MORPHO-ANATOMICAL STUDIES ON THE SHOOT'S INTERNODE IN SOME GRAPEVINE VARIETIES CULTIVATED IN IASI AND COTNARI VINEYARDS

CERCETĂRI MORFO ANATOMICE ÎN AXUL LĂSTARULUI LA UNELE SOIURI DE VIȚĂ DE VIE CULTIVATE ÎN PODGORIILE IAŞI ŞI COTNARI

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Abstract. *The morphology and anatomy of the shoot and root are criteria for the classification of taxonoms in the vine. Moreover, the anatomical variability of different genotypes is in direct relationship with the efficiency of water use. The adaptation to water stress is based on the hydraulic conductance of the plant, which is determined by the diameter and density of vessels in the xylem. In the study we analyze the morpho-anatomical structure of the shoot internode in the flowering phenophase at Frâncuşă, Fetescă albă, Grasă de Cotnari and Tămâioasă românească vine varieties cultivated in Iasi and Cotnari vineyards, under the conditions of 2011. The differences between the varieties are visible in the secondary structure which result from the activity of cambium and phelogen meristems, especially in conducting tissues and refers to the number of layers of collenchyma, number of conducting beams (vascular bundles), presence of concentric beams and calotte of lignified cells in the liberian parenchyma.*
Key words: *Vitis vinifera* varieties, water stress, shoot anatomy

Rezumat. *Morfologia şi anatomia lăstarului sunt criterii de clasificare a taxonilor la viţa de vie. Mai mult, variabilitatea anatomică a diferitelor genotipuri este în relaţie directă cu eficienţa utilizării apei. Adaptarea faţă de stresul hidric se bazează pe conductanţa hidraulică a plantei, care este determinată de diametrul şi densitatea vaselor din xilem. În lucrare analizăm structura morfo-anatomică a axului lăstarului în fenofaza de înflorire la soiurile de viţă de vie Frâncuşă, Fetească albă, Grasă de Cotnari şi Tămâioasă românească, cultivate în podgoriile Iaşi şi Cotnari, în condiţiile anului 2011. Diferenţele dintre soiuri sunt vizibile în structura secundară care rezultă din activitatea meristemelor cambiu şi felogen, în special în ţesuturile conducătoare şi se referă la numărul de straturi de colenchim, numărul de fascicole conducătoare, prezenţa fascicolelor concentrice şi calota celulelor lignificate din parenchimul liberian.*
Cuvinte cheie: soiuri *Vitis vinifera*, stres de apă, anatomia lăstarului

INTRODUCTION

The morpho-anatomical study of the grapevine represented the subject of several important papers (Metcalfe and Chalk, 1950) or individual studies (Chatelet et

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al., 2008), of specialists in anatomy (Zanoschi et Toma, 1985) or oenologists (Jackson, 2008). The characteristics of the secondary phloem and their role in classifying the cultivars was initially demonstrated by (Esau, 1965) and confirmed by further research studies (Aloni and Peterson, 1991; Swanepoel et al., 1984).

MATERIAL AND METHOD

The botanical material taken into the study is represented by fertile and sterile shoots from seven different varieties of grapes belonging to the *Vitis vinifera L.* species: Băbească gri, cultivated in Iaşi; Fetească albă, cultivated in Cotnari; Fetească regală, cultivated in Iaşi; Frâncuşă, cultivated in Iaşi; Grasă de Cotnari, cultivated in Iaşi and Cotnari; Riesling italian, cultivated in Iaşi; Tămâioasă românească, cultivated in Iaşi and Cotnari.

RESULTS AND DISCUSSIONS

The cross section of the shoot's internode presents a circular ribbed contour. All the varieties present an incipient secondary structure, so that the epidermis is not yet replaced by the periderm and the level of suberin and pheloderm is quite low.

The epidermis, characteristic to the primary structure, consists of closely united polygonal cells with convex outer walls that are thicker than the rest and costated. At the level of the collenchyma, the epidermal cells are relatively tall, while in the parenchymal area they are slightly tangentially oblong (fig. 1). Here and there tector hairs generally pluricellular, but also simple can be seen as well as stomata. The latter ones, in the case of the varieties we refer to, have a variable position; thus, most often the stomata are situated at the level of the epidermic cells and form a substomatal chamber, not very obvious.

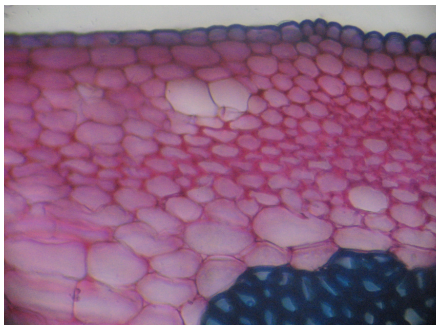

Fig. 1 - Riesling italian *variety*, cultivated in Iaşi – Cross section of fertile shoot pointing out the epidermis

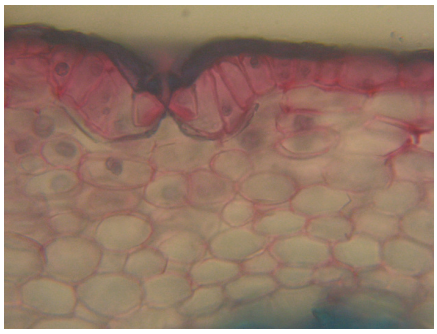

Fig 2 - Fetească albă *variety*, cultivated in Cotnari - Cross section of fertile shoot pointing out the stomata

In other cases (Fetească albă fertile shoot cultivated in Cotnari) they are situated under the level of the epidermic cells and form an obvious suprastomatal

chamber (fig. 2). This suggests the existence of some xerophyte adjustments determined by environmental conditions.

The bark is thin, formed by assimilator cellulosic parenchyma areas alternating with angular collenchyma areas (fig. 3) that are most often situated at the level of the vascular bundle. The central cylinder occupies most part of the section and consists of numerous conducting liberian and wooden fascicles of open collateral type with a circular structure. At this level we can notice the beginning of the development of the secondary structure based on lateral meristems. The moment the phellogen is formed depends of the variety's precocity. Suber and phelloderm tissues are poorly represented.

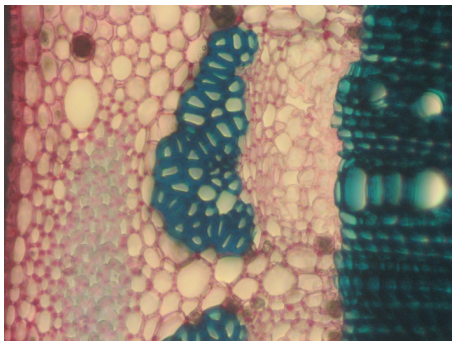

Fig. 3 - Fetească albă *variety*, cultivated in Cotnari - Cross section of fertile shoot pointing out the absence of the phellogen

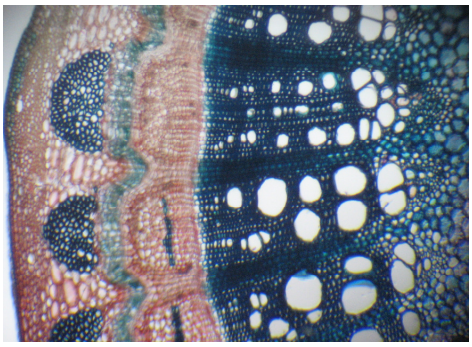

Fig. 4 - Fetească albă *variety*, cultivated in Cotnari - Cross section of sterile shoot pointing out the continuous phellogen

The sections performed at different varieties pointed out the presence of phellogen (fig. 4) in the fertile shoot of the following varieties Frâncuşă, Grasă de Cotnari and Tămâioasă românească, cultivated in Iaşi and Fetească albă cultivated in Cotnari. Pericyclic fiber (periphoemic) cordons are highly present at the periphery of the phloem (fig. 3).

The cambium has an annular shape in cross section and a bifacial functioning system, producing towards the outside the secondary liber and towards the inside the secondary wood; the latter one presents annual rings with young wood vessels (fig. 4) with a diameter larger than of the late wood vessels. Once the secondary phloem and wood are formed, the primary liber is pushed towards the outside and crushed so that it can hardly be recognized at the tendrils with a typical secondary structure.

The secondary liber is characterized by an alternation of the bands of lignified liberian fibers with thick walls (hard phloem) and screened tubes (soft phloem), annex cells and liberian parenchyma cells. The structure is different depending of the variety presenting up to 3 bands of hard phloem (fig. 5) each of them with a variable number of layers (2-5).

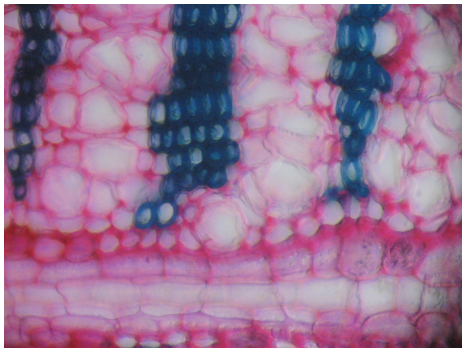

Fig. 5 - Băbească gri *variety*, cultivated in Iaşi - Cross section of sterile shoot pointing out the liber

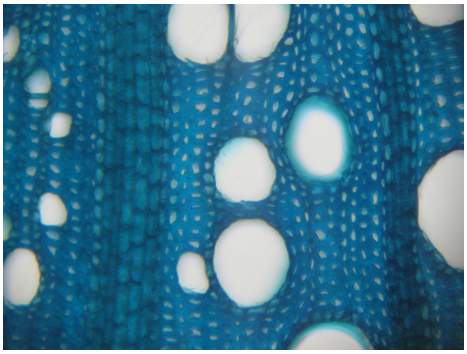

Fig. 6 - Tămâioasă românească *variety*, cultivated in Iaşi - Cross section of fertile shoot pointing out the wood

The wood occupies a wider area than the phloem, presenting medullary rays narrower than the ones from the liber. The secondary wood consists of sclariform and dotted vessels, septate wood fibers and wood parenchyma cells all having thick lignified walls. Towards the medulla, the primary wood can also be noticed with cellulosic parenchyma cells between the radiant vessels rows.

The diameters of the wood vessels are highly different despite being on the same section and the width of the medullary rays varies between 2 – 5 or even 7 layers (fig. 6).

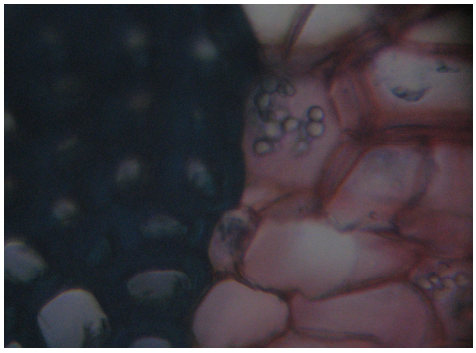

Fig. 7 - Grasă de Cotnari *variety*, cultivated in Iaşi - Cross section of fertile shoot pointing out the starch granule next to the liber

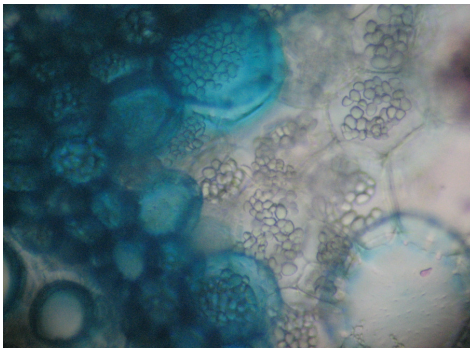

Fig. 8 - Fetească regală *variety*, cultivated in Iaşi - Cross section of fertile shoot pointing out the starch granule from the cortical parenchyma

Usually, towards the end of the vegetation season, the liberian parenchyma cells and the liberian medullary rays present starch and tannin. In the case of the varieties included in the present study we noticed only rare granules of starch at the liberian medullary rays, scarcely next to the pericyclic fibers (fig. 7) and very numerous at the wood medullary rays (for example the fertile shoots of Fetească albă cultivated in Iasi). In the case of the fertile shoot of Fetească regală that is

cultivated in Iasi, numerous granules of starch were noticed in the outer cellular layers of the cortical parenchyma (fig. 8).

From the papers consulted and included in the biography resulted that the medullar rays cells contain simple crystals (often needle like crystals) or calcium oxalate ursini (fig. 11). In the case of the varieties included in the present study, the types of crystals and their distribution was more varied. We noticed its massive presence in the marginal layers of the medullar rays from the liberian level (fig. 9) and the rare presence in the wood medullar rays (in the fertile shoot of Fetească albă, cultivated in Cotnari – fig. 10). In the medullar parenchyma cells, the presence of raphides was noticed (at the sterile shoot of Fetească albă, cultivated in Cotnari – fig. 12, at the fertile shoot of Fetească regală cultivated in Iasi).

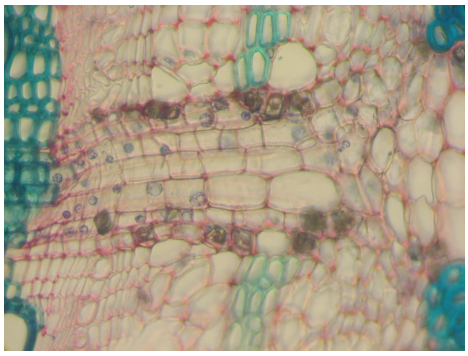

Fig. 9 - Fetească albă *variety*, cultivated in Cotnari - Cross section of fertile shoot pointing out the chrystals

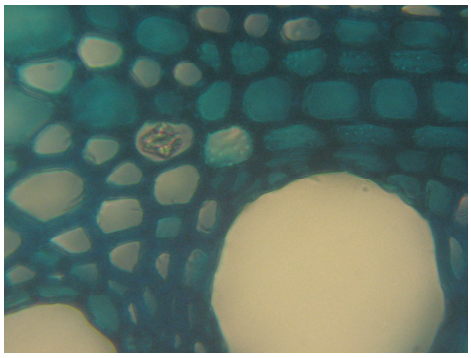

Fig. 10 - Fetească albă *variety*, cultivated in Cotnari - Cross section of fertile shoot pointing out the chrystals

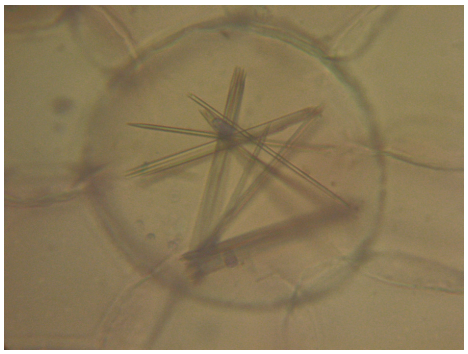

Fig. 11 - Fetească albă *variety*, cultivated in Cotnari - Cross section of fertile shoot pointing out the niddle like chrystals

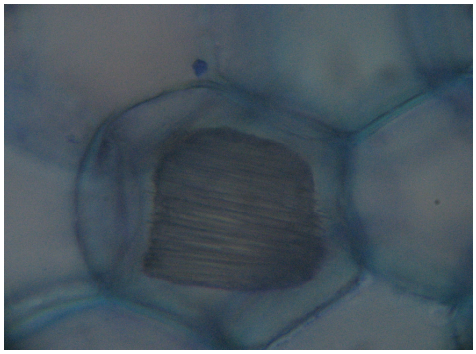

Fig. 12 - Fâncuşă *variety*, cultivated in Iaşi - Cross section of fertile shoot pointing out the raphides

CONCLUSIONS

1. The varieties taken into consideration for the present study are in the developing phase of the secondary structure.

2. The phellogen's apparition and the well functioning depend of the variety's precocity.

3. In the case of Fetească albă variety, the presence of stomata under the level of the epidermis suggests it's adaptation to the hydric stress.

4. The development of the hard phloem at the secondary phloem is different depending on the variety's precocity, the information presented in the specialized literature.

5. The distribution and the types of calcium oxalate crystals are very varied, resulting differences from what is presented in the specialized literature.

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