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ANATOMICAL CHARACTERIZATION OF *STACHYS MARITIMA* GOUAN VEGETATIVE ORGANS

Popoviciu Dan Răzvan *, Jianu Loreley-Dana
„Ovidius" University of Constanţa, Faculty of Natural Sciences and Agricultural Sciences, Constanţa, Romania
* *Correspondence author. E-mail:* dr_popoviciu@yahoo.com

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ABSTRACT

Stachys maritima Gouan is a perennial herbaceous plant from the Lamiaceae family. It only grows on sand dunes, especially littoral ones. In Romania it is considered an endangered species, only found in few coastal areas of Tulcea and Constanța counties. Its vegetative organs (rhizome, aerial stem, leaf petiole and leaf blade) were harvested for anatomic analysis.
The rhizome showed a secondary structure, with thin suber, compact and thin phloem and compact xylem annual growth rings, while pith was mostly replaced by xylem elements. Aerial stems had the four-ridged shape common in many Lamiaceae, with caps of angular collenchyma protecting four major, semicircular, collateral vascular bundles. Multiple secondary bundles were also found, joined together by sclerified external pith layers. Leaf petiole was filled with undifferentiated parenchyma, made up of large polygonal cells, similar in shape to stem cortex and pith. Leaf blade had a weakly differentiated bifacial structure and was amphistomatic. Stems and leaves were covered by dense, massive, lignified tector hairs. Secretory hairs were small, exclusively peltate, mostly found on stems.

INTRODUCTION

Stachys maritima Gouan belongs to the Lamiaceae family, Olisia section, Annuae subsection (Güner et al. 2023). It is a perennial herbaceous plant, with stems growing up to 30-35 cm. Oblong to ovate, 1-2 cm long leaves form basal rosettes, having crenate edges and cuneate apex. Both leaves and stems are tomentous. Flowers are grouped in spikes, in verticils of 4-6. They are typically labiated, with yellow petals. Fruits are grey achenes.

The plant reproduces itself by seeds and stolons. It is a mostly Mediterranean species, growing on sand dunes. While it usually occurs on littoral sands, it may rarely appear in interior areas (Molero et al. 2006).

In Romania it is considered a rare and critically endangered species, mostly found on shifting sand dunes in the Danube Delta (Sulina, Sfântu Gheorghe, Razelm-Sinoe areas) and also in reduced areas of the southern littoral (due to the impact of tourism industry), for instance on Agigea sand dunes (Făgăraș 2015).

The aim of this paper was to expand the current knowledge on this rare species by studying the anatomy of its vegetative organs.

MATERIAL AND METHODS

Fresh samples of *S. maritima* vegetative organs were collected from the small population growing on littoral sand dunes in Agigea Natural Reserve (Constanța County). They included plant rhizome, upper stem and leaves (petiole and lamina), collected from mature plants. Considering the endangered status of this plant, only the small fragments needed for anatomical study were collected.

Plant organs were fixed in a solution of formaldehyde: acetic acid: ethyl alcohol (5:5:90), cross-sectioned manually, then stained with alum carmine and iodine green and analyzed by microscopy (Bercu & Jianu, 2003) using a bright-field microscope, equipped with an Omegon Telemikro USB electronic camera. Micrographs were further analyzed on computer.

RESULTS AND DISCUSSIONS

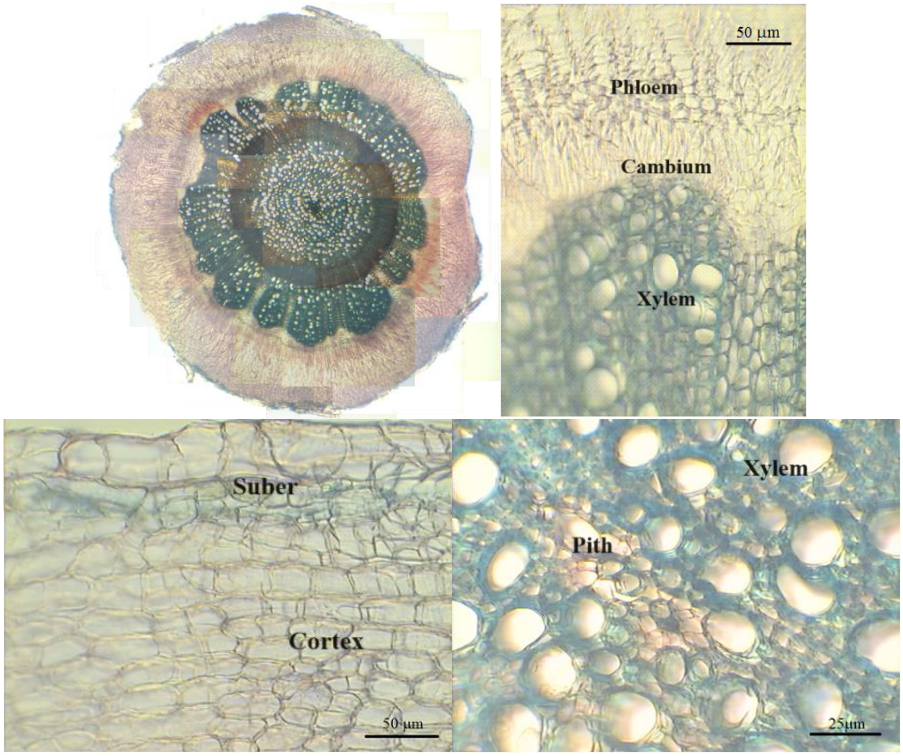

Figure 1. Anatomic features of *Stachys maritima* rhizome: A) general oultine; B) vascular tissue; C) suber and cortex; D) central area with pith.

Rhizome cross-sections showed a typical secondary structure. A thin suber, composed of few layers of large cells covered a thick cortex made up of flattened parenchymal cells, with thin cell walls. Multiple blocks of secondary phloem formed an almost continuous, thin ring. Xylem formed compact annual growth rings, with a large number of vessels. The growth of xylem replaced most of the parenchymatic pith, leaving a small number of cells in the centre (Fig. 1).

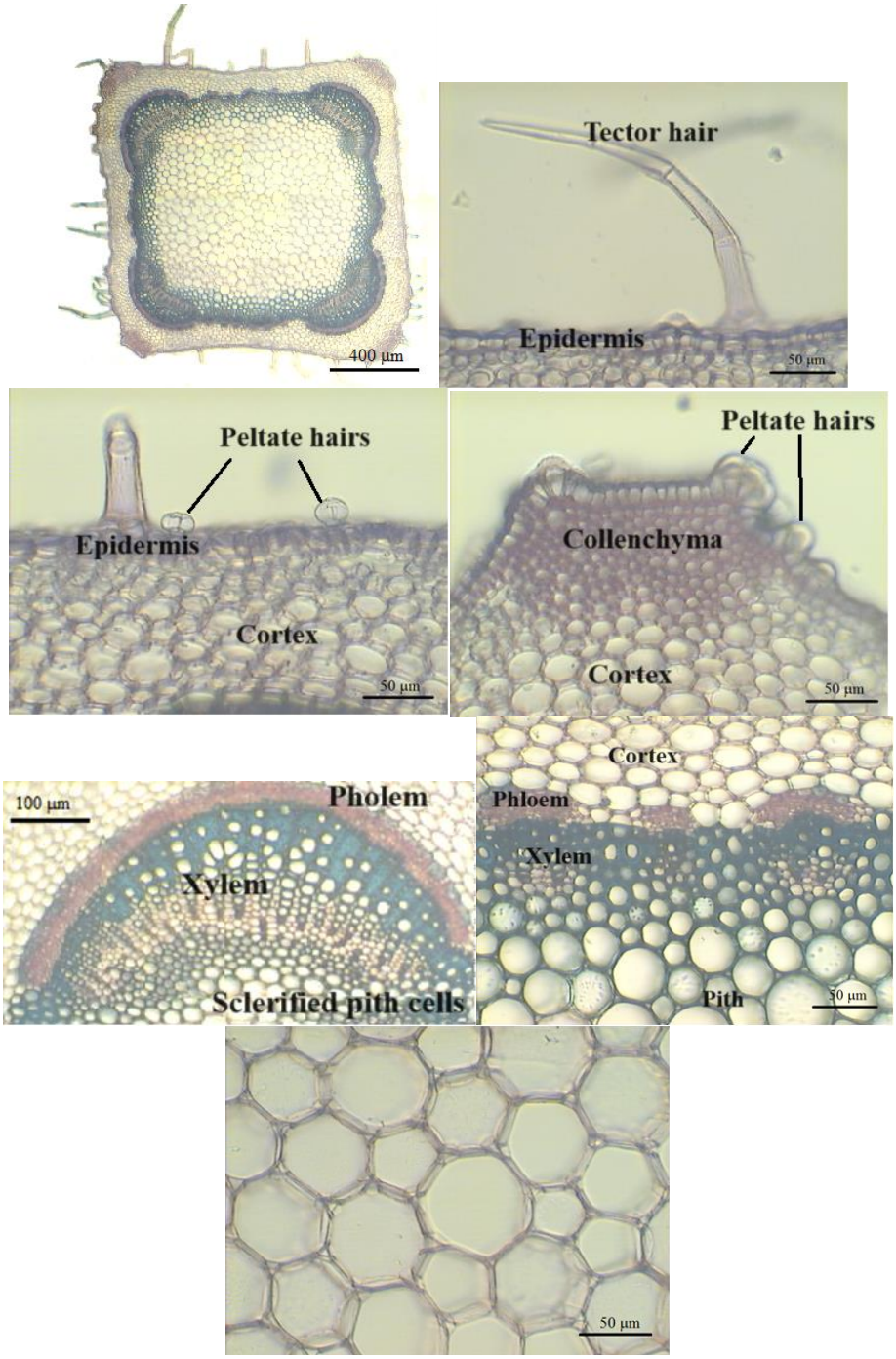

Figure 2. Anatomic features of *Stachys maritima* stem: A) general oultine; B, C) trichomes; D, E) major and secondary vascular bundles; F) pith.

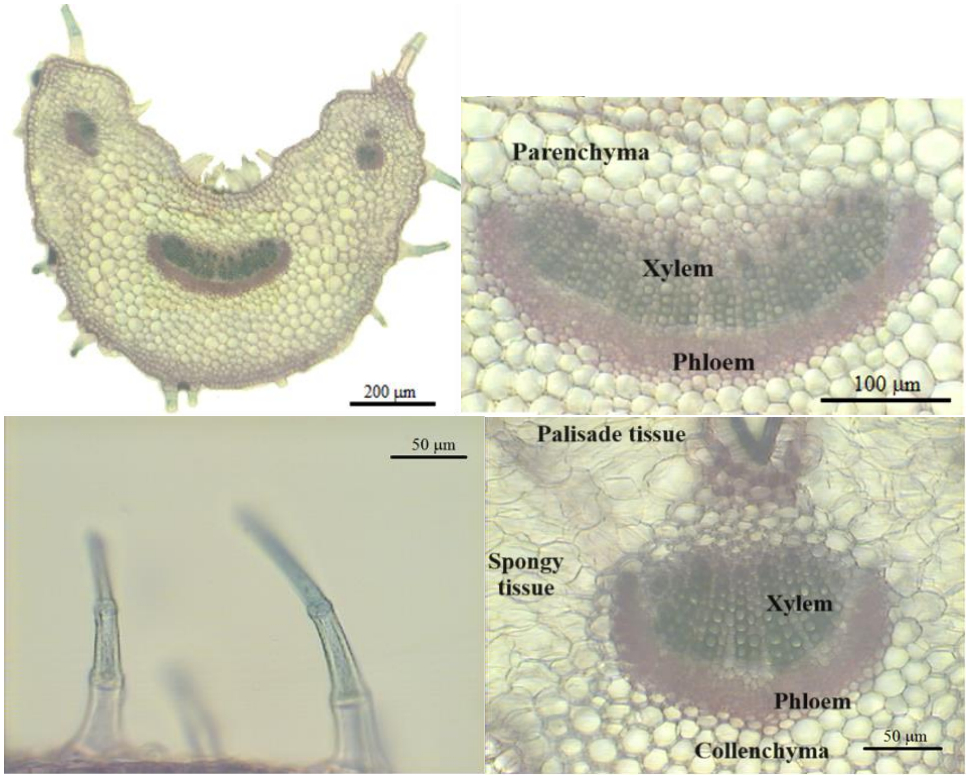

Figure 3. Anatomic features of *Stachys maritima* leaf: A) petiole oultine; B) petiole vasculary bundle; C) trichomes on leaf blade; D) leaf blade midrib.

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Aerial stems (Fig. 2) had the typical four-ridged outline of the Lamiaceae. Ridges contained angular collenchyma. Cortex was composed of massive polygonal, thin-walled cells.

Each corner of the stem hosted a major open, collateral vascular bundle with numerous phloem and xylem elements. Between the four main bundles, multiple secondary ones were located. Like the cortex, the pith was composed of large, polygonal, thin-walled cells, with clear vacuolar solution. However, the outer layers of the pith had lignified cell walls, forming a continuous sclerified ring.

Leaves (Fig. 3) had a typical bifacial structure. However, palisade and spongy tissue showed little differentiation. Both the petiole and leaf bladed hosted a massive, central, collateral vascular bundle, of semicircular shape.

Petiole was filled with an undifferentiated parenchyma, with large polygonal cells. Angular collenchymal caps were found above and below the midrib and other major vascular bundles in the blade (more abundant on the ventral side). Leaves were amphystomatic.

The epidermis of both aerial stems and leaves were covered in dense trichomes. These belonged to two types.

Tector hairs (Fig. 2B, 3C) were numerous and massive, multicellular and uniseriate, slightly lignified, made up of 3-5 cells. This feature was also found in *Stachys caroliniana* and *S. floridana* while in other species (*S. tenuifolia*), trichomes are rare (Garner 2017).

Secretory hairs were mostly found on stems, especially around the four ridges (Fig. 2C, D). These were peltate hairs formed of up to 4 cells each. In Lamiaceae, these hairs are often involved in essential oil secretion. Peltate hairs are known to be responsible for lipophilic secretions. Capitate hairs, which usually release the polysaccharidic fractions of essential oils (Huang et al. 2008) were absent in *S. maritima*.

CONCLUSIONS

The rhizome of *Stachys maritima* showed a secondary structure, with thin suber, compact and thin phloem and compact xylem annual growth rings, while pith was mostly replaced by xylem elements.

Aerial stems had the four-ridged shape common in many Lamiaceae, with caps of angular collenchyma protecting four major, semicircular, collateral vascular bundles. Multiple secondary bundles were also found, joined together by sclerified external pith layers.

Leaf petiole was filled with undifferentiated parenchyma, made up of large polygonal cells, similar in shape to stem cortex and pith.

Leaf blade had a weakly differentiated bifacial structure and was amphistomatic.

Stems and leaves were covered by dense, massive, lignified tector hairs. Secretory hairs were small, exclusively peltate, mostly found on stems.

REFERENCES

Bercu, R., Jianu, D.L., 2003. Practicum de morfologia si anatomia plantelor, Ovidius University Press, Constanța.

Făgăraș M., 2015. Embryonic shifting dunes on the Romanian Black Sea coast. Ann. Univ. Craiova, Ser. Agriculture, Montanology, Cadastre, 45(1), 306-313.

Garner C., 2017. Hallmark features of stem anatomy in the Family Lamiaceae. Senior thesis, University of South Carolina, Columbia.

Güner Ö., Özdöl T., Yıldırım H., 2023. A new rupicolous species from West of Türkiye: *Stachys cuhacioglui* (Lamiaceae). Türler ve Habitatlar, 4(2), 98-109.

Huang S.S., Kirchoff B.K., Liao J.P. 2008. The capitate and peltate glandular trichomes of *Lavandula pinnata* L. (Lamiaceae): histochemistry, ultrastructure, and secretion. J. Torrey Bot. Soc., 135, 155-167.

Molero J., Rovira A., Simon J., Bosch M., López-Pujol J., Orellana M.R., Barriocanal C., Blanché C., 2006. *Stachys maritima* Gouan. In Bañares Á., Blanca G., Güemes J., Moreno J.C., Ortiz S. (eds.), Atlas y Libro Rojo de la flora vascular amenazada (AFA) Adenda 2006, Dirección General de Conservación de la Naturaleza, Madrid, pp. 30-31.