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Histological studies on some native perennials

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Summary: Growing of native perennial species became more and more popular in the last ten years. In order to obtain more information on their histological structure, investigations were done on *Aster linosyris*, *Inula ensifolia* and *Prunella grandiflora*. The histological features are usually relating to the plants' ecological demands which is an important aspect in their growing. Differences were found in the structure of the stem of *Asteraceae* and *Lamiaceae* members. While separated vessels were formed in the stem of *Aster linosyris* and *Inula ensifolia*, continuous vessel-system forms in the stem of *Prunella*. Alternating segments of collenchyma and chlorenchyma are found in the stem of *Aster linosyris*, while palisade parenchyma is situated both on the abaxial and adaxial surface of the leaves. Vessel-system of the root is tetrarch. Histological structure of the stem of *Inula ensifolia* differs from *Aster linosyris* in the broader cortical parenchyma which is composed of approx. 8–12 cell layers. It contains neither collenchyma nor chlorenchyma. In the stem of *Prunella grandiflora* a nearly continuous vessel-ring is formed from the four primary vessels. Long, multi-celled hairs were observed in the district of angles of the stem.

Key words: histology, native perennial species, *Aster*, *Inula*, *Prunella*

Introduction

Growing and using of native wild perennial species became more and more popular in the last ten years. First they were used as bedding plants planted to perennial beds, but investigations have been done to extend the possibilities of their use as cut flowers or pot plants as well. For propagation and growing of wild species, it is necessary to know their ecological demands and also the histological structure of their vegetative and generative organs. The histological features provide useful informations to their floricultural use.

Until now, only a few references are available about histological characteristics of native wild species. The aim of the present study was to discover the inner, histological structure of some native wild perennial species with a perspective to become ornamental plants. (*Schmidt,* 2003; *Tóth,* 2000)

Material and method

Investigations were done on the histological structure of vegetative organs (stems, leaves and roots) of the following native species: *Aster linosyris* (L.) Bern., *Inula ensifolia* L., *Prunella grandiflora* (L.) Scholler. Vegetative organs of native perennials were collected from September to April in the years of 2004–2005. The samples were stored in alcohol (40%). The histological examinations were carried out in the laboratory of the Corvinus University of Budapest, Department of Floriculture and Dendrology. 30–60 μm thick cross sections were prepared with the help of a freezing sledge microtome. The prepared cross sections were investigated under light-microscope with a magnification of 32×, 100× and 200×. 50% glycerine was used for fixing the cross-sections. They were stained with toluidine-blue. Photos were taken with a digital camera.

Results and discussion

Aster linosyris, stem

Aster linosyris (L.) Bernh. has a multi-angular outlined stem. The one layer thin epidermis cells are egg-shaped and are situated parallel to the surface. Outer walls of the cells are rather thick – a characteristic feature of species of dry habitats. On the surface, cuticular extensions of 2–3 cells can be observed. There is no well defined border between the parenchyma cells and the central cylinder. Collateral vascular bundles are situated in two circles. Vessels of the outer circle are smaller and they are placed under angles. *(Figure 1)* Medullary rays contain 3–6 cell layers. In the cortical parenchyma, alternating segments of collenchyma and chlorenchyma are found. This feature occurs in some other species of *Asteraceae* family, too. (*Metcalfe & Chalk,* 1957) In the direction of angles collenchyma cells are situated. They are thinned, living cells, with the ability of growing besides solidification. (*Sárkony & Szalay,* 1966)

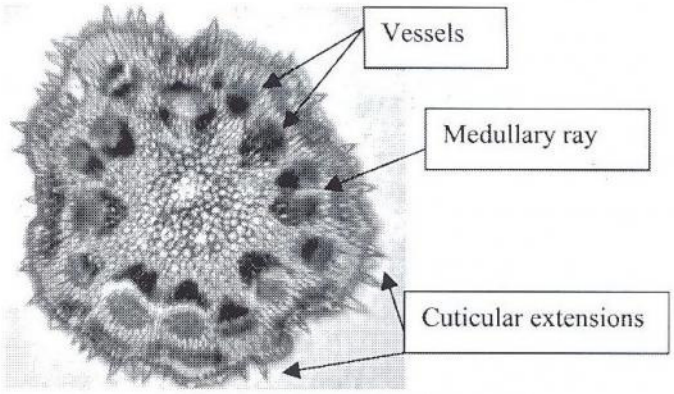
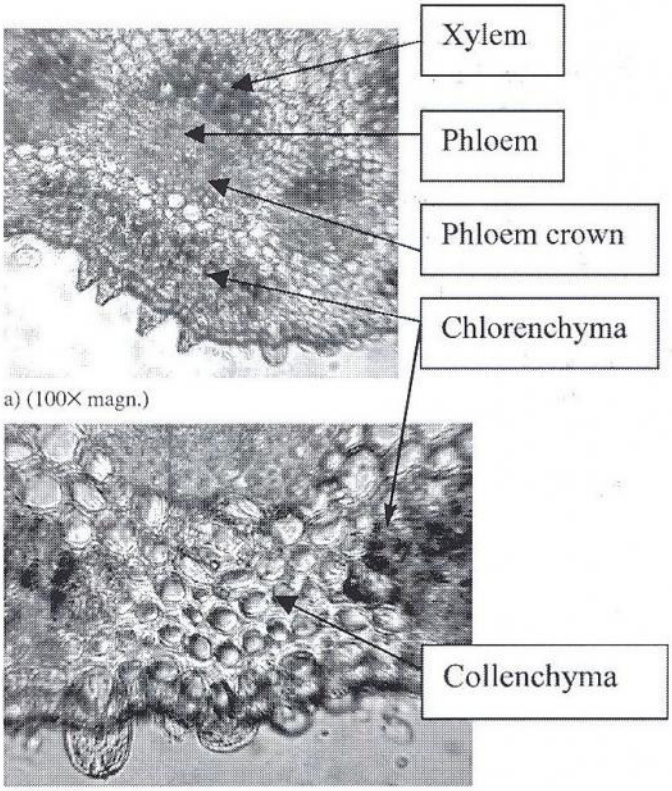


Figure 1 Cross section of *Aster linosyris*' stem (32× magn.)

Between two angles of the stem the heterogenous parenchyma forms chlorenchyma, too *(Figure 2)*. The structure of vessels is collateral: both xylem and phloem can be found in one vessel. Xylems are sickle-shaped with the ends towards the epidermis. Tracheas have large vacuolums. A 1–2-cell thick cambium is situated between the xylem and the phloem. On the outside part of the phloem, a phloem crown of 6–8 cell layers can be observed.



a) (100× magn.)

b) (200× magn.)

Figure 2 (a/b/) Chlorenchyma and collenchyma in the stem of *Aster linosyris*

Aster linosyris, leaf

The outer walls of the leaf epidermis cells are thickened similarly to the same cells of the stem. Cuticular extensions, composed of 2–3 cells are found, too. The mezophyll is rather narrow, palisade parenchyma is situated both on the abaxial and adaxial surface of the leaves, and is rich in chlorophyll. Spongy parenchyma is composed of only 2–3 cell layers. An interesting thing, that near the vein-vessel a schizogen canal exists outside of the phloem. 1–2 vessels can be observed besides the central vessel on both sides of the leaves. Stomata can be found both on the abaxial and on the adaxial surface of the leaves *(Figure 3)*.

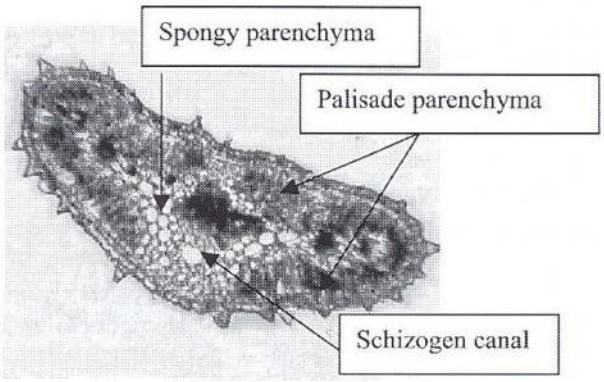


Figure 3 Cross section of a young leaf of *Aster linosyris* (32× magn.)

Aster linosyris, root structure

Under a one-cell-row rhysodermis, a one-cell-layer of hypoderm is found. Its cells are hexagonal, a little bit larger and slightly radically elongated. They contain no conspicuous content. Under the hypoderm a broad, 15–18-cell-layer cortical parenchyma follows, in which the size of cells becomes larger from the outer part toward the inner part. The outer cells contain starch. The radial walls of endodermis cells is thickened in the form of typical casparian bands. The cells of pericycle are slightly tangentially elongated. The vessel-system is tetrarch (rare triarch), 3 simple xylem and 3 simple phloem vessels can be observed *(Figure 4)*.

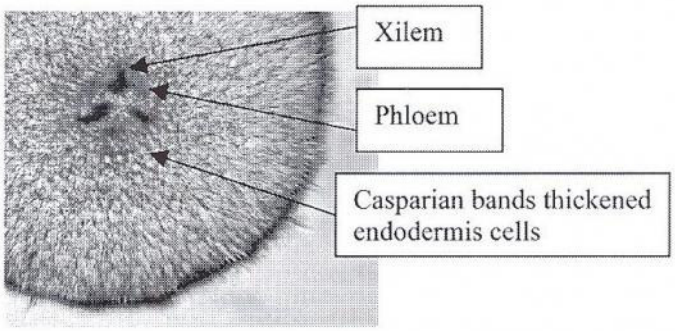


Figure 4 Cross section of a triarch *Aster linosyris* root (32× magn.)

Inula ensifolia, stem

Although the outline of the stem of *Inula ensifolia* L. is roundish, the situation of the vessels is pentagonal. Cuticular extensions, composed of 1–2 cells are found on the outer surface of the epidermis. A difference from *Aster linosyris* is that the cortical parenchyma is broad, it contains approx.

8–12 cell layers. In the central cylinder, 10 collateral vessels (5 and 5 along two circles) are found, the larger vessels placed outer, as is usual. A 2–3 cell thick cambium is situated between the xylem and the phloem. Characteristic is the broad phloem crown. Medullary rays contain 1–2 cell layers, which is thin in comparison with the species of the *Inula* genus (*Metcalfe & Chalk,* 1957) *(Figure 5).*

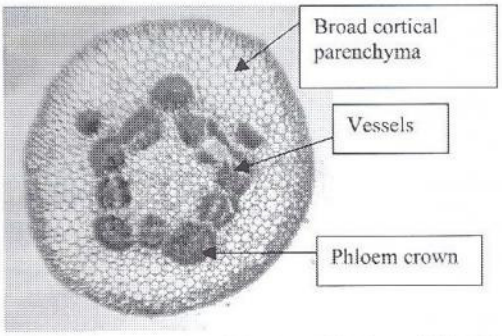


Figure 5 Cross section of the stem of *Inula ensifolia* (32× magn.)

Inula ensifolia, leaf and liguliflor flower

Leaves are a little bit thicker than those of *Aster linosyris.* Besides the vein vessel, 4–5 smaller vessels were found on both sides of the leaves. The outer walls of the epidermis cells are thickened, like in *Aster linosyris* – both species grow, however, in dry habitats. The palisade parenchyma is thin, it is composed of only 2–4 cell layers. The spongy parenchyma have quite a loose structure, the cells have large vacuoles. The vein vessel have a broad phloem crown under the phloem *(Figure 6).* The existing of cuticular extensions are quite interesting on the edge of the leaf *(Figure 7).*

Compositae inflorescences of *Inula ensifolia* consist of both liguliflor and tubuliflor flowers. The liguliflor flowers can be separated into two parts: a long lower part, which consists of three petals unit into one (the so called liguliflor flower); and a short upper part, which consists of two petals united into one (*Jakob* et al., 1985). Cross section of liguliflor flowers (the lower part of the real flower) shows that they have quite homogenous structure, with 3–5 small vessels, and extensions on the surface *(Figure 8).*

Prunella grandiflora, stem and root

The structure of the vessel-system of *Prunella grandiflora* (L.) SCHOLLER is different from that *Aster* and *Inula* and shows similarity with the members of other *Lamiaceae* genera (*Gracza,* 2004). The young stem have four vessels, and in an early stage two other vessels have initiated as well. As the stem becomes older, a nearly continuous vessel-ring forms from the four primary vessels *(Figure 9).* Separate vessels can be observed only a bit. The xylem has 2–4 large tracheas, the phloem contains 6–8 cell layers and a phloem crown of 2–3 cell layers. The diameter of the medullary parenchyma is large, the cells have rich plasmatic contain. The cortical parenchyma cells are situated in 6–8 layers.

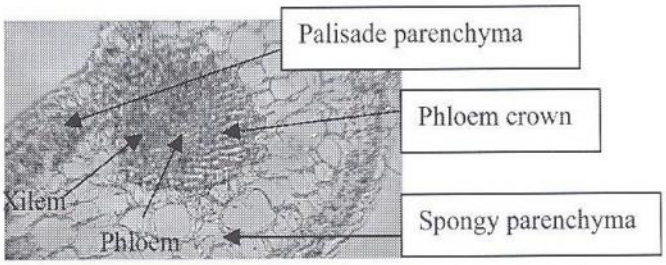


Figure 6 Central vessel of the leaf of *Inula ensifolia* (100× magn.)

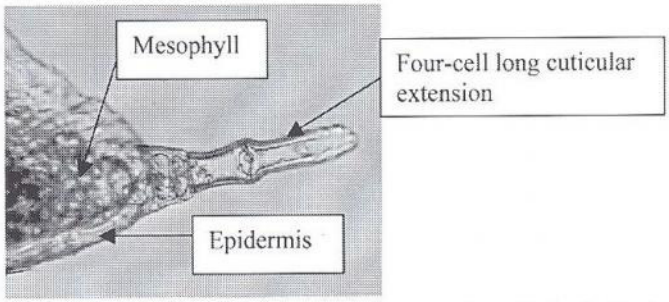


Figure 7 A 4 cells long cuticular extension on the edge of the leaf of *Inula ensifolia* (200× magn.)

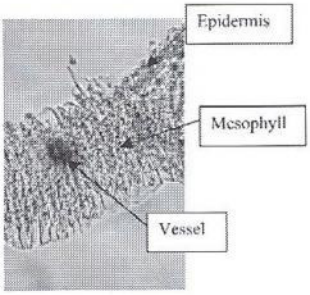


Figure 8 Cross section of the liguliflor flower of *Inula ensifolia* (100× magn.)

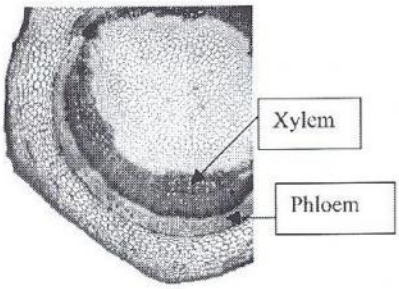


Figure 9 Continuous vessel-ring in the stem of *Prunella grandiflora* (32× magn.)

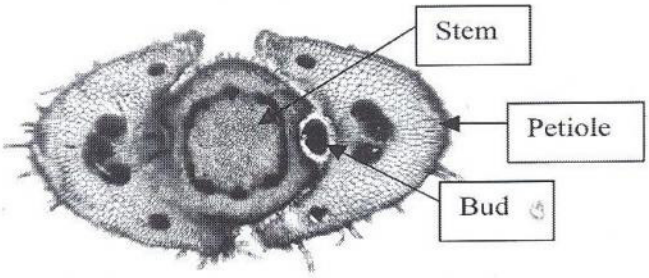


Figure 10 Cross section from the upper part of the stem of *Prunella grandiflora* (32× magn.)

There are long, multicellular hairs in the district of angles of the stem *(Figure 10)*. The roots of *Prunella grandiflora* have a continuous vessel-ring. The primary cortex is broad, composed of 17–19 cell layers. Instead of rhyzodermis, an exodermis of 3–4 cell layers was found.

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