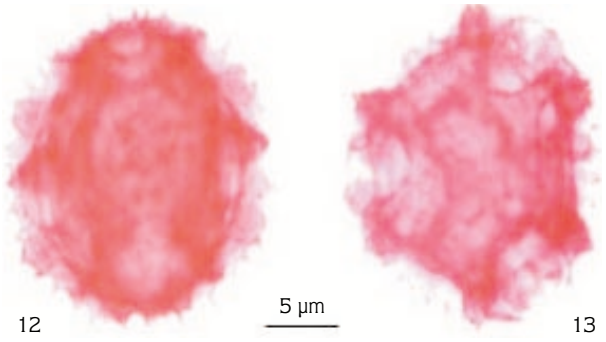

Figure 12–13. Pollen morphology of *S. erzincanicus*, 12.Equatorial view;13. Polar view.

Table 3. Chemical and physical measurements of soil sample

PH 1/2,5	EC ms/cm	O.M.	Total N	Total lime	Organic C%	Ca %	Mg %	P (ppm)	P_2O_5	FSK%
8,2	6,13	6.006	0,043	35,88	2,68	0,235	0,226	10,88	24,89	23,05

is subsphaeroidal and in polar view is triangular. The exine thickness is between 4-5 µ. Aperture membrane is psilate. Intine thickness is 1.5-2 µ. Number of lacunae is 15; 3 poral lacunae, 6 abporal lacunae and 6 paraporal lacunae. Tectum echinolophate, infratectum columellate. Apocolpium prelacunae Type II. Length of spines is 1.5-3 µ and numbers of spine rows are 6-8. The ornamentation is microreticulate and echinate.

Discussion

This is the first detailed anatomic, morphologic, palynologic and ecologic report on *S. erzincanicus*, an endemic species for Turkey.

Morphological characters such as length of stem, characters of leaf, properties of capitulum, involucrum and achen, are used as taxonomic characters to identify the species. Although our results are generally in line with the description of Flora of Turkey, a few differences are depicted here. It was reported that the length of the plant were maximum 80 cm, each face 1-2 ribbed and pappus 2-8 cm in length (Davis, 1975). In our study, the plant is maximum 130 cm, 2 ribbed dorsal face, 1 ribbed ventral face, and pappus 7-8 cm.

The anatomic features of the species are similar with pecularities of the family *Asteraceae* studied by Metcalfe & Chalk (1950). Latex canals observed in some *Asteraceae* members (Esau, 1965) are not present at the stem preparations of *S. erzincanicus*.

Mesophyll tissue is either completely palisade or spongy parenchyma in *Asteraceae* family (Metcalfe & Chalk, 1950). However, it is homogeneous in our study. Lacunar collenchyma is seen clearly underneath the lower epidermis in leaf and stem and the species has anomocytic stomata. Like the opinion was supported by Esau (1965).

Pollen type of *S. erzincanicus* is tricolporate and uniformly echinate, spine bases are perforate; pollen grain shapes in equatorial view are subsphaeroidal and in polar view are triangular. Similar results were found by Clark et. al. (1980), and Diez & Meijas, (1999) but *Sonchus palustris* pollen grains are tetrazonocolporate and quadrangular in polar view. Light microscopic observations could not clearly indicate the exine sculpturing. Bolick (1978) suggested that Scanning Electron Microscope (SEM) studies should be carried out for obtaining many characters of great taxonomic importance (Qureshi et. al. 2002).

According to ecological results, the species grows on slightly basic or neutral soil (pH 8.2). Lime ratio of soil is 35 %. It was found that Ca level which is proportional with pH is low. These results correlated with the pH

neutralizing function of Lime (Şişli, 1999). Total N, Ca and Mg contents are also low. Organic substance (O.M.) is 6.006 indicating a poor soil and these properties of soil correlate with plants habitat.

S. erzincanicus grows at subsaline marches in Erzincan and the number of the specimens belong to species has been decrased by agricultural expansion, pollution, grazing and drying activites. The species is also in the danger zone for extinction, because of the agricultural expansion and also probably by pollution and extreme drought. There are urgently need more studies about its ecological needs and the habitat of this endangered species for which the bells of extinction is already ringing (Özhatay et al., 2003).

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