

## SOME COMPARATIVE BIOLOGICAL CHARACTERISTICS OF TWO *Euphorbia* TAXA (Subgen: *Chamaesyce*) OFTEN MISTAKEN IDENTITY IN CENTRAL ANATOLIA-TURKEY

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**ABSTRACT.** In this study, anatomical and morphological characteristics of *Euphorbia maculata* L. and *E. chamaesyce* L. taxa belonging to *Chamaesyce* subgenus of *Euphorbia* genus were investigated. In the morphological examinations, some other phenological features were determined by biometric measurements of taxa. Taxonomic importance of *Euphorbia* L. genus, seed length, seed shape, seed surface decorations, seed color and presence or absence of carrots were photographed. The morphological characters were compared with the literature data and discussed. In addition, anatomical features taken from roots, stems and leaves of taxa and anatomical features were examined and compared in detail. Thus, the morpho-anatomical properties of *E. maculata* (Spotted spurge) (Syn: *E. supina*) L. and *E. chamaesyce* (Syn: *E. canescens*; *E. massiliensis*) L. taxa were determined and compared for the first time. Data was provided to the studies related to this study and data was provided to plant taxonomy by contributing to the identification, recognition and protection of floristic diversity.

**Keywords:** *Euphorbia maculata*, *Euphorbia chamaesyce*, anatomy, morphology, palynology, biodiversity, taxonomy, Turkey

### INTRODUCTION

*Euphorbia* L. genus, which is represented by approximately 340 genera and 7500 species in the world, is the richest genus of the family with approximately 2000 species [1-4]. The genus *Euphorbia* can be annual, biennial or perennial. Geofit, herbaceous, bushy, groundcover, succulent and drought taxa, including one-year creep plants up to 30 meters long succulent tree forms can contain many different forms [5]. Since the genus *Euphorbia* is a genus with many species, it has many different forms in terms of morphological features. All species contain white latex and are mostly toxic. *Euphorbia*'s latex which has irritant properties and has a strong laxative effect contains resin, rubber, starch, cyanide and enzymes. Milk is used externally against warts and as a pain reliever in rheumatic pains [7]. If a latex injury leaves the plant, it clots. This has two benefits to the plant. In this way, while the wound area is closed, on the other hand, the attack of bacteria and fungi is prevented due to the antiseptic properties of latex [8].

The flower structure of the genus *Euphorbia* is called catium. Like hermaphrodite flower structure, catium is a specialized structure consisting of highly reduced male flowers that surround a single female flower [5-9,10]. Gerhard Prenner and Paula Rudall (2007) compared the closest relatives of *Euphorbia* using scanning electron microscopy, examining the earliest stages of its development and attempting to reveal the origin of sciatium. They followed the origin of the relatives of *Euphorbia* from the Old World

(Australia, New Caledonia, Africa and Madagascar) and found that the sciatica; They concluded that the main axis may have evolved by a more open grouping of indeterminate, a terminal female flower surrounded by male flower sets, often called a cluster of cylindrical or ovoid shaped, branched flowers, whose side axes are determinant. Prenner and Rudall (2007) suggested that the most surprising suggestion of catium is neither a flower nor a flower state, but rather a hybrid: hybrid that overlaps the individual flower in their flowering state by regulating genes that control their own characteristics [11].

In all species of the Euphorbiaceae family, histologically, the seeds contain small radially elongated cells consisting of hard walls [12]. The fruits of the genus *Euphorbia* form three seeds and the seeds vary widely in size, shape and surface characteristics. Due to the wide variety, some studies have identified key identification keys based solely on seed characteristics [13]. Fruit and seed characteristics are used to distinguish the species that are closely related to each other. In addition, the seeds usually carry the caruncula in the apical portion of the seed. Existence or absence of caruncula, shape, color are important taxonomic characters used in systematic identification and comparison of species [5-9,10].

The genus *Euphorbia* consists of *Esula*, *Chamaesyce*, *Euphorbia* and *Rhizanthium* [14]. The genus *Chamaesyce* was originally classified as the *Anisophyllum* genus by Haworth (1812), but was later described as the *Chamaesyce* subgenera by Rafinesque (1817) [15,16]. The subspecies of *Chamaesyce* contain about 250 species, most of which are woody forms. Species within the *Chamaesyce* subgenus typically have an apical meristem that does not have early cleavage or does not have apical meristems. Therefore, the members of this sub-genus are found in the form of simpodial branched small grass. The distribution areas are mostly the deserts and coastal regions of the tropical American and Polynesian islands [17].

*E. maculata* shows naturally in Eskişehir, Hatay, Bursa (Turkey) province and *E. chamaesyce* shows naturally Eskişehir, Adana, İstanbul, Ankara, Antalya, İzmir, Diyarbakır, Hatay, Isparta, Manisa, Muğla, Tunceli, Karaman (Turkey) (Figure 1, 2) [18].

In this study, anatomical and morphological characteristics of *Euphorbia maculata* L. and *E. chamaesyce* L. taxa belonging to *Chamaesyce* subspecies of *Euphorbia* genus were investigated. In the morphological examinations, some other phenological features were determined by biometric measurements of taxa. Taxonomic importance of *Euphorbia* L. genus, seed length, seed shape, seed surface decorations, seed color and presence or absence of carrots were photographed. The morphological characters were compared with the literature data and discussed. In addition, anatomical features taken from roots, stems and leaves of taxa and anatomical features were examined and compared in detail. Thus, the morpho-anatomical properties of *Euphorbia maculata* L. and *E. chamaesyce* L. taxa were determined and compared for the first time. Data was provided to the studies related to this study and data was provided to plant taxonomy by contributing to the identification, recognition and protection of floristic diversity.

## MATERIALS AND METHODS

The samples of *E. maculata* used in the study were B3 Eskişehir, Eskişehir Osmangazi University Meselik Campus on 26.08.2019, 39° 44' 58" N-30° 29' 17" E, 830 m, and *E. chamaesyce* samples on 12.08.2019. Eskişehir, Eskişehir Metropolitan Municipality Asri Cemetery was collected from 39° 43' 21" N-30° 32' 01" E, 942 m *E. maculata* (ESK 2727)

and *E. chamaesyce* (ES 2728) are stored in Herbarium of Eskişehir Osmangazi University. Flora of Turkey and the East Aegean Islands were used during the identification of the samples. Morphological findings were obtained from measurements made from fresh plant samples. *Euphorbia* L. seed length, shape, surface decorations, color; The presence, absence, shape, length and color of the carunculus are important taxonomic characters used to systematically identify and compare species. In this respect, *E. maculata* and *E. chamaesyce* specimens were photographed by examining the seed shape, seed surface, seed color and presence or absence of carunula. In anatomical examination, materials which were stored in 70% alcohol were used. Photographs of cross-sections taken from roots, stem and leaves and superficial sections taken from leaves were taken with Nikon 80i type microscope with Kameram digital camera in Eskişehir Osmangazi university Faculty of Science and Letters Biology Department.

For micro morphological studies, the micro morphologies of the seed and leaf surfaces were visualized using scanning electron microscopy. Since there is no micro morphological difference between the seed dorsal and ventral surfaces, the dorsal part was preferred for surface shots. Trichome and stomata shoots were made on the lower and upper surfaces of the leaf.

In the pollen morphology studies, the investigation of current pollen was made by Wodehouse, 1935 method, and the examination of fossil pollens by Erdtman, 1969 method. Morphological examination of the pollens was made under Prior Binocular microscope, immersion objective (x100). 50 times measurements were made for all parameters to determine the average values. Standard deviation and variations have been calculated. In ocular micrometer, each range is 0.98  $\mu\text{m}$ . Micro photographs were taken with a Nikon 80i type microscope and a KAMERAM Digital camera in the Department of Biology, Faculty of Science and Letters, Osmangazi University. The magnification of the photographs is x 1000. Various basic palynological books and various studies have been used for the diagnosis of pollens.

### Distribution

Distribution in Turkey *Euphorbia maculata* and *E. chamaesyce* by taxa shown in figure 1 and figure 2. *Euphorbia maculata* has 3 known localities. *E. chamaesyce* of the known There are 13 different localities in Turkey.

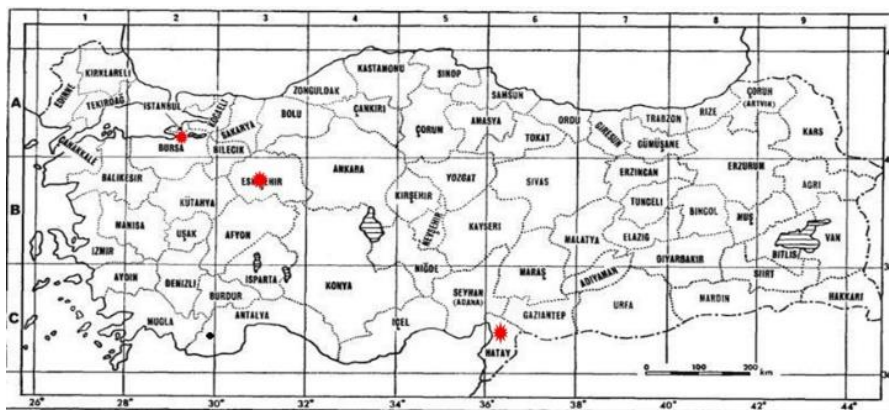
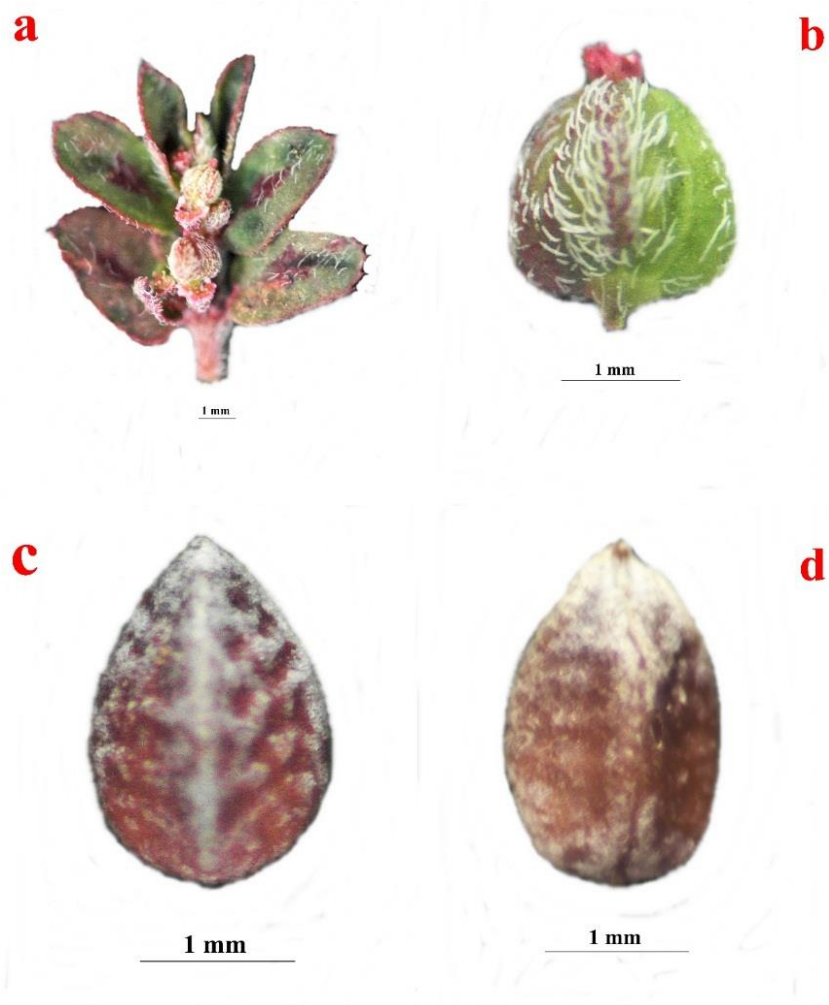


Fig. 1. Distribution map of *E. maculata* in Turkey



Involucrum campanulate, pubescent; glands transverse ovate, reddish brown, small, white or pinkish petaloid attachments. Fruits pubescent obliquely in a small amount of 1.2-1.5 mm. Seeds ovoid-quadrangular 0.6 mm transverse corrugated brown. There is no caruncula (Figure 4) [18]. Species predominate in sandy and rocky soils, waste sites, highways and railway lines, weeds in gardens, cereals, arable areas, pastures, stone walls, pavements, cracks in the asphalt cover of roads, sandy areas. Its roots can reach a depth of 50-60 cm and are drought-resistant [19].



**Fig. 4.** Fruit and seed of *E. maculata* (**a:** cationium; **b:** fruit; **c:** dorsal of seed; **d:** ventral of seed)

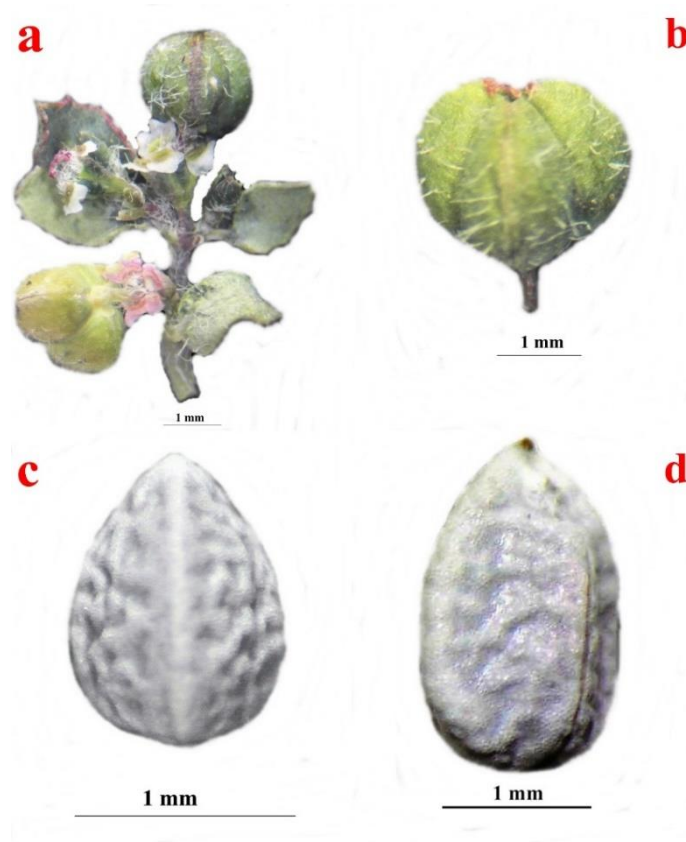
#### *Euphorbia chamaesyce*

Annual, hairy, prostate-shaped, 15 cm long. The leaves may be suborbiculate-ovate or ovate-oblong, filiform or linear stipulated, serrate towards the top of the leaf edges, the base of which is asymmetrical. Leaf length 1-7 x 1-4 mm. Stipulate linear-filiform 1 mm (Figure 5).



**Fig. 5.** General view of *E. chamaesyce* in nature

Glands are suborbiculate and hornless. They carry white or pink sciatic leaves. Fruits are flat surface and partially pubescent, 1.5-2 mm in size. Seed ovoid or rectangular shaped, tubular-rugulose irregular surface, 1-1.2 mm, color pale gray. There is no caruncula (Figure 6) [18]. They spread on rocky slopes, salty and sandy soils, fields, gardens and roadsides [17].



**Fig. 6.** Fruit and seed of *E. chamaesyce* (**a:** cationium; **b:** fruit; **c:** dorsal of seed; **d:** ventral of seed)

The morphological findings (stem, leaves, stipule, gland, fruit, seed and caruncle) of the taxa examined in this study and the comparison with the morphological findings revealed in previous studies [Radcliffe-Smith (1982)] are shown in Table 1. Thus, new morphological determinations were made for *E. maculata* an *E. chamaesyce*.

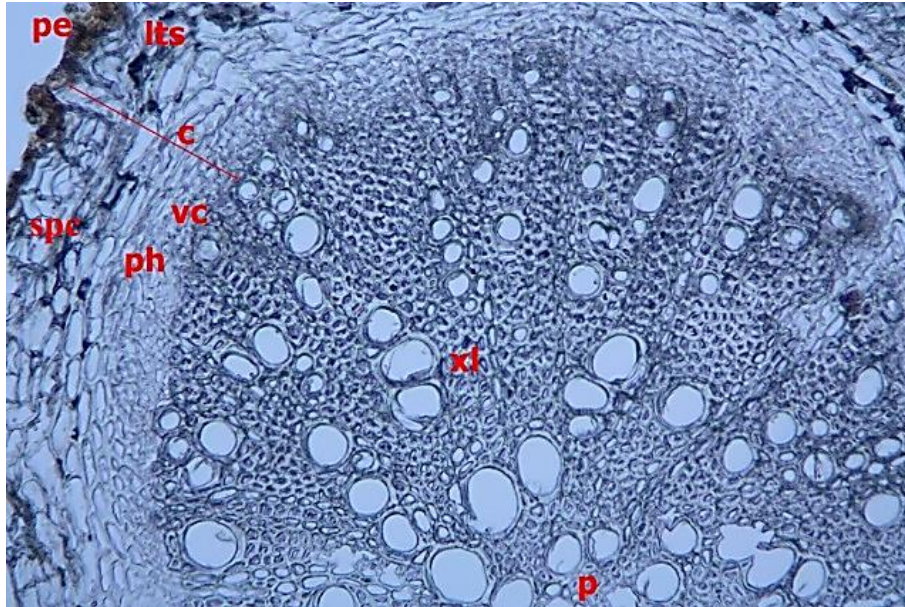
**Table 1.** Comparison of morphological characters obtained from *E. maculata* and *E. chamaesyce* species with literature data

Morphological Characters	<i>E. maculata</i> This study	<i>E. maculata</i> Radcliffe-Smith (1982)	<i>E. chamaesyce</i> This study	<i>E. chamaesyce</i> Radcliffe-Smith (1982)
<b>Stem</b>	Prostrate, hairy, annual, branches, 10-20 cm	Prostrate, pubescent, annual, branches 10-45 cm	Prostrate, hairy, annual, branches, 15-25 cm	Glabrous or pubescent, somewhat glaucous annual, branches up to 30 cm
<b>Leaves</b>	Falcately, elliptic, oblong, 4-7 x 2-3 mm	Subfalcately, elliptic-oblong to linear-oblong, obtuse, serrulate, asymmetrical at base, 4-9 x 1.5-4 mm	Ovate to oblong, oblique at base, 1-7 x 1-4 mm	Suborbiculat-ovate to ovate-oblong, obtuse to emarginate, oblique at base, 1-11 x 1-6 mm
<b>Stipule</b>	Linear-lanseolate, 1.2-17 mm	linear-lanseolate to linear or filiform, sometimes 2-3-partite lacinate or fimbriate, 1.5 mm	Linear-filiform	Linear-filiform, 1 mm
<b>Gland</b>	Transverse ovate, reddish-brown small white or pinkish petalloid appedages	Transversely ovate, reddish-brown, with small white or pinkish petalloid appedages suborbicular-transversely ovate	Suborbiculate, transversly ovate, yellowish- or reddish-brown, with White or pinkish petalloid appedages	Suborbiculate, transversly ovate, yellowish- or reddish-brown, with White or pinkish petalloid appedages
<b>Fruit</b>	1.2-1.5 mm, adpressed-pubescent	1.5 mm diam, sparingly adpressed-pubescent	1.5-2 mm, pubescent	2 mm diam
<b>Seed</b>	Ovoid-quadrangular, 0.8 mm, transverly grooved, brown ,0.6 mm	Ovoid-quadrangular, 0.8 mm, transverly grooved, brown	Ovoid-quadrangular, 1,2 mm, irregular tuberculate-rugulose, pale-grey 1-1.2 mm	Ovoid-quadrangular, 1.2 mm, irregular tuberculate-rugulose, pale-grey
<b>Caruncle</b>	absent	-	absent	-

## Anatomy

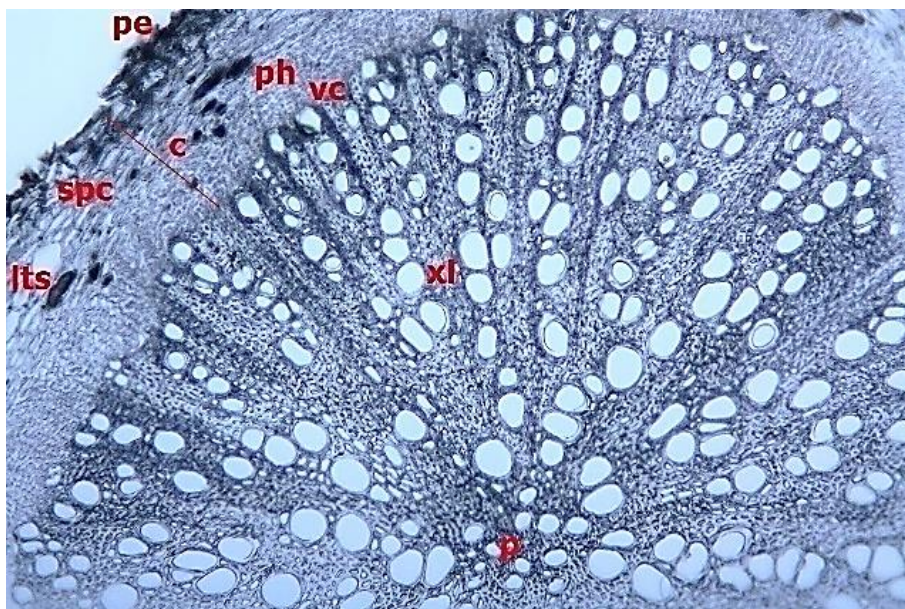
### Root

When the cross-section from *E. maculata* root is examined, it is seen that the root shows secondary root structure. The outermost protective tissue is periderm. Immediately beneath the periderm layer is the crushed epidermis. Just below the epiderma is a layer of cortex consisting of 10-12 rows of crushed parenchymatic cells. Parenchyma cells include secretory channels called lattices. Phloem elements and cambium could not be clearly distinguished. The xylem elements are enlarged to cover the core and are thick-walled (Figure 7).



**Fig. 7.** Root cross-section of *E. maculata* (pe: periderma; c: cortex; lts: laticifer; vc: vascular cambium; spc: crushed parenchyma cells; ph: phloem; xl: xylem; p: pith)

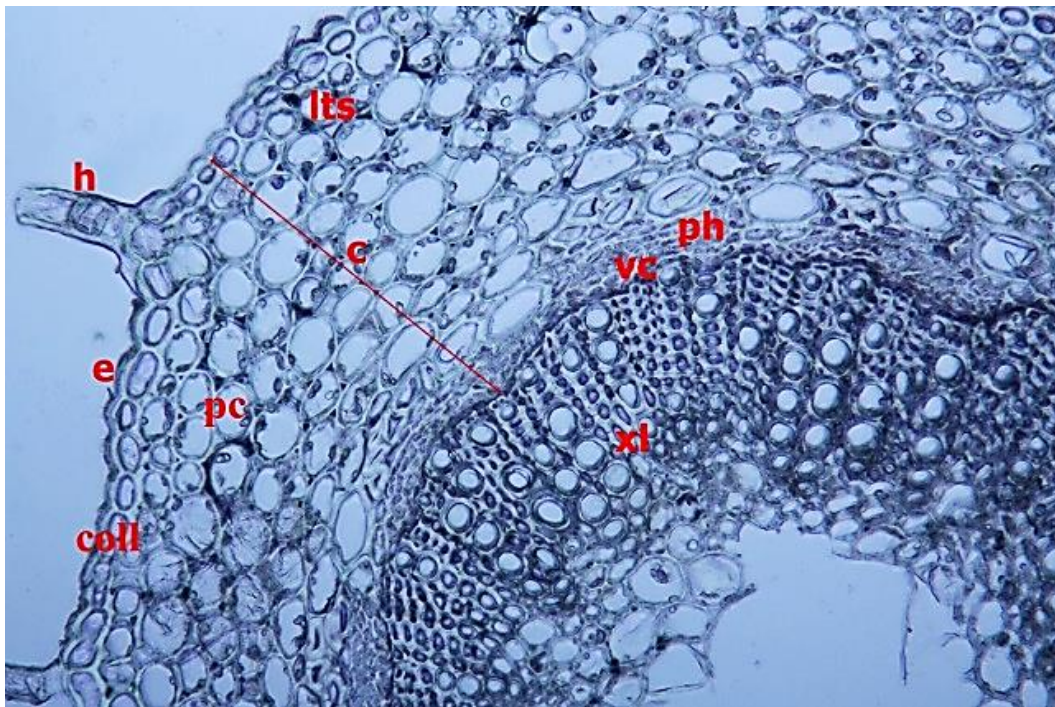
When the cross-section taken from *E. chamaesyce* root is examined, the outermost protective tissue is periderm. Immediately beneath the periderm layer is the crushed epidermis. The cortex layer consisting of 8-10 rows of crushed parenchymatic cells is located just below the epiderma. Parenchyma cells include secretory channels called lattices. Phloem elements were located just below the cortex, while phloem elements and cambium could not be clearly distinguished. The xylem elements are enlarged to cover the core and are thick-walled (Figure 8).



**Fig. 8.** Root cross-section of *E. chamaesyce* (pe: periderma; c: cortex; lts: laticifer; vc: vascular cambium; spc: crushed parenchyma cells; ph: phloem; xl: xylem; p: pith)

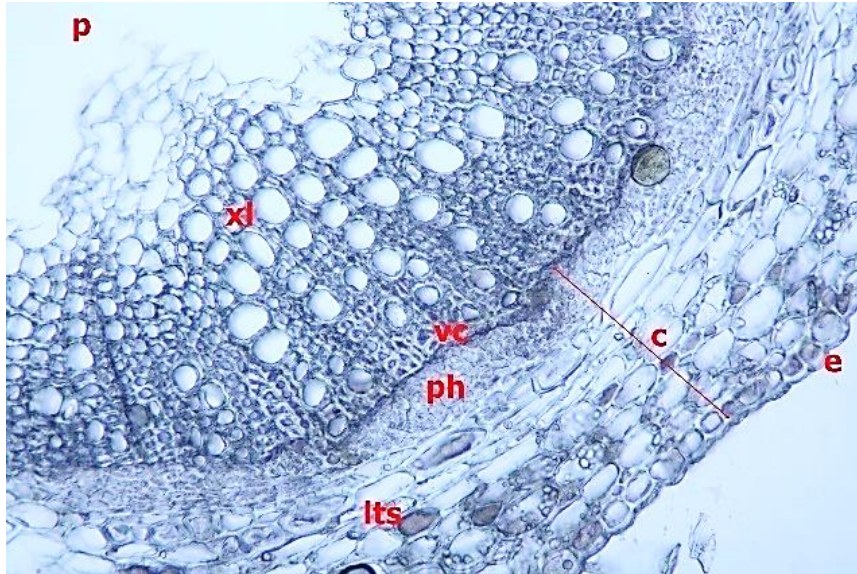
### Stem

In the cross-section of the body of *E. maculata*, there is a layer of epidermis composed of single row cells at the outermost part. The epidermis has cover hairs. There is a single row of collenchyma cells beneath the epidermis. In the region up to the conduction bundles, there is a layer of cortex consisting of 7-8 rows of large and small round-rectangular parenchymatic cells. There are secretory ducts and abundant starch grains in the cortex parenchyma. The transmission bundles are of the open-collateral type. Vascular cambium is seen in a narrow space under the phloem. Xylem is located under the vascular cambium layer. The core region is empty (Figure 9).



**Fig. 9.** Stem cross-section of *E. maculata* (h: cover feather; e: epiderma; coll: collenchyma; c: cortex; lts: latifer; pc: parenchyma cell; vc: vascular cambium; ph: phloem; xl: xylem; p: pith)

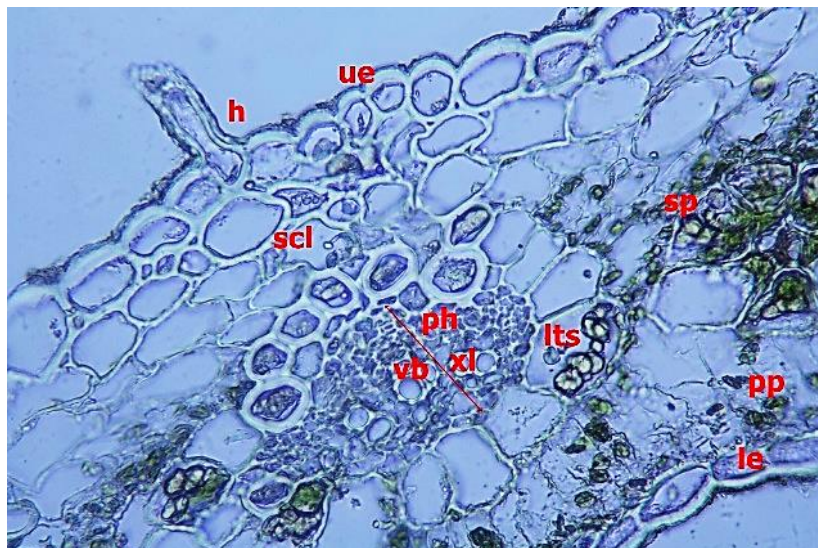
In the *E. chamaesyce* stem cross section, there is an outermost layer of epiderma composed of single row of cells. There is a single row of collenchyma cells beneath the epidermis. In the region up to the transmission bundles, there is a layer of cortex consisting of 6-8 rows of large and small round-rectangular parenchymatic cells. There are secretory ducts and abundant starch grains in the cortex parenchyma. The transmission bundles are of the open-collateral type. Vascular cambium is seen under the phloem. Xylem is located under the vascular cambium layer. The core region is empty (Figure 10).



**Fig. 10.** Stem cross-section of *E. chamaesyce* (h: cover feather; e: epiderma; coll: collenchyma; c: cortex; lts: laticifer; pc: parenchyma cell; vc: vascular cambium; ph: phloem; xl: xylem; p: pith)

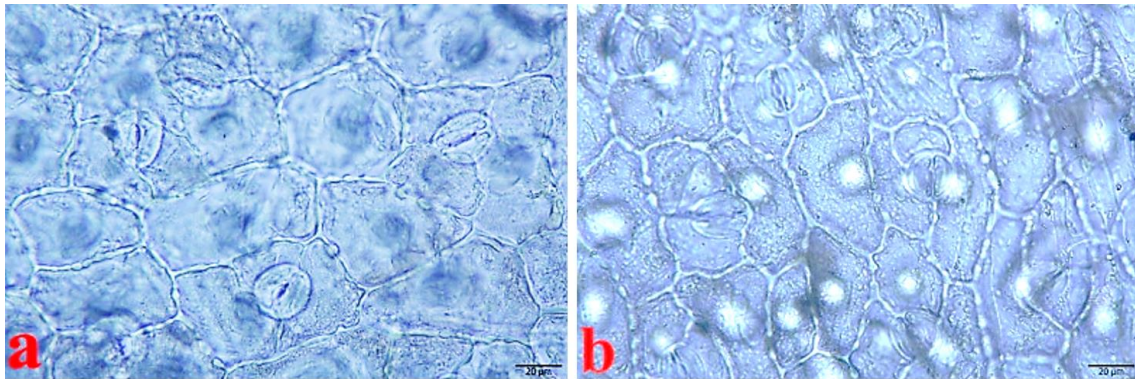
#### Leaf

*E. maculata* leaves rarely cover hairs on the outer part of the leaf in cross section. The upper and lower epidermis consist of rectangular single-row cells. Sclerenchymal fibers are found under the upper epidermis. The conduction bundles are located in the middle of the mesophyll. In the mesophyll tissue, the palisade parenchyma is located on both sides. The sponge parenchyma is irregular and takes up less space between the two palisade parenchyma, and the mesophyll tissue has a lattice (Figure 11).



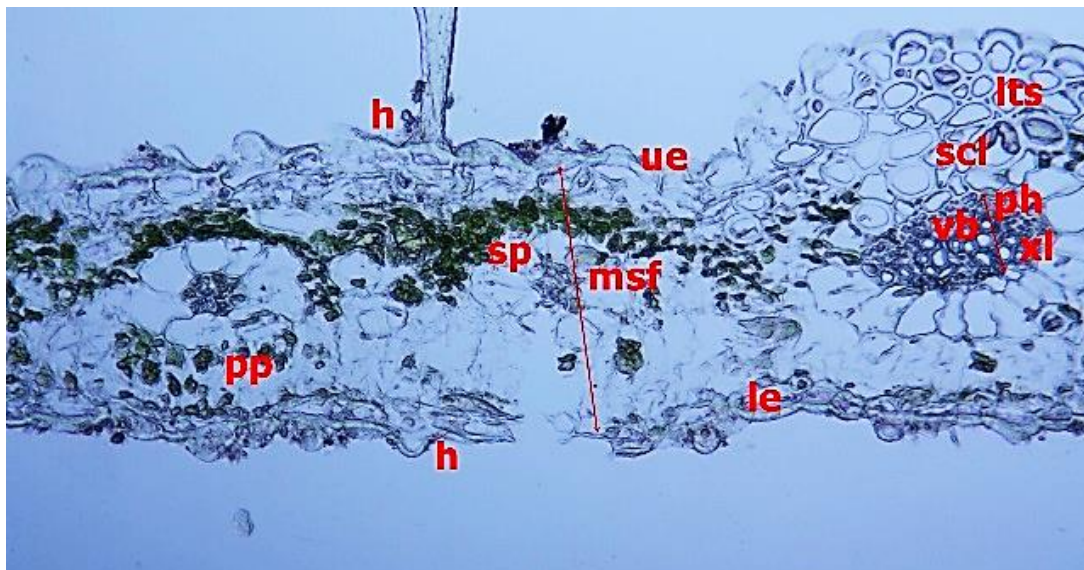
**Fig. 11.** Leaf cross-section of *E. maculata* (ue: upper epidermis; pp: palisate parenchyma; msf: mesophyll; sp: sponge parenchyma; le: lower epidermis; h: feather; scl: sclerenchymal fibers; ph: phloem; xl: xylem)

Anomocytic type stomas were observed between the lower and upper surface epidermis cells of *E. maculata* leaf (Figure 12).



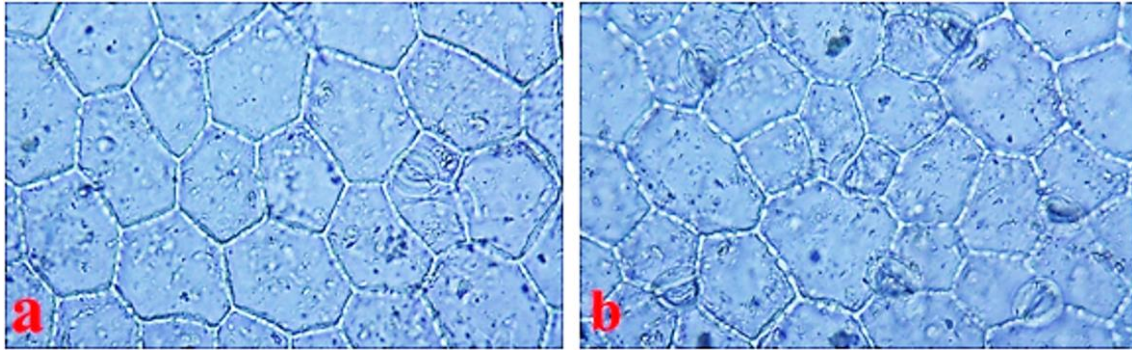
**Fig. 12.** Superficial cross section of *E. maculata* leaf (a: upper epidermis; b: lower epidermis)

*E. chamaesyce* leaf cross section intensively covers the outer part of the leaf hairs. The upper and lower epidermis consist of rectangular single-row cells. Sclerenchymal fibers are found under the upper epidermis. The conduction bundles are located in the middle of the mesophyll. The mesophyll parenchyma is located on both sides of the mesophyll tissue. The sponge parenchyma is irregular and occupies less space between the two palysate parenchyma, and the mesophyll tissue has a lattice (Figure 13).



**Fig. 13** Leaf cross-section of *E. chamaesyce* (ue: upper epidermis; pp: palisate parenchyma; sp: sponge parenchyma; msf: mesophyll; le: lower epidermis; h: feather; scl: sclerenchymal fibers; ph: phloem; xl: xylem)

*E. chamaesyce* anomocytic type stomata were observed between the lower and upper surface epidermis cells (Figure 14).

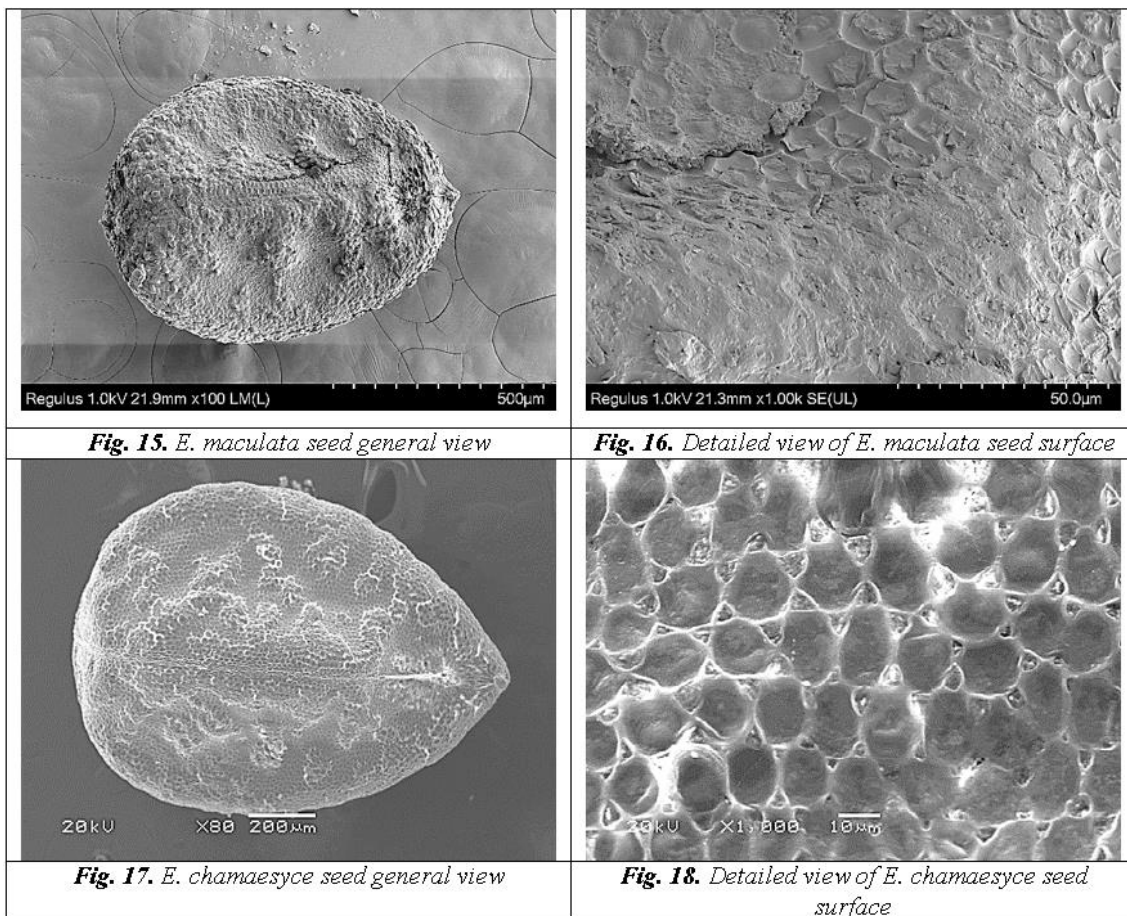


**Fig. 14** Superficial cross section of *E. chamaesyce* leaf (a: upper epidermis; b: lower epidermis)

### Scanning Electron Microscopy

#### Seed

Seed characters are used in determining the boundaries of subgenus, section or sub section groups and species in *Euphorbia* genus. The presence or absence, shape, size of the seed, shape, and decorations on its surface are important taxonomic characters that are systematically used in identifying and comparing species. While the seed surface is reticulate in *E. maculata*; In *E. chamaesyce*, the seed surface is areolate, both species have a high periclinal wall and do not contain oil granules (Figure 15-18).



**Fig. 15.** *E. maculata* seed general view

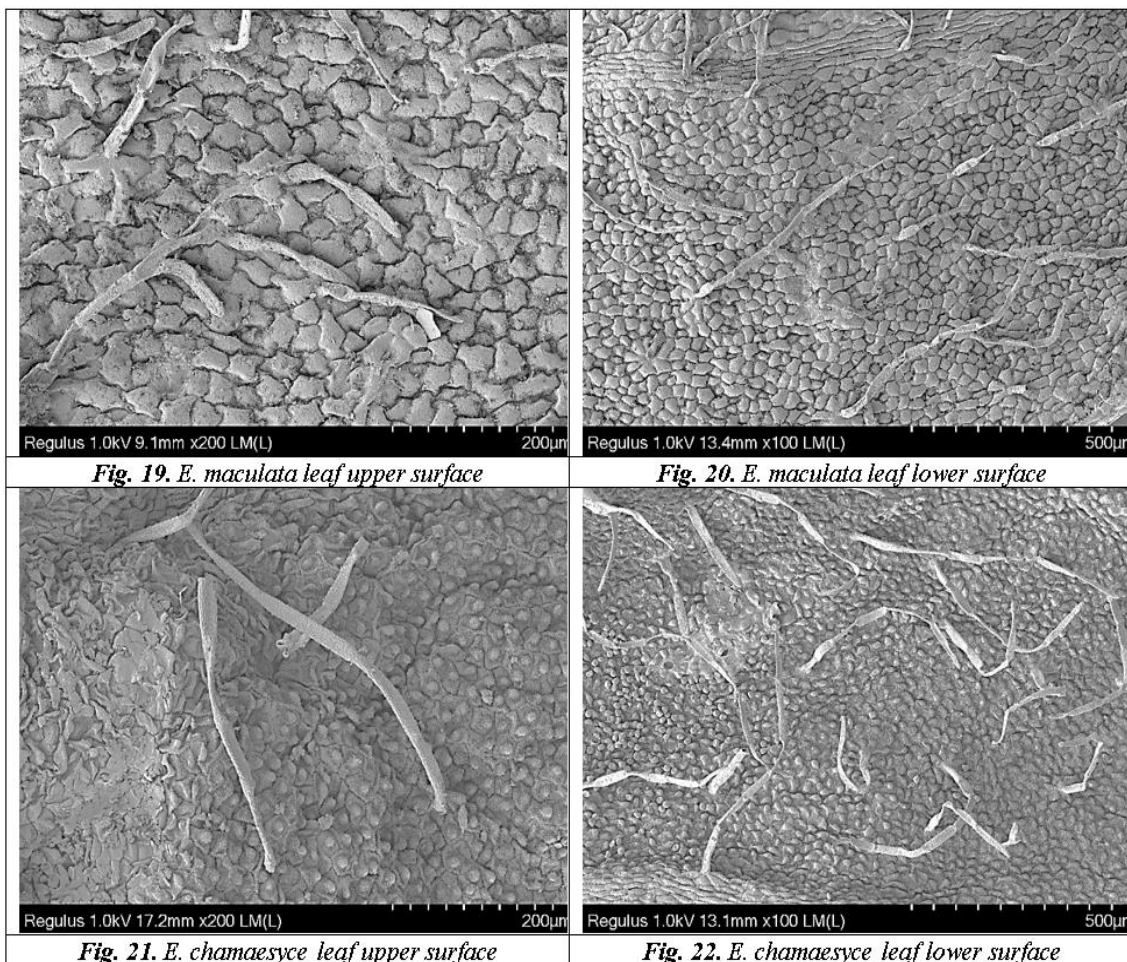
**Fig. 16.** Detailed view of *E. maculata* seed surface

**Fig. 17.** *E. chamaesyce* seed general view

**Fig. 18.** Detailed view of *E. chamaesyce* seed surface

### *Leaf surfaces and hair*

The protrusions formed by the epidermis cells are called hairs. Trichoms can develop from all parts of the plant. Trichoms formed by the elongation of an epidermis cell are called simple trichom. Trichoms formed by the elongation of an epidermis cell are called simple hairs. These trichoms sometimes show branching. Hairs consisting of more than one cell lined up on a base cell located between epidermis cells are called multicellular hairs. Branched events of these are also encountered. Hair cells can be dead as well as alive. In *E. maculata*, while the hairs on the upper and lower surface of leaves are multicellular; In *E. chamaesyce*, the hairs on the lower surface of the leaf are unicellular, and the hairs on the upper surface are both unicellular and multicellular. While *E. maculata* has a large number of hairs on both surfaces; In *E. chamaesyce*, there are few hairs on the upper surface close to the petiole. In *E. chamaesyce* there are papillae on the upper and lower surface of the leaf; It is absent in *E. maculata* (Fig. 19-22).



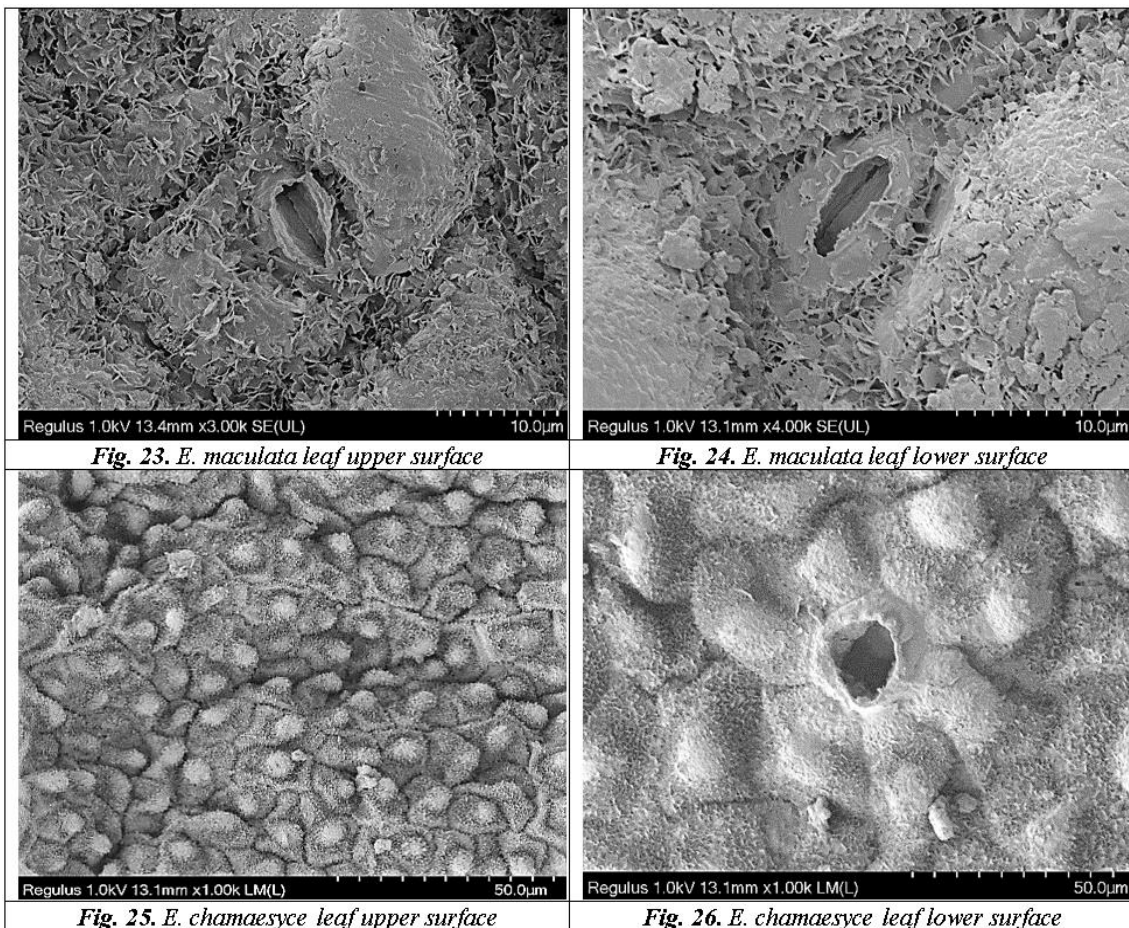
### *Stomata*

The stomata consists of the por, two guard cells around the por and the stoma chamber below. Stomata are usually located on the underside of the leaf, but they can be found on both sides or one side of the leaf depending on the ecological situation of the plant. Again, depending on ecological conditions, the stomata can be found at the same level with the

leaf surface, embedded in the epidermal or protruding from the epidermal layer. Stoma guard cells are surrounded by epidermal cells. Sometimes epidermal cells adjacent to guard cells differ from other epiderma cells. Such differentiated epidermal cells are called subsidiary cells. The cell wall structures of these cells are distinctly different from other epidermal cells. These helper cells are also used by taxonomists as auxiliary characters in the classification of plants due to their differences compared to other epidermal cells. Stomas are classified according to the characteristics of these specialized auxiliary cells, such as shape, size and wall structure, as well as their ecologically based characters.

One or more of these types of stoma can be found on the same leaf. The number of stomata types the leaves have on different surfaces can be counted as the sequences of these types on the lower and upper leaf surfaces of the leaves and the number of stomata per unit area (stomatal index) used in the classification of plants based on stomata. As a result of both the relevant literature and our examination, we have determined that there are important differences between *Euphorbia* taxa in terms of taxonomic characters related to stoma.

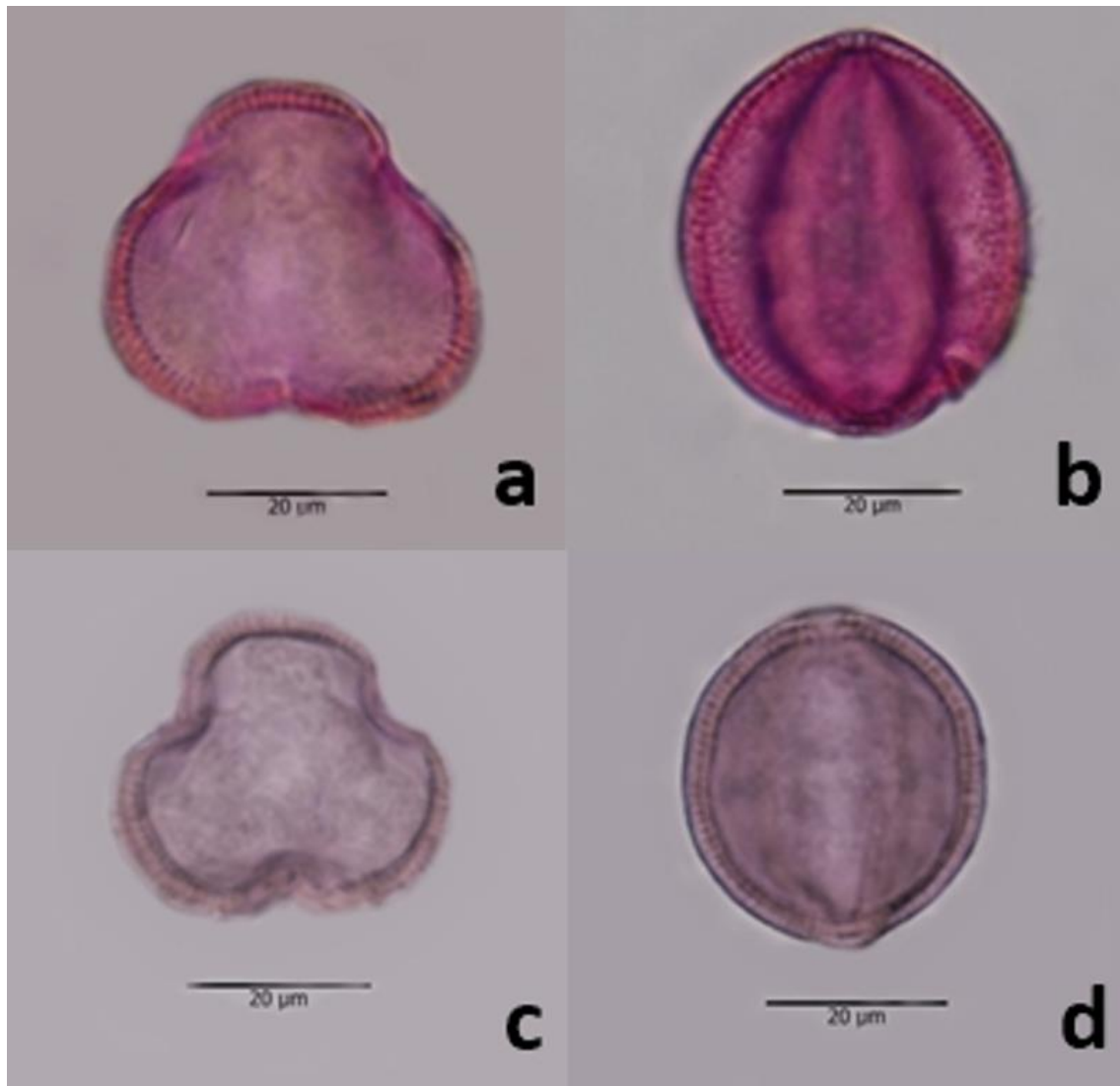
In *E. maculata*, there are anomocytic type stomata on the upper and lower surface of the leaf. In *E. chamaesyce*, stoma is not found on the upper surface of the leaf, while there are anomocytic type stomata on the lower surface (Fig. 23-26).



### *Palynological Results*

In the pollen morphology studies, it was determined that the examined *Euphorbia* L. taxa were tricolporate type and spheroid shaped, and showed a tectate and rugule ornamentation.

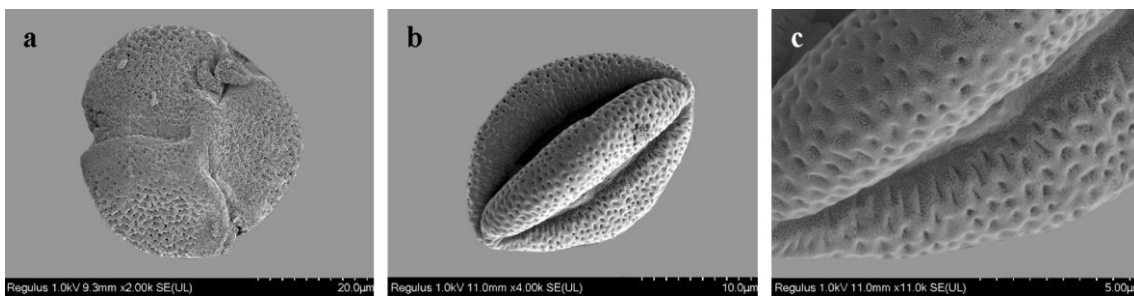
It has been reported in the literature that aperture features and exine structure are among the essential criteria to determine the phylogenetic relationships of the species. We determined by differences in measurements that all species have genetic differences in their analysis, which seem to complement the claim that pollen structures have a valid morphological character in taxonomy (Figure 27-30).



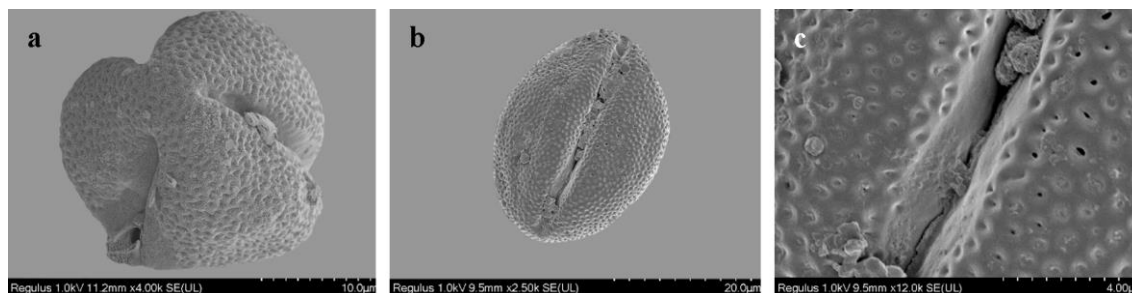
**Fig. 27** Light microscope microphotographs of *E. maculata* (a-polar view (W) bequatorial view (W), c-polar view (E) d-equatorial view (E))



**Fig. 28** Light microscope microphotographs of *E. chamaesyce* (a-polar view (W) bequatorial view (W), c-polar view (E) d-equatorial view (E))



**Fig. 29** SEM of pollen grains in *E. maculata* Polar view, Equatorial view, Exine structure



**Fig. 30** SEM of pollen grains in *E. chamaesyce* Polar view, Equatorial view, Exine structure

## CONCLUSION

In this study, anatomical and morphological features of *E. maculata* and *E. chamaesyce* species belonging to *Chamaesyce* subspecies are explained in detail.

As a result of the anatomical studies, when the root cross-sections of the species are examined, it is seen that the roots show a secondary root structure. The outermost protective tissue is periderm. The epidermis is crushed just below the periderm layer. Secretory channels are extensively present in the cortex layer of both species. The phloem was placed in a narrow space and the xylem expanded to cover its core.

When the trunk cross sections were examined, cover hairs were found in the epidermis of *E. maculata*, while cover hairs were not observed in *E. chamaesyce*. While both species have secretory channels and abundant starch grains in the parenchyma of the cortex, the cortex layers consist of round and rectangular parenchymatic cells of various sizes. The transmission bundles are of the open-collateral type. The core regions are empty

When the leaf cross sections were examined, cover hairs were observed intensely in *E. chamaesyce* sample while cover hairs were rarely observed in *E. maculata*. In both species, the palisade parenchyma is located on both sides of the mesophyll tissue. The sponge parenchyma is irregular and occupies less space between the two palisade parenchyma, and the mesophyll tissue has a lattice. The conduction bundles are located in the middle of the mesophyll. In both species, anomalous type stomas were observed between the lower and upper surface epidermis cells.

The morphological characters found in the morphological studies in this study are generally similar to the definition of Radcliffe-Smith (1982) as shown in Table 1.

Radcliffe-Smith (1982) *E. maculata* in his description of the species has a flat and hairy stems, the body in the range of 10-45 cm; stem leaves are almost sickle-shaped elliptical oblong to linear oblong, optus 4-9 x 1.5-4 mm; the transverse ovate of the glands and the small, stipule from linear-lanceolate to the linear or filiform occasional 2-3 portions; small amount of fruits flattened pubescent 1.5 mm; Seeds ovoid-rectangular, transversely corrugated, brown; stated that there was no carunculus.

In our study, we examined *E. maculata* specimen body up to 10 cm, flat, hairy; stem leaves are almost sickle-shaped, elliptical oblong, optus and 4-7 x 2-3 mm; glands transverse ovate and small; stipule linear-lanceolate; berries 1.2-1.5 mm flat-lying pubescent; The seeds do not ovulate-oblong, transverse corrugated, brown and carunculus.

Radcliffe-Smith (1982) *E. chamaesyce* in his description of the body up to 30 cm, hairy or hairless; trunk leaves suborbiculate-ovate or ovate-oblong 1-11 x 1-6 mm; glands suborbiculate and hornless; linear-filiform 1 mm of the stipule; flat surface of fruits,

partial pubescent 2 mm; seeds ovoid or quadrangular, tubercular-rugulose, areolate, pale gray 1.2 mm; stated that there was no carunculus.

In our study we examined *E. chamaesyce* samples up to 15 cm body, hairy; stem leaves ovate-oblong 1-7 x 1-4 mm; glands suborbiculate and hornless; stipule linear-filiform 1 mm; fruits flat surface, partially pubescent 1.5-2 mm; seeds ovoid, tubercular-rugulose, areolate, pale gray 1-1.2 mm and do not have carunculus.

*E. maculata* is morphologically similar to *E. chamaesyce* and *E. maculata* leaves are almost sickle-shaped, elliptic-oblong or linear-oblong and serrulate; *E. chamaesyce* berries 1.2-1.5 mm small amount of slant hairy; *E. chamaesyce* leaves suborbiculate-ovate or ovate-oblong; fruits are smooth and partially pubescent, 1.5-2 mm in size; seed ovoid or quadrangular shaped, tubular-rugulose irregular surface, 1-1.2 mm, pale gray color is separated from each other.

In the pollen morphology studies, it was determined that the examined *Euphorbia* L. taxa were tricholoporate type and spheroid shaped, and showed a tectate and rugule ornamentation.

According to the SEM results for micro morphological studies on the seed surfaces, while the seed surface is reticulate in *E. maculata*; In *E. chamaesyce*, the seed surface is areolate, both species have a high periclinal wall and do not contain oil granules.

According to the results of the SEM performed to determine the feather structures in *E. maculata* and *E. chamaesyce*, while the hairs on the upper and lower surface of the leaf in *E. maculata* are multi-celled; in *E. chamaesyce*, the hairs on the lower surface of the leaf are unicellular, and the hairs on the upper surface are both unicellular and multicellular. While *E. maculata* has a large number of hairs on both surfaces; In *E. chamaesyce*, there are few hairs on the upper surface close to the petiole. In *E. chamaesyce* there are papillae on the upper and lower surface of the leaf; not in *E. maculata*.

Morphological and anatomical studies on *E. maculata* and *E. chamaesyce* species have been tried to be introduced better. This study contributed to plant systematics and biological diversity. Thus, Turkey has contributed to both the recognition and protection of the world's plant diversity. This data has been provided for scientific studies on similar subjects.

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## REFERENCES

- [1] Webster, G. L. (1994): Synopsis of the genera and suprageneric taxa of *Euphorbiaceae*. *Annals of the Missouri Botanical Garden*, 33-144.
- [2] Radcliffe-Smith, A., Esser, H. J. (2001): *Genera Euphorbiacearum*, Royal Botanic Gardens, Kew.
- [3] Berry, P. E., Hipp, A. L., Wurdack, K. J., Van, E. B., Riina, R. (2005): Molecular phylogenetics of the giant genus *Croton* and tribe *Crotoneae* (*Euphorbiaceae* sensu stricto) using ITS and trnL-trnF DNA sequence data. *American Journal of Botany*, 92(9): 1520-1534.
- [4] Bruyns, P. V., Klak, C., Hanáček, P. (2011): Age and diversity in Old World succulent species of *Euphorbia* (*Euphorbiaceae*). *Taxon*, 60(6): 1717-1733.

- [5] Küçükler, O. (2011): Bitki Morfolojisi (Kapalı Tohumlu Bitkiler) Ders Notları, İstanbul Üniversitesi Fen Fakültesi, İstanbul, Türkiye.
- [6] Can, L. (2012): Trakya’da yayılış gösteren sütleğen (*Euphorbia*) (*Euphorbiaceae*) türleri üzerinde karpolojik ve amilotaksonomik araştırmalar, Yüksek Lisans Tezi, İstanbul Üniversitesi.
- [7] Lukovic, J., Malencic, D., Zoric, L., Kiprovski, B., Merkulov, L., Boza, P. (2009): Anatomical characteristics and antioxidant properties of *Euphorbia nicaensis* ssp. *glareosa*. Cent. Eur. J. Biol., 4(2): 214-223.
- [8] Yentür, S. (1995): Bitki Anatomisi. İstanbul Üniv. Fen Fak. Yay., İstanbul, Türkiye.
- [9] Patterson, A. (2017): Trakya Bölgesi’nde Yayılış Gösteren Sütleğen (*Euphorbia* L.) Türlerinde Morfolojik ve Moleküler Taksonomik Araştırmalar, Doktora Tezi, İstanbul Üniversitesi.
- [10] Narbona, E., Arista, M., Ortiz, P. L. (2005): Explosive seed dispersal in two perennial Mediterranean *Euphorbia* species (*Euphorbiaceae*). American Journal of Botany, 92(3): 510-516.
- [11] Prenner, G., Rudall, P. J. (2007): Comparative Ontogeny of the Cyathium in *Euphorbia* (*Euphorbiaceae*) and its Allies: Exploring the Organ-Flower-Inflorescence Boundary. American Journal of Botany, 94(10): 1612-1629.
- [12] Tokuoka T., Tobe H. (2002): Ovules and seeds in Euphorbioideae (*Euphorbiaceae*) structure and systematic implications. J. Plant Res., 115(5): 361-374.
- [13] Can, L., Küçükler, O. (2013): Trakya’da yayılış gösteren bazı *Euphorbia* L. (Sütleğen) türlerinin tohum özelliklerinin (şekil, yüzey, renk) teşhis-tayin ve zookori ile dağılıma olan katkıları, DOI:10.13140/2.1.1129.9203 Ekoloji Konferansı, Mayıs 2013.
- [14] Horn, J. W., Van Ee, B. W., Morawetz, J. J., Riina, R., Steinmann, V. W., Berry, P. E., Wurdack, K. J. (2012): Phylogenetics and the evolution of major structural characters in the giant genus *Euphorbia* L. (*Euphorbiaceae*). Molecular Phylogenetics and Evolution, 63(2): 305-326.
- [15] Haworth, A. H. (1812): Synopsis plantarum succulentarum, cum descriptionibus locis. R. Taylor, London.
- [16] Rafinesque, C. S. (1817): Second decade of undescribed American plants. Am. Monthly Mag. & Crit. Rev., 2: 119-120.
- [17] Pahlevani, A. H., Riina, R. (2011): A synopsis of *Euphorbia* subgen. *Chamaesyce* (*Euphorbiaceae*) in Iran. Ann. Bot. Fennici, 48: 304-316.
- [18] Davis P. H. (1982): Flora of Turkey and The East Aegean Island, Vol. 7, Edinburg University Press., pp. 566- 630.
- [19] Petrova, A., Vladimirov, V., Georgiev, V. (2013): Invasive Alien Species of Vascular Plants In Bulgaria, Institute of Biodiversity and Ecosystem Research, Bulgarian Academy of Sciences, ISBN 978-954-9746-30-3.