MORPHOLOGICAL AND HISTO-ANATOMICAL CHARACTERISTICS OF CULTIVATED *MELISSA OFFICINALIS* L. PLANT

CARACTERISTICI MORFOLOGICE ŞI STRUCTURALE LA PLANTA CULTIVATĂ DE *MELISSA OFFICINALIS* L.

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Abstract. *Melissa officinalis L. (lemon balm) is a perennial herb of Lamiaceae family, with culinary and medicinal use. This paper analyzes the developmental stages of Melissa officinalis cultivated plant. The successive ontogenesis stages of seedling, including the development of root, hypocotyl, epicotyl, cotyledons and nomophylls are described. The histo-anatomical characteristics of mature organs (root, stem and leaf) are identified. Peculiar attention is given to the morphology and distribution of glandular and non-glandular hairs on the vegetative organs.*

Key words: ontogenesis, morphology, anatomy, *Melissa officinalis*

Abstract. *Melissa officinalis L. este o plantă perenă din familia Lamiaceae cu importanţă culinară şi medicinală. Lucrarea de faţă reprezintă un studiu amplu asupra creşterii şi dezvoltării plantei cultivate, fiind analizate morfologia şi structura organelor vegetative în evoluţie ontogenetică, o atenţie deosebită acordându-se distribuţiei şi morfologiei perilor secretori, producători de uleiuri volatile.*

Cuvinte cheie: ontogeneză, morfologie, anatomie, *Melissa officinalis*

INTRODUCTION

***Melissa officinalis* L.** (lemon balm) is a perennial herb of *Lamiaceae* family, grown spontaneous in Romania, only on limited areas in south-west of the country, and cultivated in gardens and monachal places.

The numerous phytochemical researches revealed the importance of this species as aromatic, melliferous and medicinal plant (Heitz et al.,2000; Gille et al., 2004; Blank et al., 2005).

The present paper is an ample study of grown and development of cultivated plant, being analysed the morphology and the structure of the vegetative organs in successive ontogenesis stages. Peculiar attention is given to the morphology and distribution of glandular and non-glandular hairs on the vegetative organs.

MATERIAL AND METHODS

Seeds belonging to *Melissa officinalis* plant obtained from „Stejarul" Researches Station of Piatra Neamţ, were planted in soil under normal environmental conditions. Individs of different age were crop and fixed in 70% ethylic alcohol for histo-anatomical reserches.

The cross-sections of the vegetative organs were performed using a manual microtome, coloured with iodine green and ruthenium red, analysed and photographed at photonic microscope Olympus BX51 with a photo camera Olympus E-330.

RESULTS AND DISCUSSIONS

The seed germination is epigeous. The 35-day-old seedling presents: primary root with few secondary roots, short hypocotyl, two cotyledons and foour nomophylls. The cotyledons have different morphology comparing to authentic leaves (fig. 1).

Fig. 1. Successive stages of *Mellisa officinalis* seedling ontogenesis

The seedling root presents primary structure. The stele is of diarch type and is protected by a Casparyan endodermis. At the mature plant, secondary roots result from the activity of both lateral meristems, the cambium and the phellogen.

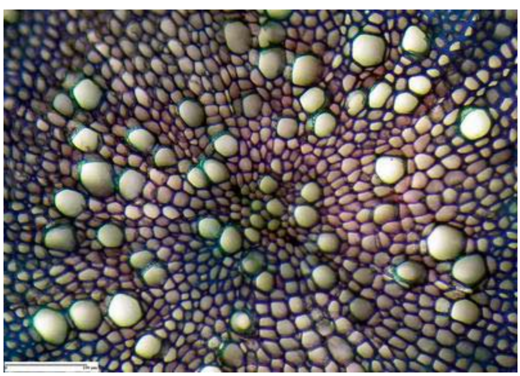

Fig. 2. Cross-section through the mature root of *Mellisa officinalis* (detail from the stele)

Most part of xylem corpus is lignified. A few islands of parenchymatous cellulosic cells in external part and in the inner of the xylem mass may be observed. The central part of the root is occupied by primary xylem vessels. The cambium is thick. The parenchymatous cells of the secondary phloem ring are numerous, the vascular elements being grouped in small islands.

The root is protected by the peridermis; the phellogen is formed from the pericicle. The phellodermis comprises 12-13 layers of collenchymatous cells comparatively to the cork, which is thin (2-3 layers).

The hypocotyl (fig. 3) presents circular contour in transverse section and is protected by epidermis, with numerous, multicellular, short trichomes. The passing from the primary structure of the root to the primary structure of the stem takes place along the hypocotyl and could be explained by the desmogenesis theory (Chauveaud, 1911) according to which three stages in vascular transition are distinguished, as follows: 1) alternate stage (characteristic to the root); 2) intermediary (tangential) stage (characteristic to the hypocotyl); 3) overlapped stage (characteristic to the stem)

Fig. 3. Cross-section through the hypocotyl of *Mellisa officinalis* 35day-old seedling.

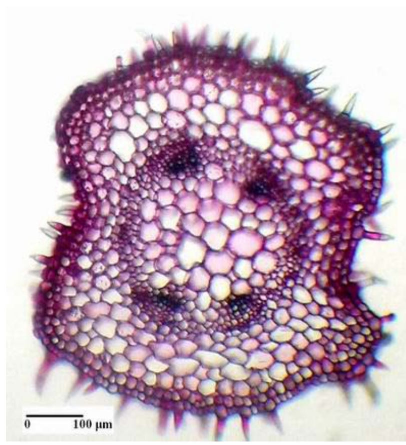

Fig. 4. Cross-section through the epicotyl of *Mellisa officinalis* 35 day-old seedling.

The epicotyl (fig. 4) presents primary structure with quadratic contour in transverse section, and four proeminent ribs. The mechanic tissues are in developing; a tangential hypodermic collenchyma may be observed.

At the mature plant, ***the stem*** presents different contour in transverse section depending of the level taken into study (fig. 5, 6); four pronounced ribs in the upper third of the stem may be observed. The secondary structure of the aerial stem results only from cambium activity.

The primary vascular tissues are organised vascular bundles of open collateral type (in ribs) and small islands of phloem (in depressions). The cambium produces more vascular secondary elements in the ribs than in the depressions. The secondary xylem ring is entire lignified. Vessels of primary xylem surrounding by parenchymatous cellulosic cells are present at the periphery of xylem corpus.

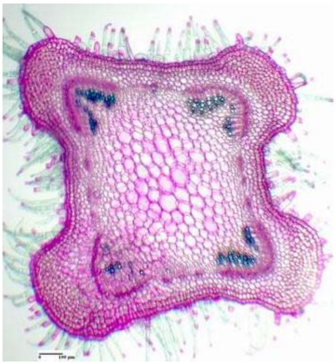

Fig. 5. Cross-section through the upper third of the aerian stem of *Mellisa officinalis* mature plant

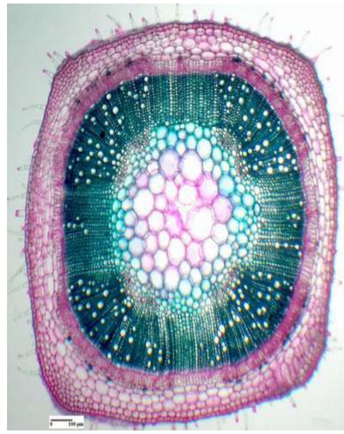

Fig. 6. Cross-section through the lower third of the aerian stem of *Mellisa officinalis* mature plant

The pith is of parenchymatous cellulosic type (in the upper third of the stem) and lignified towards its periphery.

The mechanic tissues are represented by cordons of angular (in ribs) and tangential (in depressions) collenchyma.

At the external part of the phloem, isolated or grouped sclerenchymatous fibers are in developing, especially in the ribs.

On its entire surface, the stem is protected by the epidermis covered by a striated cuticle. Numerous multicellular non-glandular trichomes may be observed. The cotyledons present the same structure as the nomophylls; the mesophyll is differentiated in one layer of palisade tissue (at the adaxial face) and 2-3 layers of lacunous tissue (at the abaxial face).

The stomata are of anomocytic type and are disposed on the both face of the foliar. The median and the secondary nervures are prominent at the abaxial face of the limb (fig. 7).

The glandular hairs are early formed during plant ontogenesis. in hypocotyl there are secretory hairs with unicellular gland. Fahn (1988) notes that glandular hairs of *Lamiaceae* can be classified in two types: capitate and peltate glandular hairs.

According to this classification at *Melissa officinalis*, are distinguished the following types of glandular hairs: *1*. capitate glandular hairs with unicellular secreting head (fig. 8); *type 2*. capitate glandular hairs with 2-cellular secreting head (fig. 9); *type 3*. peltate glandular hairs with 8-celled secreting head (fig. 10).

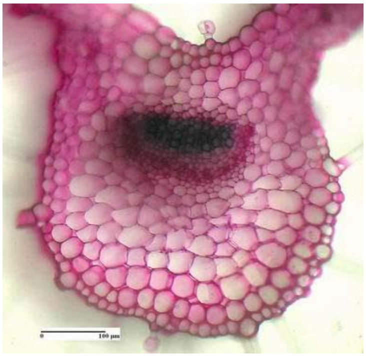

Fig. 7. Cross-section through the median nervure of *Mellisa officinalis* foliar limb

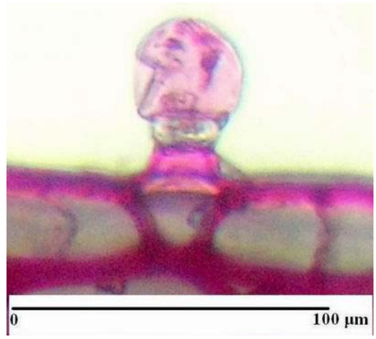

Fig. 8. Glandular hair with unicellular secreting head in the stem of *Mellisa officinalis* (cross-section).

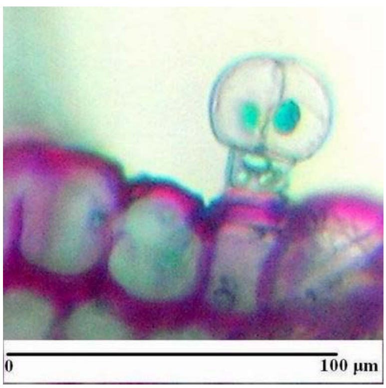

Fig. 9. Glandular hair with 2-cellular secreting head in the stem of *Mellisa officinalis* (cross-section).

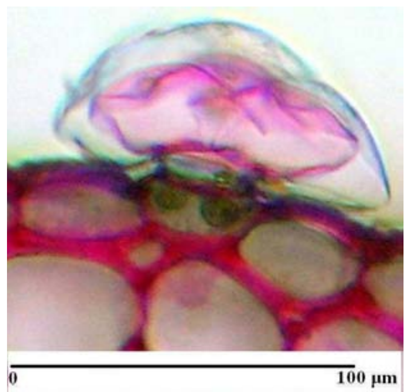

Fig. 10. Glandular hair with multicellular secreting head in the stem of *Mellisa officinalis* (cross-section).

CONCLUSIONS

The evolution of vascular system could be explained by the desmogenesis theory (Chauveaud, 1911) according to which three stages in vascular transition are distinguished. The cotyledons have a different morphology and the same structure as the nomophylls. At the mature plant the axial vegetative organs have secondary structure, with the exception of the upper third of the stem.

The glandular hairs with uni- or multicellular glands are early formed during plant development and are numerous in mature vegetative organs (the upper third of the stem and leaves).

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