STUDIES ON THE MORPHO-ANATOMY AND CHOROLOGY OF THE BANAT PEONY (*PAEONIA BANATICA* ROCHEL)

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Abstract: *This paper is a botanical (morphological and anatomical) and chorological study of the endemic species Paeonia banatica Rochel (Paeonia officinalis subsp. banatica (Rochel) Soó) – the Banat peony. Knowing the distribution areas of this species is important in the conservation and monitoring of the existing populations. It is well known that, without careful monitoring, numerous protected species are threatened or even extinct in Romania's flora; this could be prevented through both proper management measures and thorough monitoring of the protected areas. The studied material was collected from the Nature Reserve at Baziaş, a reserve included in the Porţile de Fier National Park (Caraş-Severin County). The population present here is well represented and sampling per sections does not threaten the species. We have carried out several morphological and anatomical studies. Anatomic sections were studied microscopically and photographed with a video camera of a MOTIC M 230 microscope. The population in the area analysed is uneven morphologically – this is why we tried to observe certain features or differences – and anatomically – to clarify the species taxonomy. There are controversies related to the taxonomy of the Banat peony in the area: according to certain authors, there are not one, but two different species of the genus Paeonia. The distribution area of the species is rather small in Romania, Hungary and Serbia: this is why we have chosen this species to be studied in detail. Though in the Banat area there is also the species Paeonia mascula, in the Simion Peak area of the Nera Gorges, we did not study both species because the population in the Ciclova-Ilidia Reserve is critically threatened: the picking of a single sample is prohibited because there are only 7-10 plants that do not bloom every year.*

Key words: *Paeonia banatica, Nature Reserve, biology, morpho-anatomy, chorology, endemic species*

INTRODUCTION

Peony (*Paeonia officinalis* L.) is a species known particularly for its ornamental and medicinal aspect. *Paeonia officinalis* L. has been used since Ancient times for its medicinal properties. They use its dried petals to colour herbal teas. (Flora R.P.R., vol. II)

The petals and roots have an antiseptic, diuretic action. In humans, it is used to treat gout, arthritis, and rheumatism; in animals, it is used to treat haemorrhagic cystitis. Petals are picked when they start shedding in potted samples. Fresh petals are picked while the weather is fine, after 10:00 a.m. they are dried on newspapers, in the shadow, preferably in attics covered with tin. The roots are harvested in the fall, at the end of the vegetation period. They are kept in paper bags. The seeds have purgative and emetic properties. In human medicine, they are used to treat chest pains, gout, arthritis, and rheumatism. (PÂRVU, 2000)

Banat peony is a very rare protected species included in the Red List of Romanian Plants (critically endangered). (DIHORU GH., NEGREAN G., 2009)

MATERIAL AND METHODS

We harvested for scientific purposes five samples of Banat peony from the Baziaş area, where the population is well represented and the species is not endangered.

The samples were analysed morphologically (we observed them directly and we noted plant features) and anatomically.

We sectioned the fresh vegetative organs such as root, tuber root, stem, leaf, ovary, and anther. The sections were coloured with Geneva Reactant according to the working protocol, and we then prepared temporary preparations for the microscopic study.

The sections were analysed microscopically and photographed with a video camera of a MOTIC M 230 microscope.

RESULTS AND DISCUSSIONS

Banat peony *Paeonia banatica* Rochel is relatively rarely spread: it can be found in only three countries of Eastern Europe, i.e. in Hungary, Serbia, and Romania. (Flora Europaea http://rbg-web2.rbge.org.uk/FE/fe.html)

In Hungary, its population can be found in the Mecsek Mountains, in an oak forest at an altitude of 280-640 m, with thermophilous vegetation characterised by warm, dry climate. The woody species characteristic to the forest association is *Paeonio banaticae-Quercetum cerridis*, where there is also the Banat peony, are *Quercus cerris* and *Q. petraea* (30-60 cm in diameter), *Fraxinus ornus*, *Acer campestre*, *Sorbus torminalis*, etc. (KEVEY B., 2007)

In Serbia, the species can be found in the sandy steppe of Deliblat, i.e. in the Deliblatska Pescara Nature Reserve, part of the Derdap Nature Park (Province of Vojvodina). There, the Banat peony grows together with *Paeonia tenuifolia*, a species well represented in the area.

The area of origin of the Banat peony is the sandy steppe of Deliblat, Serbia. In the Deliblatska Pesčara Reserve of Serbia, located on the Serbian bank of the Danube River, facing the Baziaş-Belobreşca area, grows the Banat peony together with the steppe peony (*P. tenuifolia*).

In Romania, the Banat peony can be found in at least two places: in the Baziaş Nature Reserve of the Porţile de Fier Nature Park (Caraş-Severin County) and on the Borz Hill (Bihor County).

Literature also mentions its presence at Lugoj and Buziaş but so far, this has not been confirmed. (Flora României, vol. II, 1953, CIOCARLAN, 2009)

Located close to the place where the Danube enters Romania, the Baziaş area is protected for its flora and fauna. The Banat carnation, the Banat peony, the Banat maple, and yellow crocus, together with the land turtle, rock partridge, and black-eared wheatear are just a few of the flora and fauna elements in the area.

The Banat peony was identified in the Baziaş area by Rochel in 1835 as *Paeonia banatica* and later on by Soo 1960. The area where this species was identified lies between Baziaş and Divici, but it is not strictly delimited: this is why identifying it needed several visits in the forests in the area because the natives either do not its exact location.

In this area, the peony is well represented both in the reserve and outside it. It can be found in the forest areas and on grasslands. It prefers rare forests of *Carpinus* sp. and *Quercus* sp. or the borders of forests and avoids the bright sunshine on the grasslands. When on grasslands, it is rare and not in compact groups.

On the Borz Hill (Bihor County), a Botanical Reserve since 1978, there is a well-represented population of *Paeonia officinalis* subsp. *banatica*. Peony can be found at an altitude of 450-600 m (including the Commune of Şoimi). The area is part of the association *Cytiso nigricantis – Quercetum cerris* made up of representative woody species such as *Quercus cerris*, *Quercus petraea*, *Fagus sylvatica*, *Acer pseudoplatanus*, *Cornus mas*, *Crataegus monogyna*, *Ligustrum vulgare*, etc. (TUDUCE A., BRONŢ L., 2007)

Our morphological and anatomical observations are based on similar data presented in various specialty papers. (ANDREI M., 1987, BAVARU A., BERCU R., 2002; CIOBANU I., 1971; ŞERBĂNESCU-JITARIU G., TOMA CT., 1980; IANOVICI N., 2010; SCHWEINBRUGER F.H., BORNER A., SCHULZE E.D., 2005)

Regarding the species of wild peony in Romania, morphological and anatomical recent studies were conducted at *Paeonia peregrina* Mill. (MEREACRE ET AL., 2015).

Morphology and Anatomy of the Species

Based on our own observations, we can note the following:

Peonies are perennial, herbaceous plants, with erect, simple stems; however, cultivated species can also have woody, branchy stems.

Root

Morphologically: It is thick, with a secondary, lignified structure, with tuber-like elongated roots (4-10 cm). It has buds that ensure the vegetative multiplication of the species.

Anatomically: It has a secondary structure because of the cambium and phellogen activity. The secondary structure is recognisable due to the absence of the pith in the central cylinder. (figure 1)

The areas identified from outside towards inside are:

1. Rhizodermis: single layered, present, at the beginning, in the first year of life and replaced later by the suber.

2. Outer layer: it has differentiated areas:

- suber, with 2-3 cell layers, with no inter-cellular spaces;
- phellogen, a secondary tissue that forms suber and phelloderm through division;
- phelloderm (secondary outer layer) with cells that store reserve substances.

3. Central cylinder: it represents 2/3 of the section:

- isolated primary phloem;
- secondary phloem, looking like a continuous ring;
- cambium, a secondary meristem generating secondary liber (phloem) in the outer area and secondary wood (xylem) in the inner area;
- secondary wood, that occupy most of the central cylinder, i.e. about 2/3 of the sectioned area; it has lignified woody fibbers and lignified woody parenchyma that are visible and clearly differentiated annual rings;
- lignified woody rays;
- dilating parenchyma with non-lignified cells;
- no pith.

We have also sectioned the **tuber-like roots** (figure 2).

Anatomically, they have:

- in the outer area: suber, phellogen, phelloderm;
- a visible cambium ring with fuzzy liber-woody fascicles, uneven in size;
- reserve substances (amyloplasts) in the cortical parenchyma; we also noticed frequent solitary or grouped brahisclereids at the level of cortical parenchyma.

Stem

Morphologically: 45-60 cm tall, usually without branches, single-flowered; it has rare hairs.

Anatomically (figures 3, 4):

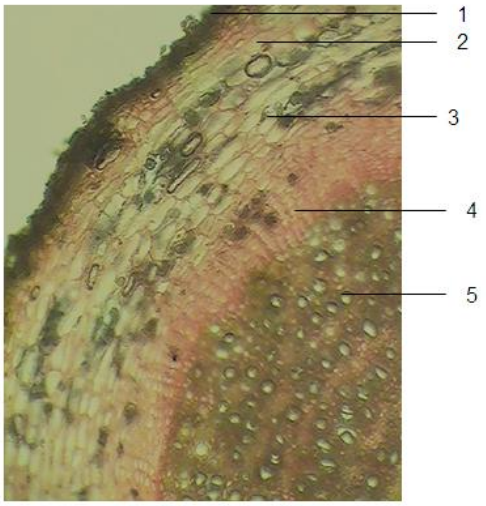
- its transversal cut is pentagonal;
- it has a secondary structure.

The areas identified from the exterior towards the interior are:

1. Epidermis: single-layered, with tightly close cells, with cutinised outer walls.

2. Outer layer: it has differentiated areas:

Outer area with chloroplasts: tabular collenchymas (5-6 cell layers) making up a continuous layer playing a mechanical role.



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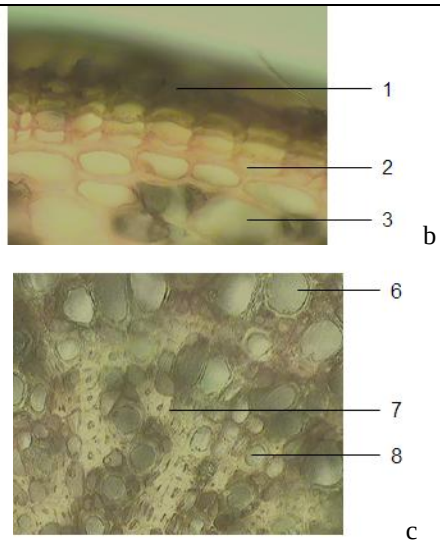

Fig. 1. Cross section of the root: 1- suber; 2- phellogen; 3- phelloderm; 4- secondary liber; 5- secondary wood, (a, b); 6-springwood; 7-woody fibbers; 8-summerwood (c)(10x40, original photos)

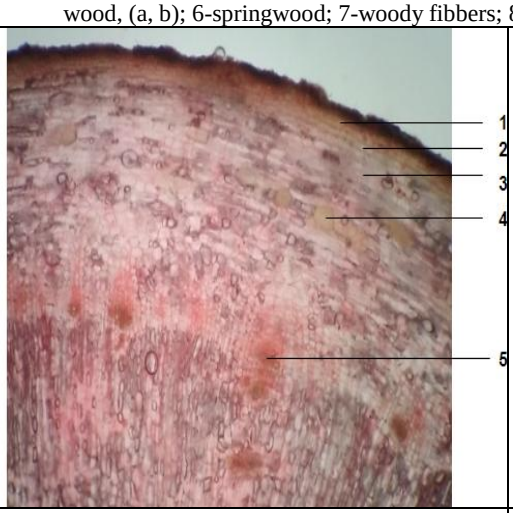

Fig. 2. Cross section of the tuber-like root: 1- suber; 2- phellogen; 3- phelloderm; 4-brahisclereids; 5- liber-woody fascicles; (10x10, original photo)

Fig. 3. Cross section of the stem – general aspect: 1- epidermis; 2- outer layer; 3- central cylinder; (10x10, original photo)

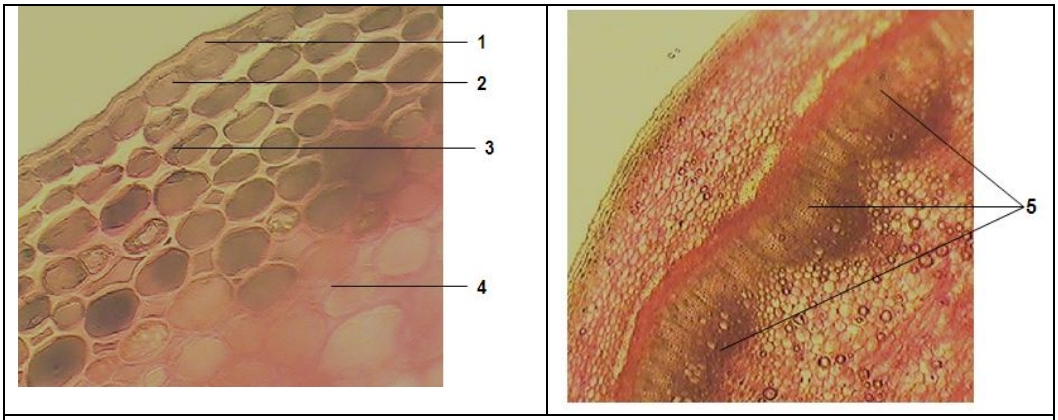

Fig. 4. Cross section of the stem details: 1- cuticle; 2-epidermis; 3- tabular collenchymas; 4- parenchyma cells with reserve substances; 5- liber-woody conducting fascicles (10x40;10x10, original photos)

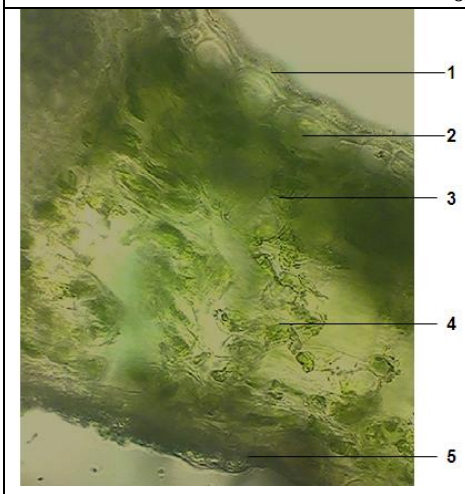

Fig. 5. Cross section of the leaf: 1- cuticle; 2-upper epidermis; 3- palisade mesophyll; 4- lacunose mesophyll; 5- lower epidermis (10x40, original photo)

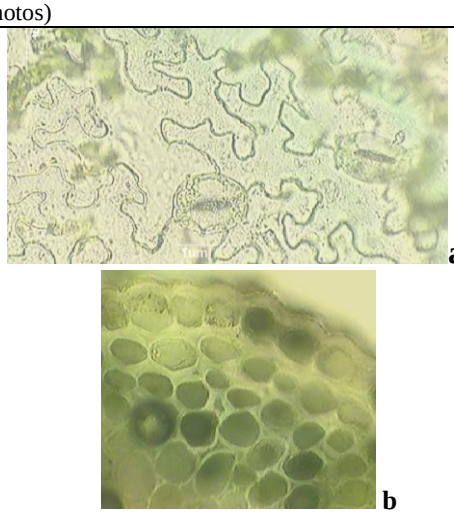

Fig. 6. Cross section of the leaf details: a- anomocytic stomata; b- angular collenchymas (10x40, original photos)

Inner area:

- large, parenchyma cells with reserve substances;
- endodermis not clearly identified as self-supporting tissue.

3. Central cylinder: represents 2/3 of the section:

- it has no peri-cycle;
- it has collateral-open liber-woody conducting fascicles in a single circle, alternating large and small ones, very close and making up an almost continuous area with:
  - outer fibbers of liber sclerenchyma making up a thick rope of 3-5 layers interrupted over small portions;

- phloem (liber) made up of tubes with small holes, annexe cells and a few liber parenchyma cells;
- xylem (wood) with proto-xylem towards the pith and meta-xylem towards the cambium; it has liber sclerenchyma fibbers characteristic to secondary structures;
- pith made of thin wall parenchyma cells.

Leaves

Morphologically: compound, alternate, with no stipple, 2-3 times sectate, with broad-lanceolate acute folioles, full margined or unilaterally lobate, with bilaterally-lobate terminal margins, green below, glabrous or with rare hairs, long decurrent along the rachis.

Anatomy: bifacial structure with the following organisation (figures 5,6):

Epidermis:

- **upper:** single-layered, cutinised, glabrous;
- **lower:** cutinised single-layered, with stomata and rare hairs (hipostomatic lamina); stomata are anomocytic, with kidney-like stoma cells accompanied by 4 annexe cells;

Mesophylle:

- palisade towards the upper epidermis, made up of 2-3 cell layers;
- lacunose more developed than the palisade one (dorso-ventral bifacial structure).

Median nerve:

- below the lower epidermis and also on the upper one there is an angular collenchymas playing a mechanical role;
- the liber-woody conducing fascicle has wood towards the upper epidermis and liber towards the lower one.

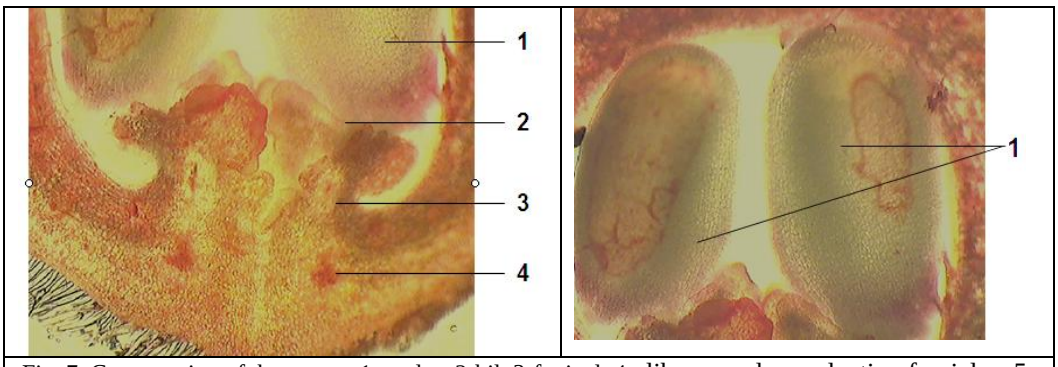

Fig. 7. Cross section of the ovary : 1-ovules; 2-hil; 3-funicul; 4 - liber-woody conducting fascicles; 5-polen (10x40, original photo)

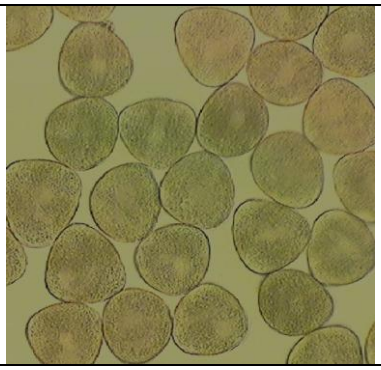

Fig. 8. Polen morphology (10x40, original photo)

Flower

Morphologically: bisexual, solitaire, actinomorphic, of the 5 type, with free elements:

- 5 free sepals;
- 5-8 red-purplish petals;
- androecia with numerous stamina with red-purplish filaments at the basis and white filaments in the upper third portion; the anthers are yellow with prismatic pollen (figure8);
- gynaecium with a variable number of carpels (1-4);
- pubescent ovary, style plus absent, purplish stigma;
- nice-smelling flowers;
- it blooms in our area at the beginning of April (April 10-20).

Anatomically:

- epidermis;
- homogeneous parenchyma;
- liber-woody fascicles of the collateral type (liber close to the outer side);
- ovules, 2 orthotropic (figure 7).

Fruit

Morphologically:

- poly-follicle, made up of 1-5 or, frequently, 2-3 follicles, very hairy upon maturity (figure 9, a);
- large seeds, ovate, black upon maturity, red at the beginning (figure 9, b,c).

a

b

c

Fig. 9. Fruit: a- poly-follicle; b-immature seeds; c-mature seeds (original photo)

CONCLUSIONS

Banat peony has not been studied morpho-anatomically: its features can be comparative reference points in species taxonomy.

Though important from a medicinal perspective, the species analysed above is protected and could be used medicinally only if cultivated. We recommend sampling genetic material for storage in gene banks though the population is well represented in the Baziaş Reserve.

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