



Examination of the leaflets hairs and stoma structures with the electron microscope of the genus *Ebenus* L. (Leguminosae) in Turkey

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Abstract

In this study, the characteristics of the hairiness on the leaflets surfaces and the stoma structures are examined with the electron microscope (EM) for the taxa of the *Ebenus* L. genus, all species are endemic to Turkey. In the samples examined, it was determined as differentiating characteristics whether or not there were cuticular folds in the membrane structures of the epidermis cells, the characteristics of the hair wall structures and whether or not there were glands. It was also determined that stoma structure.

Key words: *Ebenus*, leaflets, stoma, trichome, Turkey

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Türkiye’de yetişen *Ebenus* (Leguminosae) cinsi üyelerinin yaprakçık tüylerinin ve stomalarının electron mikroskopu ile araştırılması

Özet

Bu çalışmada, bütün türleri Türkiye için endemik olan *Ebenus* L. cinsi türlerinin yaprak yüzeylerinin tüylenme karakteristikleri ve stoma yapıları elektron mikroskopu (SEM) ile incelenmiştir. Türleri ait kutikula yapısında yer alan epidermis hücreleri, tüy hücre duvarlarının yapılarında farklılıkların olup-olmadıkları, glandlarının olup-olmayışı incelenmiştir. Ayrıca stoma yapıları araştırılmıştır.

Anahtar kelimeler: *Ebenus*, yaprakçıklar, stoma, tüy, Türkiye

1. Introduction

The genus *Ebenus* L. within the Leguminosae family is represented by 19 species in the world (International Plant Names Index [Ipni]). Thirteen species of the genus known with the Turkish names of morgeven (purple tragacant) and sarı geven (yellow tragacant) (Aytaç, 2000) grow in Turkey. All of these species are endemic to Turkey (Hub-Mor., 1973). Furthermore, 6 species in the world grow in the following regions: *E. cretica* L. and *E. sibthorpii* DC. on the islands in the Aegean Sea; *E. pinnata* Alt. in Egypt, Tunisia and Morocco; *E. armitagei* Schwein in Libya ve Algeria; *E. stellata* Boiss. in Iran, Pakistan and Afghanistan; and *E. lagopus* Boiss. in Southern Iran.

According to their morphological appearances, even if they resemble the genus *Astragalus* L., they are differentiated, especially with the structure of the calyx teeth being formed longer than the calyx tube and the monodelphus shape of the stamens.

The genus members are perennial, hemicryptophyte, woody at the base or herbaceous, creeping or erect. The leaves are trifoliolate or imparipinnate with 3–15 pairs of entire leaflets. The inflorescence is globose, oblong or cylindrical on long peduncles. The calyx is campanulate–tubulose with 5 plumose teeth. The petals are yellow or purple. The standard obovate or obcordate; keel truncate, obtuse; the wings are much shorter than the other parts. The vexillare stamen connate with the outer. The style filiform, incurved; the stigma small, terminal. The fruit small, enclosed by the calyx, flattened, membranous, smooth, sparingly hairy, 1–seed.

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When the distributions of the species endemic to Turkey are examined, it is observed that the *E. haussknechtii*, *E. macrophylla* and *E. laguroides* species are localized on the Anatolian diagonal and that those in the other taxa grow to the west of the diagonal (Aytaç, 2000).

Within the genus, the *E. hirsuta*, *E. plumosa* and *E. boissieri* species have yellow flowers and the others have violet and purple flowers.

The *E. pisidica* species grows on serpentine rock soils and all of the other species grow on calcareous and basalt rock soils..

2. Materials and methods

The specimens used in the study are deposited in the GAZI. In addition, the locations where the plants were collected are given in the table 1. The leaflets, also to be examined with the scanning electron microscope (SEM), were taken from the regions close to the end points of the dried plant leaf and mounted on the SEM stubs with double-sided tape in a manner in which the lower and upper surfaces could be examined. They were coated with gold by using the Polaron SC 502 Sputter Coater and were examined with the Jeol JSM 6060 SEM operated at 15 kW in the Gazi University electron microscope unit. The locations of the specimens collected and used in the study are given in Table1.

Information was given respectively on the species, Latin names and authors, their synonyms, if any, and Turkish names, brief differentiating characteristics of the species, growing regions, to which regional element they belong, their IUCN (2011) categories, chromosome numbers, pollen structures, the upper and lower surface hairiness of the leaves and the stoma structures. These structures were discussed after adding the hair and stoma photographs for the species.

The terminology of Al-Shammary & Gornall (1994) was used to define all of the hairs.

3. Results

Identification key for the species in Turkey

1. Keel bearded.....*barbigera*
1. Flowers completely glabrous
 2. Inflorescence spike
 3. Flowers completely purple.....*macrophylla*
 3. Flowers yellow; keel pinkish-suffused*plumosa*
 2. Inflorescence ovate, globose or oblong
 4. Flowers yellow
 5. Clearly caulescent; plants with spreading hairs.....*hirsuta*
 5. Shortly caulescent at base; adpressed hairy.....*boissieri*
 4. Flowers purple
 6. Peduncle at least 5 times longer than stem; leaves with 3–5 pairs of leaflets at base*longipes*
 6. Peduncle as long as or shorter than stem
 7. Stem leaves with 1–3 pairs of leaflets
 8. Plant with long spreading hairs; corolla 15–17 mm.....*depressa*
 8. Plant with shortly adpressed hairs; corolla shorter than 12 mm
 9. Outer bracts linear-lanceolate; standard longer than keel.....*cappadocica*
 9. Outer bracts ovate to lanceolate; standard shorter than keel.....*bourgaei*
 7. Stem leaves with 3–4 pairs of leaflets
 10. Plant with adpressed hairs; bracts linear-lanceolate.....*reesei*
 10. Plant with spreading hairs; bracts ovate-lanceolate
 11. Creeping; standard longer than keel.....*haussknechtii*
 11. Erect; standard as long as keel or shorter
 12. Lower calyx teeth twice as long as upper; outer bracts 5–7 mm wide.....*pisidica*
 12. Lower calyx teeth 1/3–1/4 longer than upper; outer bracts at least 4 mm wide.....*laguroides*

This study, in which the systematic and morphological (Aytaç *et al.*, 2001), cytogenetic (Aksoy, *et al.*, 2001), pollen structures (Pınar & Aytaç, 2000), and seed morphologies (Bayraktar *et al.*, 2010) and seed chemistries (Azcan, 2001) were studied previously, set forth the leaf hairiness and the stoma characteristics of the genus members, discussed whether or not there is a systematic significance of these two structures and examined the correlations with the other characteristics.

3.1. *E. plumosa* Boiss. & Heldr. Turkish name: Tarlamorgeveni

Leaves 4–7 pairs; with long peduncle; has flowering on spike; yellow corolla.

It has two varieties.

Var. *plumosa*

Type: Uşak. The flowers are completely yellow. The second record is from Antalya.

Var. *speciosa* Hub.–Mor.

Type: Ermenek. Pink color is dominant on the keel.

IUCN category: CR. Mediterranean element.

The chromosome number of both taxa is $2n=14$.

The second chromosome is metacentric in and var. *speciosa*, submetacentric *plumosa* (Aksoy *et al.*, 2001).

Both taxa grow on calcareous rock soils.

IUCN category: EN. It is a Mediterranean element.

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate, $3-4\mu\text{m}$ in polar diameter and $16.2\mu\text{m}$ in equatorial diameter. Ornamentations reticulate exine $1\mu\text{m}$ thick in both taxa.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate and 7 ± 1.1 per μm^2 . The glands are rather small and they are fewer than the cover hairs. The stomas are parasitic and 18 ± 1.2 per μm^2 (Figure 1).

3.2. *E. macrophylla* Jaub. & Spach. Turkish name: İriyapraklımorgeven

It is unique species which is the biggest leaflets in the genus, inflorescence in spikes, corolla shorter than the calyx teeth.

Type: Cappadocia ad Euphratem.

IUCN category: EN. Irano–Turanian element.

The chromosome number is $2n=14$ and all chromosomes are metacentric.

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. $28.3\mu\text{m}$ in polar diameter, $16.8\mu\text{m}$ in equatorial diameter. Ornamentations reticulate, exine $1\mu\text{m}$.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. Hairs are simple and 1–2 celled. The hair walls are striate, echinate and $40-50 \pm 2.1$ per μm^2 . The glands are rather small and they are fewer than the cover hairs. The stomas are parasitic and 10 ± 1.1 per μm^2 (Figure 2).

3.3. *E. barbiger* Boiss. Turkish name: Sakallı morgeven

Sinonim: E. pogonotropis Jaub. & Spach.

It is unique species with long–bearded keel. Prostrate. Leaves with 3–4 leaflets.

Type: Denizli Babadağ.

Also growing between Kale (Denizli)–Muğla screen of *Pinus brutia* Ten. forest.

IUCN category: EN. Mediterranean element.

The chromosome number is $2n=14$ and three chromosomes have satellites.

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate, $24.6\mu\text{m}$ in polar diameter and $17.3\mu\text{m}$ in equatorial diameter. Ornamentations reticulate, exine $1\mu\text{m}$ thick

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate, echinate–granulate and 12 ± 1.2 per μm^2 . The glands are rather small and they are fewer than the cover hairs. The stomas are parasitic and 20 ± 1.1 per μm^2 (Figure 3).

3.4. *E. reesei* Hub.–Mor. Turkish name: Yatık morgeven

Synonym: *E. reesei* var *minor* **syn. nov.**

Prostrate; leaves with 2–4 pairs of leaflets; stipules longer than internodes at base; outer bracts oblong–lanceolate.

Type: Muğla: Fethiye–Dirmil, Pinetum auf mergelkalk 51 km V von Fethiye, 1000 m, limestone slopes.

IUCN category: EN. Mediterranean element.

The chromosome number is $2n=14$ and three chromosomes have satellites.

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. $27.9\mu\text{m}$ in polar diameter, $18\mu\text{m}$ in equatorial diameter. Ornamentations reticulate, exine $1\mu\text{m}$ thick

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate–granulate and 10 ± 1.5 per μm^2 . The glands are absent. The stomas are parasitic and 18 ± 1.1 per μm^2 (Figure 4).

3.5. *E. haussknechtii* Bornm. ex Hub.–Mor. Turkish name: Harput morgeveni

Prostrate; leaves with 3–4 pairs of leaflets; calyx longer than corolla.

Type= Elazığ.

IUCN category: LC. Irano–Turanian element.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. 29.1 μm in polar diameter, 17.7 μm in equatorial diameter. Ornamentations reticulate exine 1 μm thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate–granulate and 15 ± 1.2 per μm^2 . The glands are absent. The stomas are parasitic and 3 ± 1.5 per μm^2 (Figure 5).

3.6. *E. depressa* Boiss. & Bal. Turkish name: Bodurmorgeven

Plant 5–10 cm; the leaves with a pair of leaflet.

Type: Kayseri, Develi.

IUCN category: EN. Irano–Turanian element.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate, 27.8 μm in polar diameter and 17.2 μm in equatorial diameter. Ornamentations reticulate, exine 1 μm thick

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate, echinate–granulate and 17 ± 1.2 per μm^2 . The glands are very small. The stomas are parasitic and 20 ± 1.5 per μm^2 (Figure 6).

3.7. *E. bourgaei* Boiss. Turkish name: Çalımorgeven

Woody at base leaves trifoliolate at base with 5 leaflets on stem, peduncle 2–7 cm, inflorescence ovoid–oblong.

Type: Antalya, Elmalı.

IUCN category: VU. Mediterranean element.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. 28.8 μm in polar diameter, 16.8 μm in equatorial diameter. Ornamentations reticulate exine 1 μm thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate, echinate–granulate and 4 ± 1.2 per μm^2 . The glands are very small. The stomas are parasitic and 16 ± 1.5 per μm^2 (Figure 7).

3.8. *E. cappadocica* Hausskn. & Siehe ex Bornm. Turkish name: Bozkırmorgeveni

Woody at base, 5–10 cm long, leaves trifoliolate, peduncle 1–4 cm.

Type: Niğde, Çamardı–Bereketli.

IUCN category: LC. Irano–Turanian element.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. 25.2 μm in polar diameter, 17.8 μm in equatorial diameter. Ornamentations reticulate exine 1 μm thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate–granulate and 4 ± 1.6 per μm^2 . The glands are absent. The stomas are parasitic and 6 ± 1.5 per μm^2 (Figure 8).

3.9. *E. boissieri* Barbey, Turkish name: Antalyamorgeveni

Synonym: *E. candidus* G. Beck apud Stapf

20–50 cm length, leaves with 2–5 pairs of foliolate, bracts orbicular, flowers yellow.

Type: Antalya: Beydağları.

IUCN category: LC. E. Mediterranean element

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. 35.8 μm in polar diameter, 17.7 μm in equatorial diameter. Ornamentations reticulate exine 1 μm thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are echinate–granulate and 15 ± 1.2 per μm^2 . The glands are absent. The stomas are parasitic and 3 ± 1.5 per μm^2 (Figure 9).

3.10. *E. longipes* Boiss. & Balansa. Turkish name: Kayserimorgeveni

Synonym: *E. argentea* Siehe ex Bornm.

20–40 cm long, leaves 3–5 foliate at base with 2–3 pairs of leaflets, bracts ovate–orbicular.

Type: Kayseri, Develi.

IUCN category: LC. Irano–Turanian element.

The chromosome number is $2n=14$, all chromosomes metacentric.

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. $35.6\ \mu\text{m}$ in polar diameter, $18.4\ \mu\text{m}$ in equatorial diameter. Ornamentations reticulate exine $1\ \mu\text{m}$ thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate–echinate and 15 ± 1.5 per μm^2 . The glands are absent. The stomas are parasitic and 15 ± 1.2 per μm^2 (Figure 10).

E. hirsuta Jaub. & Spach Turkish name: Altınbaşmorgeveni

Leaves with 3–6 pairs of leaflets; corolla yellow.

Type: Konya, Karadağ.

IUCN category: LC. Irano–Turanian element.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. It is $30.3\ \mu\text{m}$ diameters in polar and $17.7\ \mu\text{m}$ diameter in equatorial. Ornamentations reticulate exine $1\ \mu\text{m}$ thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate, echinate–granulate and 20 ± 2.5 per μm^2 . The glands are absent. The stomas are parasitic and 5 ± 1.6 per μm^2 (Figure 11).

3.12. *E. laguroides* Boiss. Turkish name: Anadolomorgeveni

Synonym: *E. montbretii* Jaub. & Spach

Leaves with 3–5 pairs of leaflets, stipules longer than internode at base.

It has the wide distribution in the genus with purple flowers in Turkey.

Type: Sivas.

IUCN category: LC. Irano–Turanian element.

It has two varieties, var. *laguroides* where grows central Anatolia, var. *cilicica* (Boiss.) Bornm. grows around İçel province. The taxonomic position is contentious.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. $28.31.8\ \mu\text{m}$ in polar diameter, $16.3\text{–}16.7\ \mu\text{m}$ in equatorial diameter. Ornamentations reticulate exine $1\ \mu\text{m}$ thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate–echinate and 6.6 ± 1.5 per μm^2 . The glands are rather small and they are fewer than the cover hairs. The stomas are parasitic and 5 ± 2.5 per μm^2 (Figure 12).

3.13. *E. pisidica* Hub.–Mor & Reese, Turkish name: Dirmilmorgeveni

Leaves with 3–4 pairs of leaflets, outer bracts sub orbicular, calyx longer than corolla.

It is the unique species which is growing on serpentine in the genus.

Type: Burdur, Dirmil.

IUCN category: EN. E. Mediterranean element.

The chromosome number is $2n=14$

Pollen grains radially symmetrical, isopolar, tricolpate, operculate, prolate. $32.1\ \mu\text{m}$ in polar diameter, $18.8\ \mu\text{m}$ in equatorial diameter. Ornamentations reticulate exine $1\ \mu\text{m}$ thick.

The leaves are of an amphistomatic type. The stoma cells are at the same level as the epidermis. There are ornamentations in the cuticle of the epidermis cells on the upper surface of the leaf. The lower surface epidermis cell membranes are slightly wavy. The cover hairs are simple and 1–2 celled. The hair walls are striate–echinate and 15 ± 2.5 per μm^2 . The glands are rather small and they are fewer than the cover hairs. The stomas are parasitic and 5 ± 1.2 per μm^2 (Figure 13).

4. Conclusions

The morphological characteristics (Aytaç, 2000), chromosome numbers (Aksoy *et al.*, 2001) and pollen morphologies (Aytaç *et al.*, 2000), show as, not useful for differentiation of the genus members.

The trichome situation on the upper and lower surfaces of the leaves and information about the stomas of the *Ebenus* members which are endemic to Turkey were studied. Trichomes and stomata's studies not common, but they can be used for systematics studies (Alan *et al.*, 2015; Koyuncu, *et al.*, 2008).

All of the leaves have an amphistomatic structure and have parasitic stoma. The leaves of the stoma cells and the epidermis cells are the same.

The *E. cappadocica* is the only taxon that does not have cuticle decoration in the upper epidermis cells. With this characteristic, this taxon, which resembles *E. bourgaei* morphologically, can be easily differentiated within the genus.

The taxa are collected under two groups according to the characteristics of the hair wall structures:

1. The taxa, which have striate–echinate hair walls: *E. plumosa*, *E. macrophylla*, *E. reesei*, *E. haussknechtii*, *E. depressa*, *E. bourgaei*, *E. cappadocica*, *E. laguroides* and *E. pisidica*.
2. The taxa, which have striate–echinate–granulate hair walls: *E. barbigera*, *E. boissieri*, *E. longipes*, *E. hirsuta* and *E. laguroides*.

Except *E. reesei*, *E. haussknechtii*, *E. cappadocica* and *E. hirsuta*, all taxa have glandular structures on leaves.

The stomas in all of the taxa have a parasitic characteristic. Furthermore, since the taxa grow in areas having a steppe land characteristic, the numbers of stomas in the unit area are also almost the same. It is not possible to group the taxa with the stomatic characteristics. In conclusion, it is observed that rather good results were provided in the studies made with the EM for the hairiness characteristic, which is accepted as simple hair and which is thought that it could not be used in the differentiation of taxa. In particular, it was observed that the trichome wall structures and the cuticle ornamentations in the epidermis cells within the *Ebenus* genus were distinguishable.

Anatomical studies as trichoms, stoma, pollen and chromosome morphologies will lead to a better understanding of the species, and provide a contribution to systematics studies.

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Table 1. The collection localities

Taksonlar	Localitions	altitute (m)	Habitat	Collectr numbers
<i>E. macrophylla</i>	B ₆ Sivas:Zara–Divriği	1386	Gypseous soil	Z. Aytaç, 9145
<i>E. plumosa</i> var. <i>plumosa</i>	C ₂ Antalya: Elmalı–Kokuteeli, 25. km	1470	Dry slopes	Z. Aytaç, 7420
<i>E. plumosa</i> var. <i>speciosa</i>	C ₄ Karaman: Ermenek–Mut, 1.km	1300	Dry rocky limestone slopes with <i>Quercus coccifera</i> shrubs	Z. Aytaç, 7581
<i>E. barbiger</i>	C ₂ Muğla: Kale–Muğla, 24. km	1150–1170	Limestone rocks, screen of <i>Pinus nigra</i> forest	Z. Aytaç, 7385
<i>E. reesei</i>	Burdur : Dirmil Fethiye road, 41.km	1030	Protected area, limestone slopes	Z. Aytaç 7664
<i>E. haussknechtii</i>	B ₇ Elazığ: Keban road, çakmaklı geçidi	1310	Steppe, dry river bed	Z. Aytaç, 7483
<i>E. depressa</i>	B ₆ Sivas: Darende–Gürün 24. km	11400	Rocky places	Z. Aytaç, 7479
<i>E. bourgaei</i>	C ₂ Burdur–Antalya road, 3. km	1030	<i>Quercus coccifera</i> bushes	Z. Aytaç, 7767
<i>E. cappadocica</i>	C ₄ Konya: Ereğli, around İvriz damp	1250	Protected area	Z. Aytaç, 7597
<i>E. boissieri</i>	C ₂ Antalya: Elmalı–Korkuteli, Beyiş village.	1470	Near field	Z. Aytaç, 7421
<i>E. longipes</i>	B ₅ Kayseri: Sarız, Yalak, Binboğa Mountain	1600	Stony slopes, steppe	Z. Aytaç, 5131
<i>E. hirsuta</i>	C ₄ Konya: Karapınar, Erosion protected area	1000–1100	Stony limestone slopes, rocks, protected area	Z. Aytaç, 3095
<i>E. laguroides</i>	B ₆ Kayseri: Göksun–Sarız, 20 km.	1500–1650	Steppe, rocky slopes	Z. Aytaç, 8587
<i>E. pisidica</i>	C ₂ Burdur: Altınyayla pass	1650	Serpentine, <i>Pinus nigra</i> forest	Z. Aytaç, 7784

FIGURES

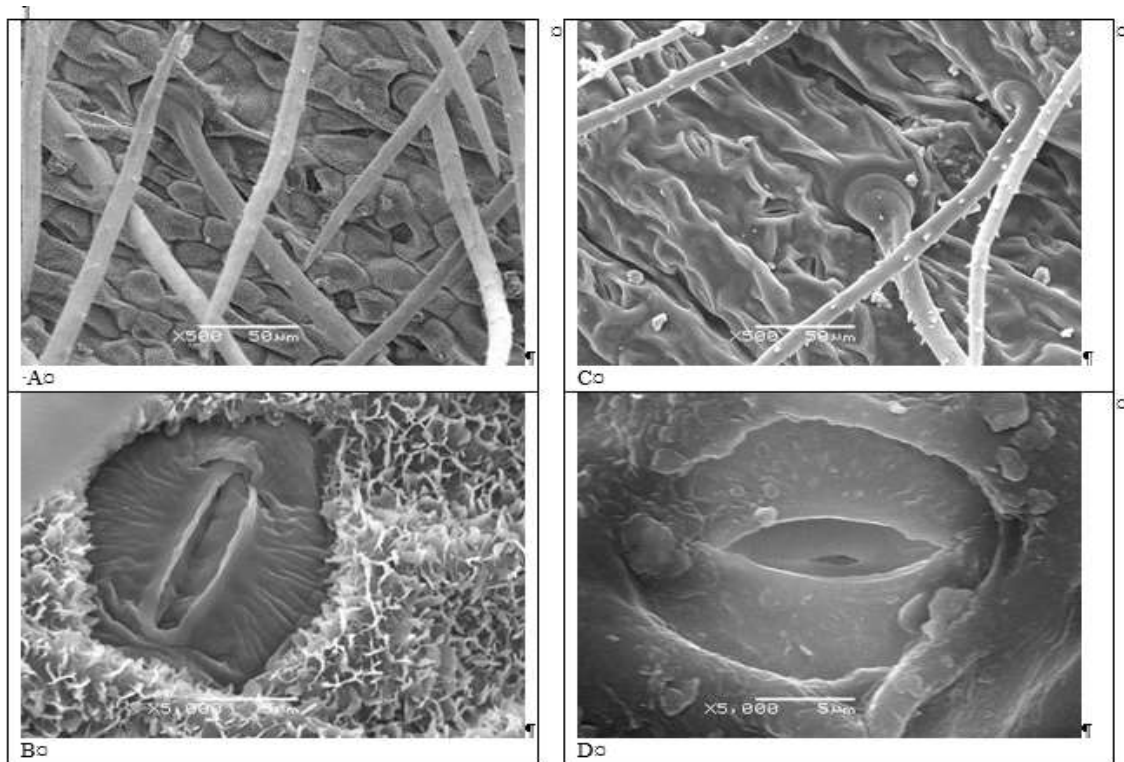


Figure 1. *E. plumosa* Boiss. & Heldr. Upper surface of leaves, A–The cuticular decoration and trichome, B–Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D–Stoma

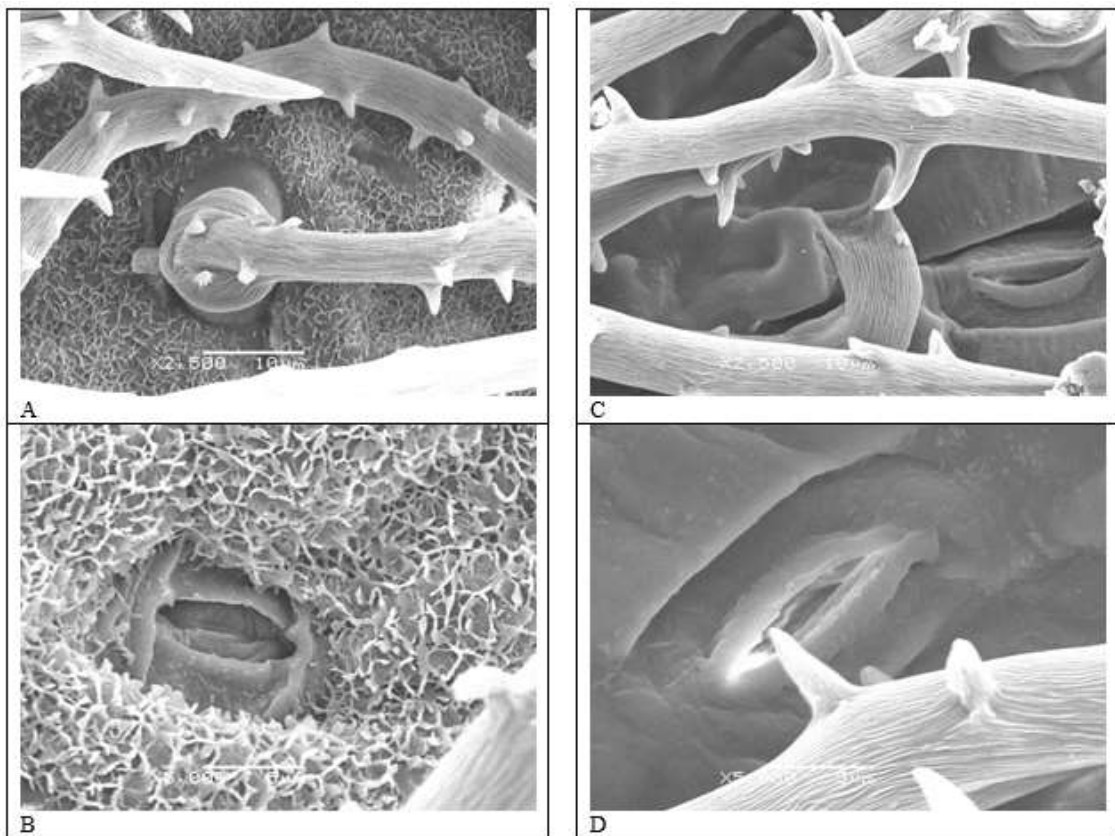


Figure 2. *E. macrophylla* Jaub. & Spach. Upper surface of leaves, A–The cuticular decoration and trichome, B–Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D–Stoma

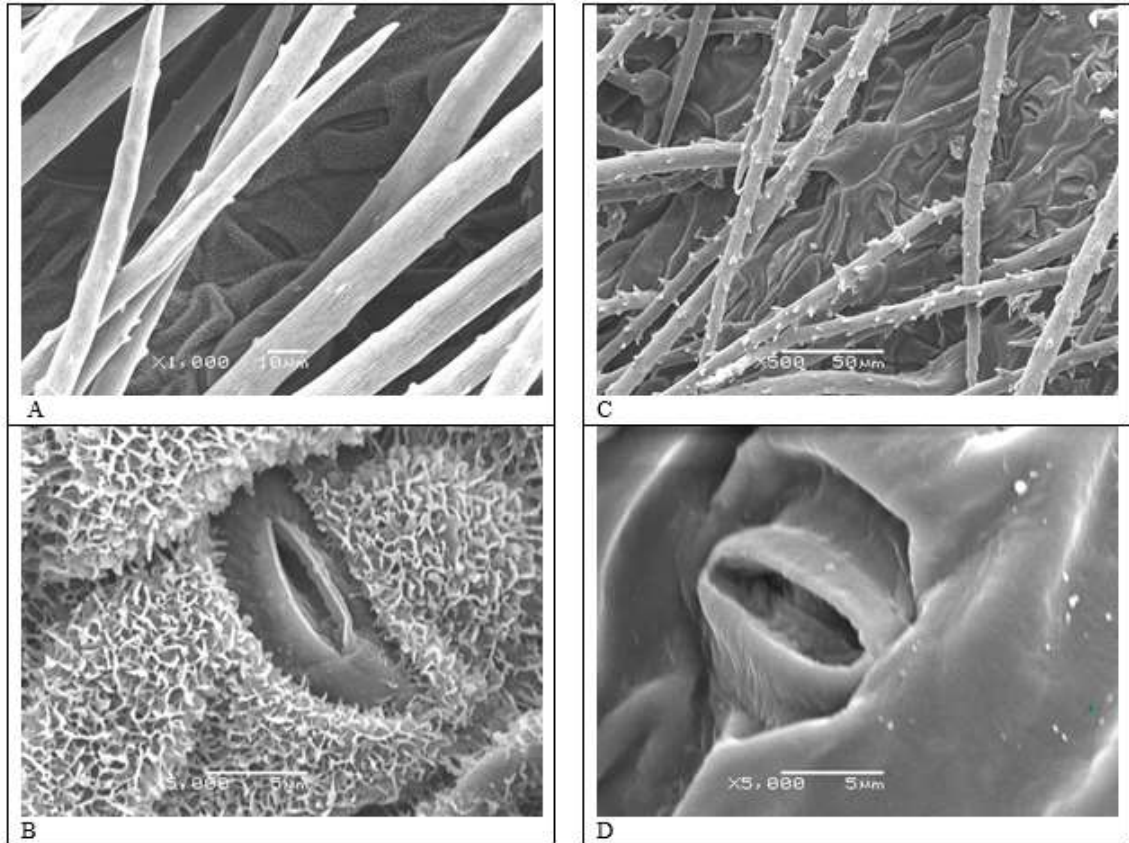


Figure 3 *E. barbiger* Boiss. Upper surface of leaves, A–The cuticular decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D– Stoma

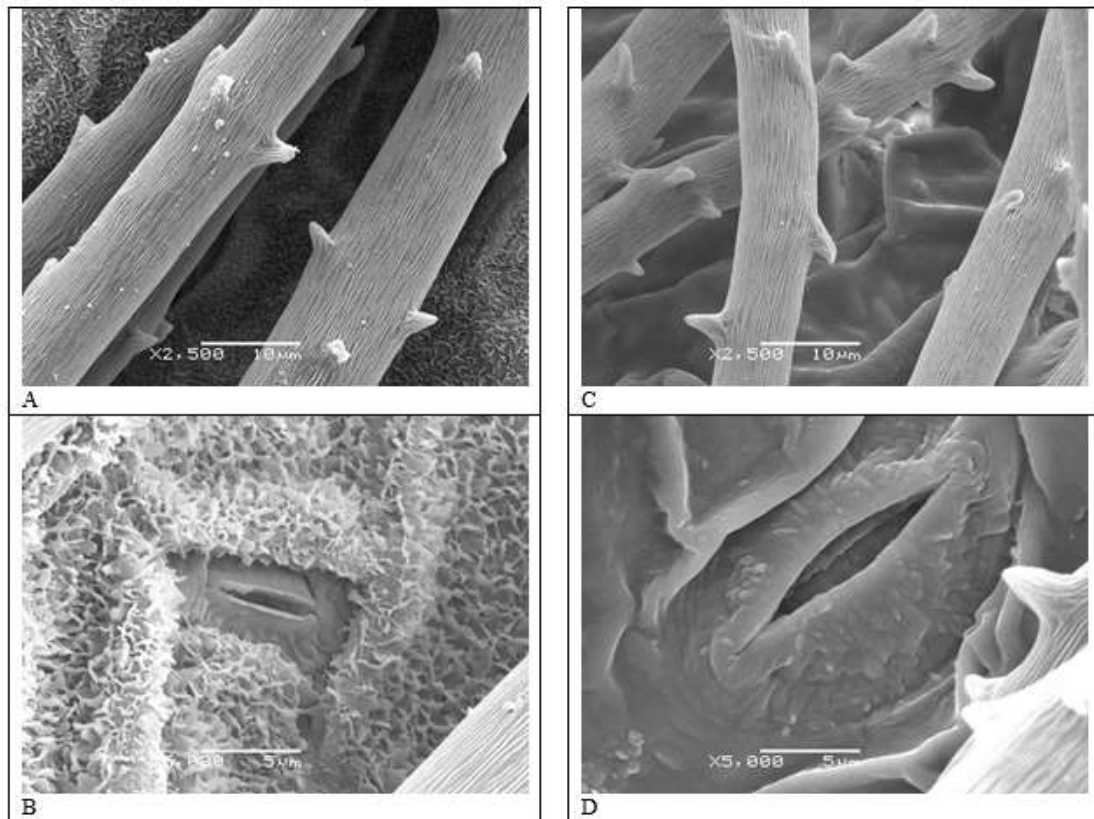


Figure 4 *E. reesei* Hub.–Mor. Upper surface of leaves, A–The cuticular decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D– Stoma

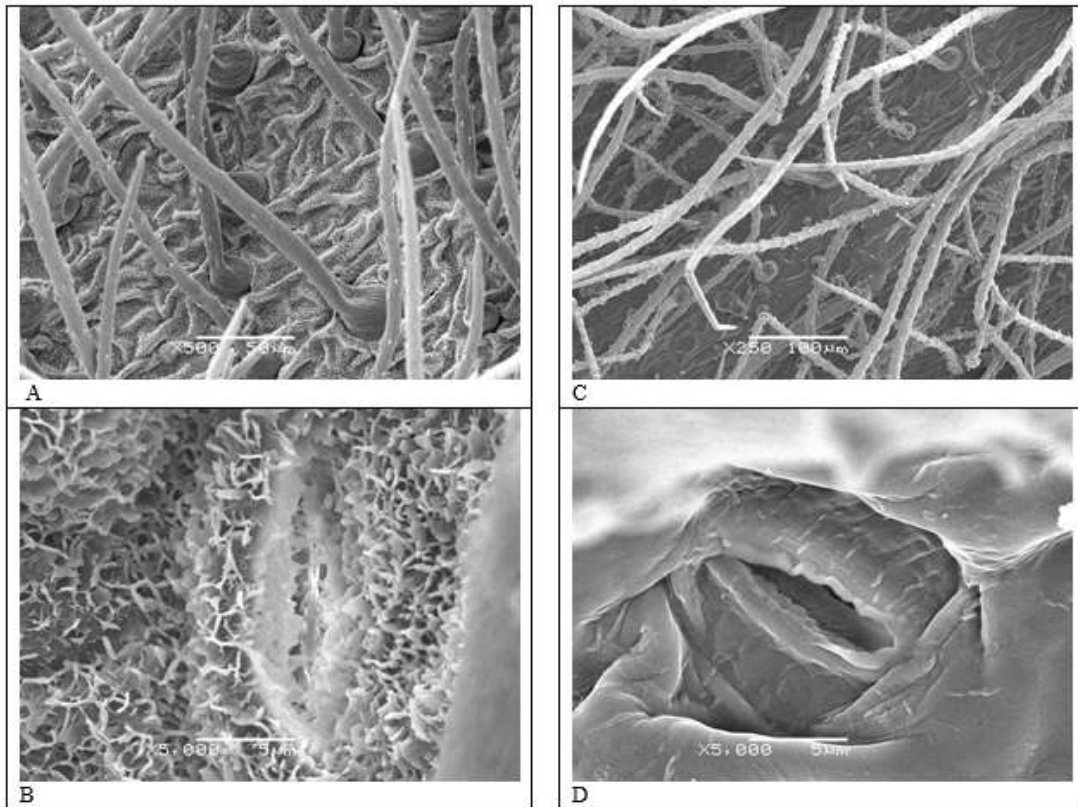


Figure 5. *E. haussknechtii* Bornm. ex Hub.–Mor. Upper surface of leaves, A–The cuticular decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D– Stoma

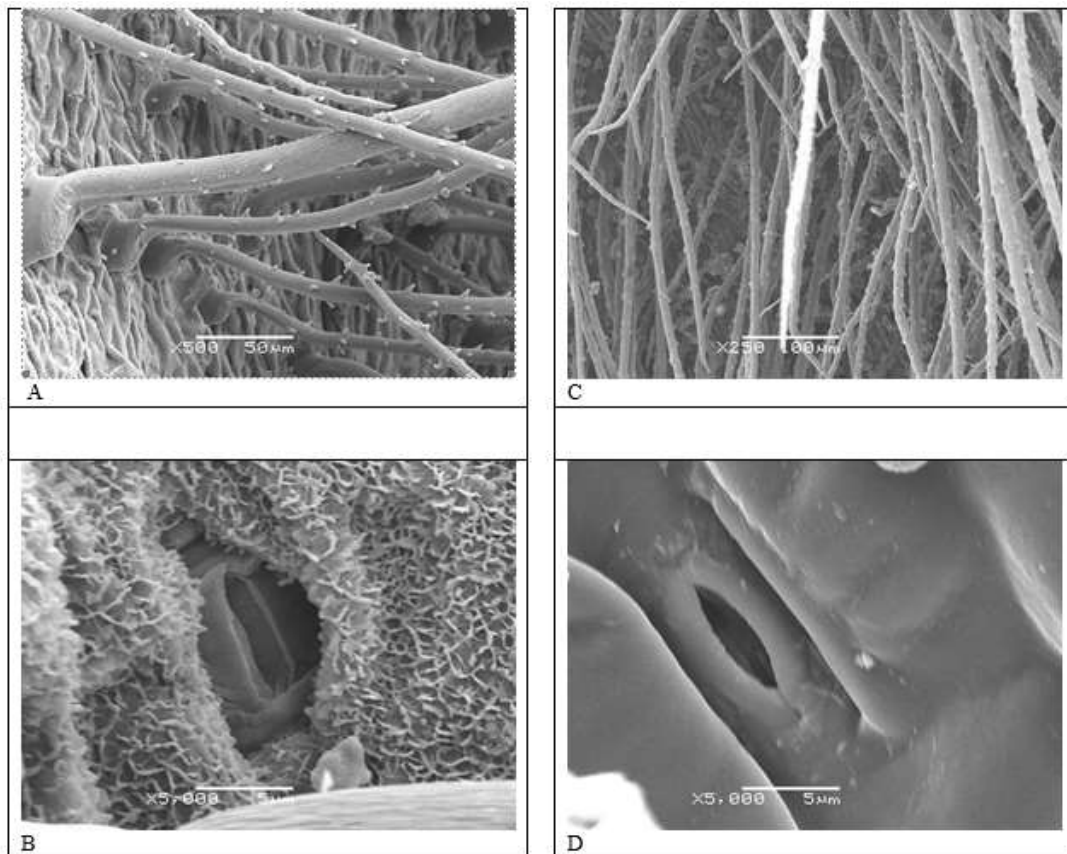


Figure 6. *E. depressa* Boiss. & Bal. Upper surface of leaves, A–The cuticular decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D– Stoma

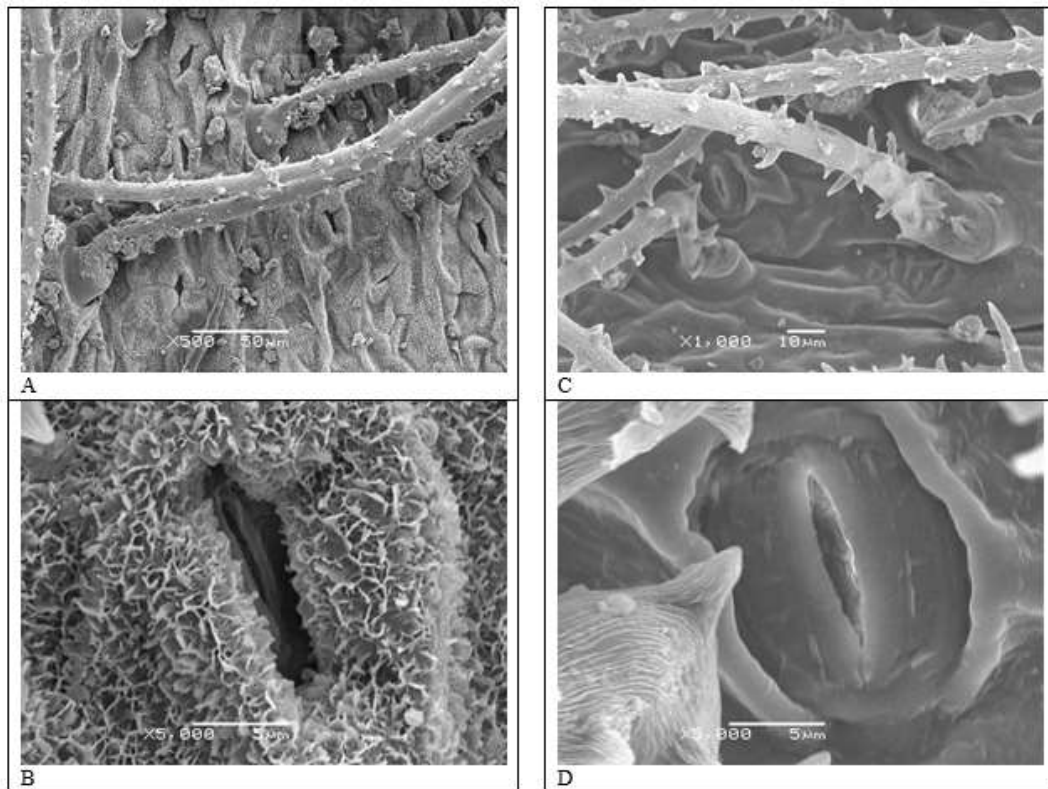


Figure 7. *E. bourgaei* Boiss. Upper surface of leaves, A–The cuticulare decoration and trichome, B– Stoma; over surface of leaves, C–The cuticulare decoration and trichome, D– Stoma

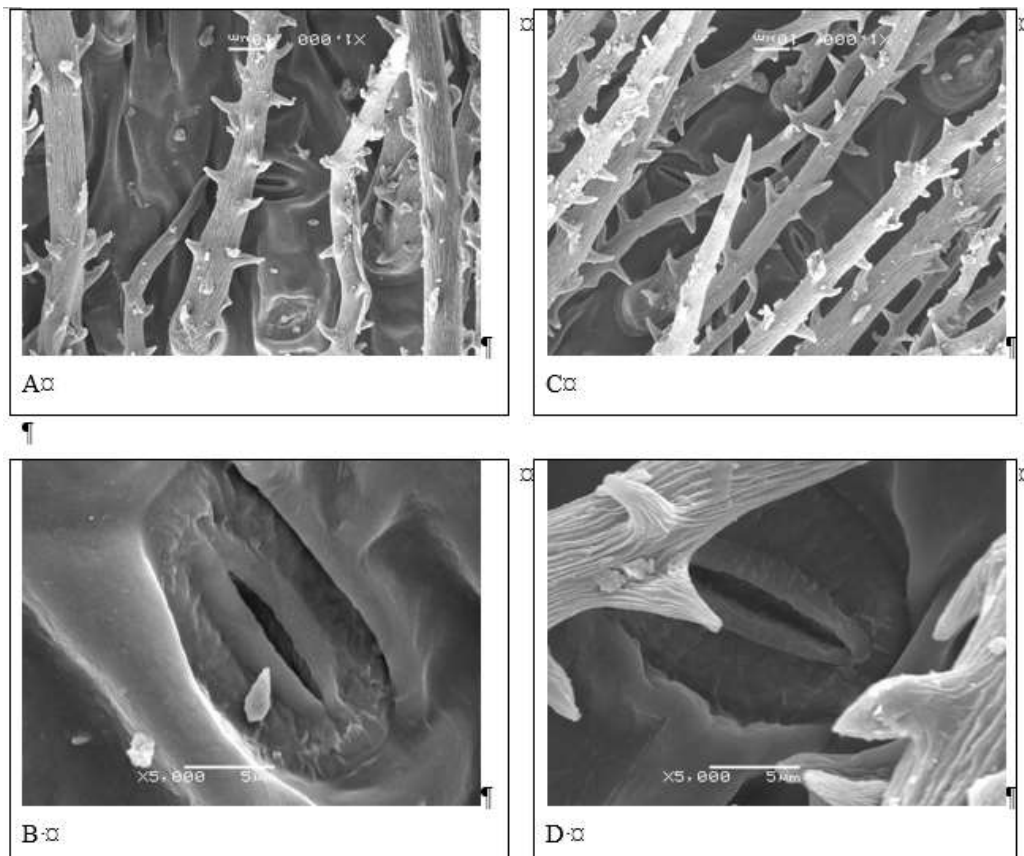


Figure 8. *E. cappadocica* Hausskn. & Siehe ex Bornm. Upper surface of leaves, A–The cuticulare decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticulare decoration and trichome, D– Stoma

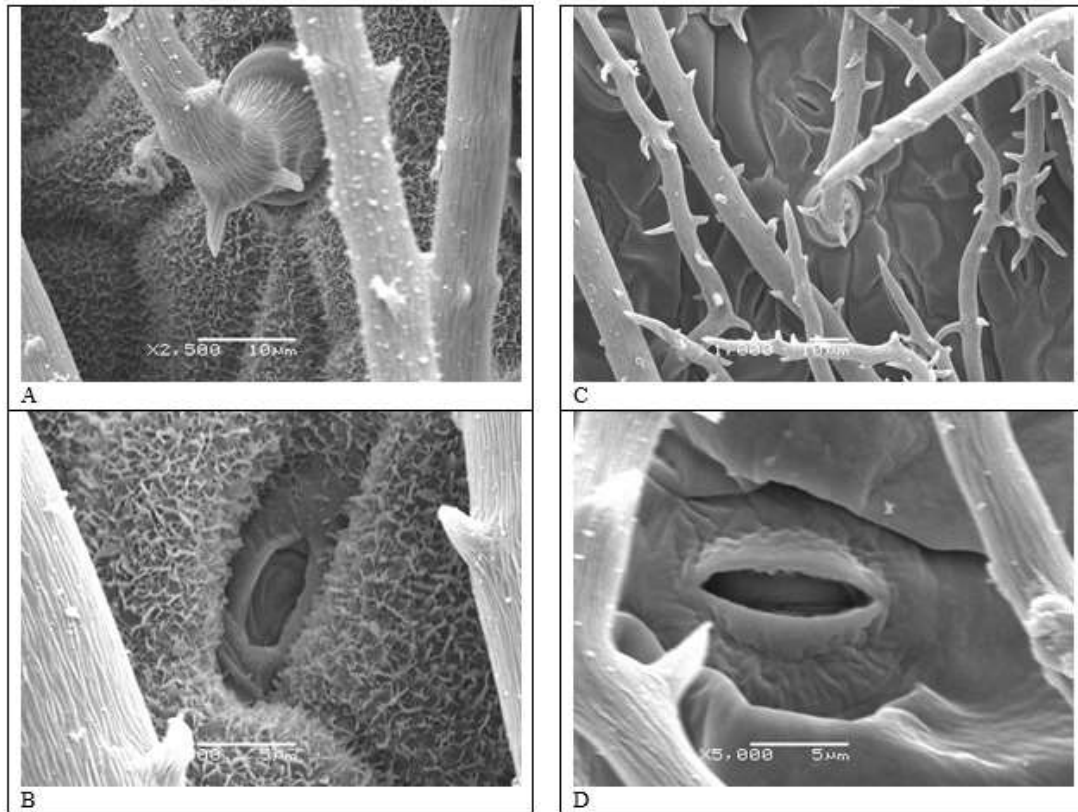


Figure 9. *E. boissieri* Barbey Upper surface of leaves, A–The cuticulare decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticulare decoration and trichome, D– Stoma

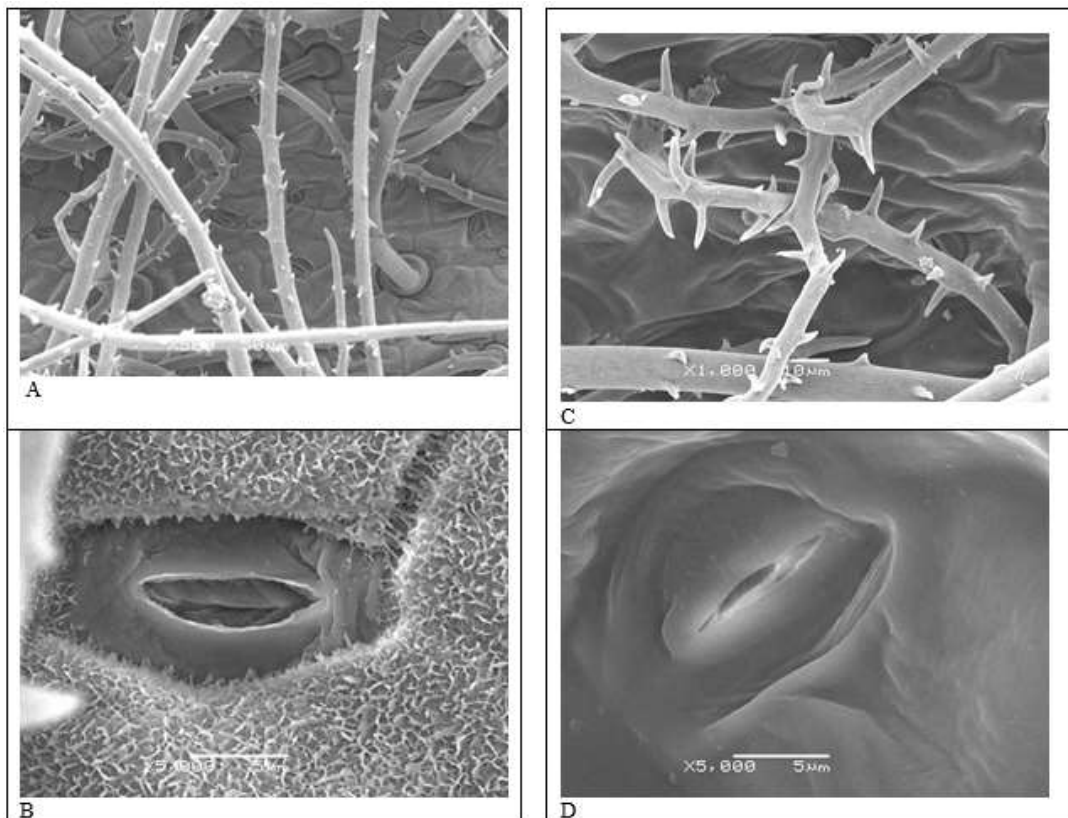


Figure 10. *E. longipes* Boiss. & Bal. Upper surface of leaves, A–The cuticulare decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticulare decoration and trichome, D– Stoma

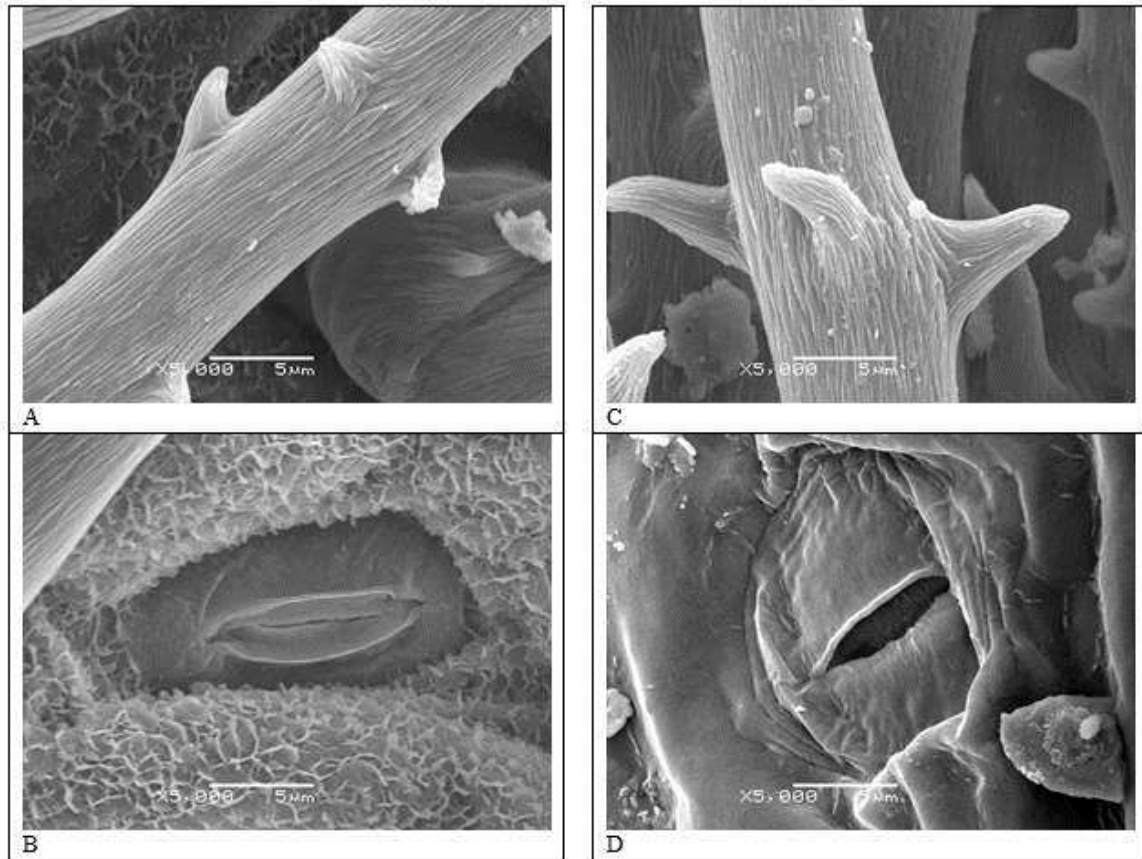


Figure 11. *E. hirsuta* Jaub. & Spach Upper surface of leaves, A–The cuticular decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D– Stoma

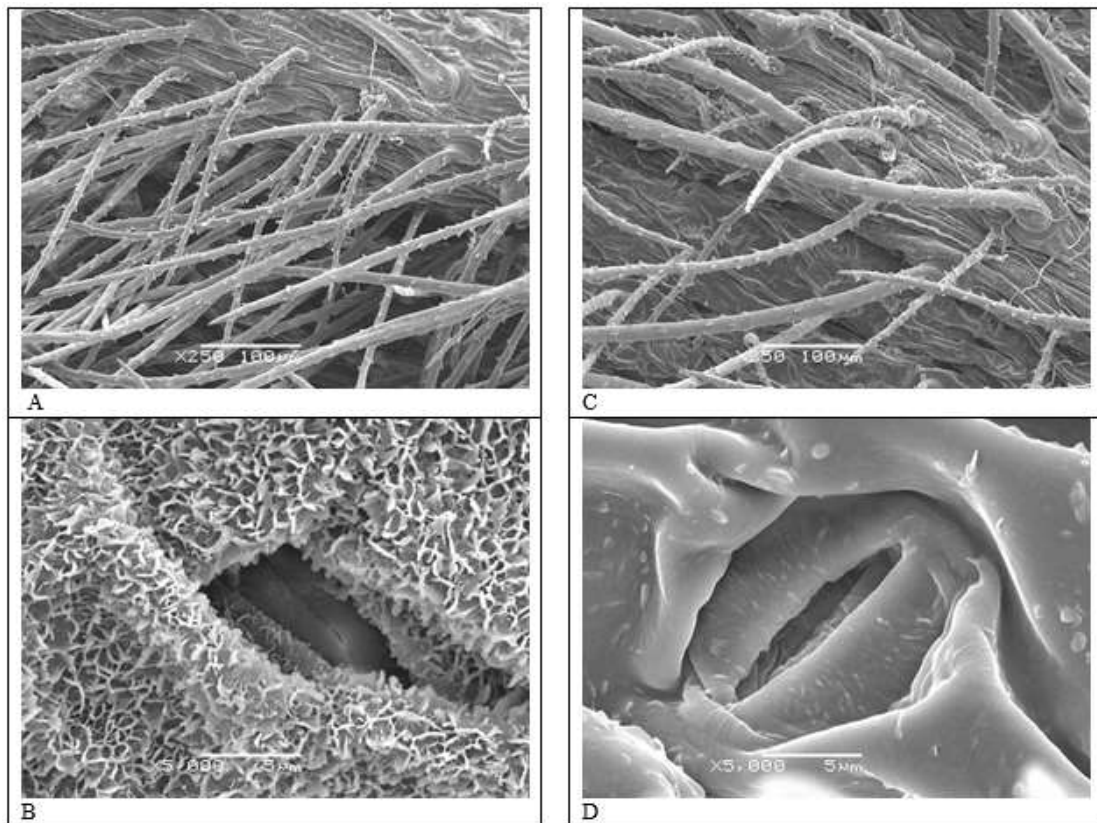


Figure 12. *E. laguroides* Boiss. Upper surface of leaves, A–The cuticular decoration and trichome, B– Stoma; Lower surface of leaves, C–The cuticular decoration and trichome, D– Stoma

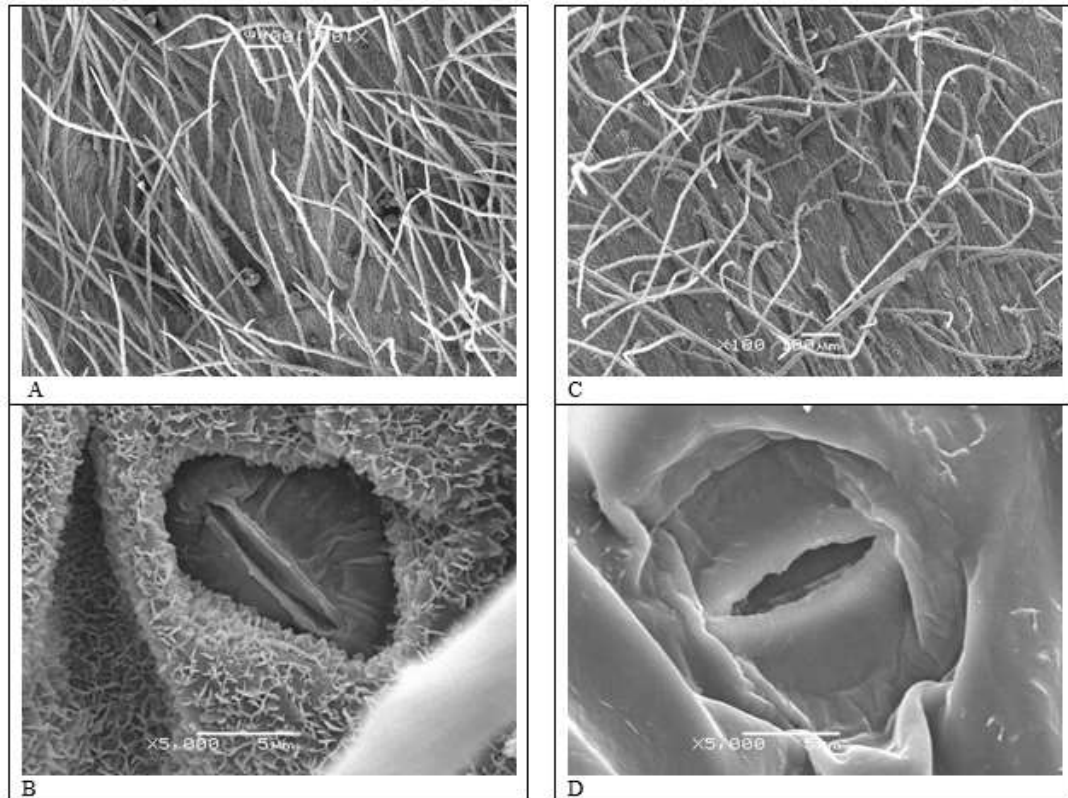


Figure 13 . *E. pisidica* Hub.–Mor & Reese, Upper surface of leaves, A–The cuticulare decoration and trichome, B–Stoma; Lower surface of leaves, C–The cuticulare decoration and trichome, D– Stoma

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