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NOTES ON THE MORPHO-ANATOMY OF *ACONITUM DEGENII* GAYER

IRINA STĂNESCU[*], C. MARDARI[*], C. TĂNASE[**]

Abstract. The paper is focused on some morpho-anatomy aspects of *Aconitum degenii* which belongs to *Ranunculaceae* family. The vegetal material has been preserved in ethylic alcohol 70% and then prepared after protocols specific to the vegetal histo-anatomy laboratories. The root reveals known anatomic regions: rhizodermis, cortex and endodermis. The cross section through the stem shows a thick sclerenchymatic pericycle represented by numerous layers of cells with thickened and lignified walls. The vascular bundles are numerous, their phloemic pole is implanted in the sclerenchymatic ring. In the inferior level of the stem, the medullary tissue disorganizes and forms a wide aeriferous canal. Leaves are petiolated. Their petioles bear vascular bundles of various numbers and dimensions. As much as the cuttings are made towards the inferior level, the phloemic pole of the vascular bundles presents a few sclerenchymatic elements or is entirely implanted in a sclerenchymatic ring as in the stem from the same level. The foliar limb is hypostomatic (anomocytic stomata) and reveals bifacial-isofacial (in the leaves from the upper level of the stem) or bifacial-heterofacial (in the leaves from the other levels of the stem) structure, with normal dorsiventrality.
Key words: *Aconitum degenii*, sclerenchymatic pericycle, anomocytic stomata

Introduction

Aconitum genus belongs to *Ranunculaceae* family, *Helleboroideae* subfamily and includes almost 70 species, most of them native in the mountaineous regions of the north temperate zone. *Aconitum* species contain aconitine, a very poisonous alkaloid. *Aconitum* species have long been used in the traditional medicine of Asia (India, China). The herb was cultivated widely in Europe, where it was farmed with some difficulty, but came to be widely valued as diuretic and diaphoretic; also, it is used to treat coldness, general debilitation, appendicitis and to reduce fever in colds, pneumonia, quinsy, laryngitis. Taken internally, aconite acts very notably on the circulation, the respiration, and the nervous system [14].

Aconitum degenii (Figs. 1 and 2) is a spontaneous herbaceus perennial plant, with eurasiatic origin. It prefers full light, montaneous cool regions, neutral moist soil, rich in nitrogen. *A. degenii* is a plant of 60 – 150 cm high. The leaves are altern disposed, petiolated, palmately divided [3]. The flowers are violet, zygomorphic, with numerous stamens, hooded and long petiolated, clustered in lax inflorescences, which give to the plant an ornamental importance. Is a perennial hemicryptophyte plant. It can be easyly and frequently recognized in phytocoenoses of high scrubs and weeds. *A. degenii* is a diplo-polyploid plant, sporadic in our country (beech level – fir level).

Information about species belonging to *Ranunculaceae* family were presented in many studies regarding the organization of the angiosperms [4, 5, 8, 12], plant development [7], floral diversity [10, 12] or anatomy and morphology investigations [2, 6, 9, 13]. The

[*] "Anastasie Fătu" Botanic Garden, "Alexandru Ioan Cuza" University of Iasi. irinastanescu2005@yahoo.com, mardariconstantin@yahoo.com
[*]Faculty of Biology, "Alexandru Ioan Cuza" University of Iasi. tanase@uaic.ro

present paper enphasizes a few morpho-anatomic aspects of *A. degenii* related with its ornamental importance.

Material and methods

In order to investigate the histo-anatocmic structure, the vegetative organs of *Aconitum degenii*, collected by Bistritei Mountains, were subjected to the following steps: 1) preservation in etylic alcohol 70%; 2) obtaining various histologic cuttings using manual microtom; 3) eliminating the cellular content (using sodium hypochlorite for 20-35 minutes, then washing with acetic water and distilled water); 4) staining the cuttings with iodine green and ruthenium red- a classical staining used in vegetal histo-anatomic studies [1 and 15]; 5) obtaining permanent slides: mounting in gel the histo-anatomic cuttings and 6) analyzing the slides in Optika light microscope and obtaining photos by means of a Canon A540 camera.

Results and discussions

The root. A cross section through a thin root reveals a waved shape and evidences a primary structure, with known anatomic regions: rhizodermis, cortex and central cylinder (Figs. 3-5). The rhizodermis consists of small, almost isodiametric cells with stucked out external wall and thickened external wall, which give us information about the fact that the root forms mycorhizis with some fungi species. The cortical parenchyma consists of 10-12 layers of big cells; here and there a few isolated cells or clusters of cells with thick and strongly lignified walls can be seen. There is no exodermis, but there is a typical endodermis with Casparian thickenings in the lateral walls of the cells. The pericycle is formed by a layer of parenchymatic cells with thin walls. The central cylinder (Fig. 5) consists of 4 xylemic bundles, formed by vessels with thick and lignified walls and 4 phloemic bundles, alternatively disposed, formed by sieved tubes and guard cells.

The cross section through a thicker root (Figs. 6-11) shows a primary structure, too, similar to the anterior one, but the rhizodermic cells are bigger, the cortical parenchyma is thicker, while its component cells present a initiation of angular collenchymatization process (Fig. 7). Endodermis presents Casparian thickenings in the lateral walls of the cells. Pericycle presents small cells, most of them have division walls. The central cylinder (Fig. 8) consists of 7 xylemic bundles which alternate with 7 phloemic bundles. The xylemic vessels are numerous/bundle and bear thickened and strongly lignified walls. At the same time, cambium shows numerous division cells which means that differenciation is in progress. The tissue of the external part of phloem presents angular collenchyma in its component cells. The center of the root is occupied by a celulosed parenchyma consisting of cells with thick walls.

The stem. The cross section through the superior level of the stem (Figs. 12-14) evidences a pentagonal profile. The epidermis consists of isodiametric cells, with stucked out, thickened external walls, covered by thin cuticle. Here and there, stomata are present, at the same level with the epidermic cells. The cortex is parenchymatic, thin, formed by 3-4 layers of cells, the external one is collenchymatised. The central cylinder starts with a sclerenchymatic pericycle represented by 6-7 layers of cells with thickened and lignified walls (thicker near the phloem of the vascular bundles, protecting it). The phloemic-

xylemic vascular bundles are numerous (18), of various dimentions, with the phloemic pole implanted in the sclerenchymatic ring, as it is mentioned in anatomy handbooks, too [11]. Each vascular bundle bear xylem vessels of various dimentions, with thick and lignified walls, while the phloem consists of sieved tubes and guard cells. The bundles are separated by cellulosed parenchyma formed by cells with thin walls. The medullary parenchyma bears big cells, with thin cellulosed walls, which form big meatus.

The cross section through the middle level of the stem (Figs. 15-17) evidences the same pentagonal profile, but the sclerenchymatic ring is thicker and its cells bear strongly thickened walls. The central cylinder consists of more (20-22) phloemic-xylemic vascular bundles of various dimentions, with similar structure as the first one analyzed. The cross section through the inferior level of the stem (Figs. 18-20) evidences a circular profile. The cortex is thicker, but less collenchymatised. The sclerenchymatic ring is thicker, with cells bearing thick and lignified walls, but the thickness and lignification is stronger in the cells closed to the phloemic elements, resulting a protective sheath. The central cylinder consists of almost 40 vascular bundles of various dimentions, while the medullary parenchyma is disorganized, resulting a wide medullary canal.

Aconitum degenii has big leaves, altern disposed, petiolated, palmately divided.

The petiole belonging to the leaves from the upper level of the stem has a crescent profile in cross section (Figs. 21 and 22). Epidermis consists of isodiametric cells, with the external wall stucked out, thickened and covered by thin cuticle. The fundamental parenchyma consists of few layers of parenchymatic cells. Eight vascular bundles of various dimentions are disposed on two layers; they present the same structure as the bundles of the stem. In front side view, the epidermis (Figs. 23 and 24) consists of cells with curved walls; the walls are more curved in the lower epidermis. Stomata of anomocytic type are present only in the lower epidermis (Fig. 24), so the foliar limb is hypostomatic.

The cross section through the foliar limb shows liniar profile (Fig. 25 and 26). Both epidermis consist of big polygonal cells, with the external walls covered by thin cuticle. Stomata are present in the lower epidermis. The mesophyll is homogenous, lacunary, but with small lacuna towards the upper epidermis and big lacuna towards the lower epidermis; vascular bundles are present, the middle one is bigger than the others; its phloemic pole is protected by a sheath of parenchymatic cells which collenchymatize their walls. As the parenchyma is homogenous, the foliar limb has a bifacial-isofacial structure, with normal dorsi-ventrality. In the middle level of the stem, the petiole is crescent in cross section, with a deeper groove at the adaxial face (Fig. 27 and 28). The tissue from the center of the petiole disorganizes, resulting an aeriferous canal.

In front side view, the foliar limb is hypostomatic (Figs. 29 and 30), with similar structure as we mentioned before. The cross section through the foliar limb is quite liniar. This time, the mesophyll (Fig. 31 and 32) is differentiated into uni-layered pallisade tissue toward the upper epidermis and lacunary tissue toward the lower one, so the foliar limb has bifacial-heterofacial structure, with normal dorsi-ventrality. In the lower level of the stem, the petiole is wider with a less depper groove at the adaxial face (Figs. 33-35); the fundamental parenchyma consists of 12-15 phloemic-xylemic vascular bundles of various dimentions, implated in s sclerenchymatic ring formed by cells with thickened and lignified walls. The tissue from the center of the petiole disorganizes, resulting a wider aeriferous

canal. The foliar limb is hypostomatic (Figs. 36 and 37); the mezophyll is differentiated in pallisade tissue and lacunary tissue (Figs. 38-40).

Conclusions

The root reveals known anatomic regions. The stem shows a thick sclerenchymatic pericycle represented by numerous layers of cells with thickened and lignified walls. The vascular bundles are numerous, their phloemic pole is implanted in the sclerenchymatic ring. Leaves are petiolated. Their petiole bears vascular bundles of various numbers and dimensions. As much as the cuttings are made towards the inferior level, the phloemic pole of the vascular bundles presents a few sclerenchymatic elements or is entirely implanted in a sclerenchymatic ring as in the stem from the same level. The foliar limb is hypostomatic (anomocytic stomata) and reveals bifacial-isofacial (in the leaves from the upper level of the stem) or bifacial-heterofacial (in the leaves from the other levels of the stem) structure, with normal dorsiventrality.

Acknowledgements

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REFERENCES

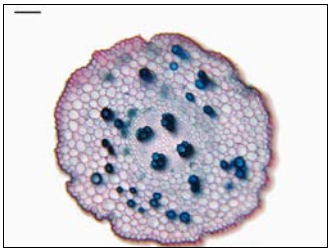
1. ANDREI M., PARASCHIVOIU R. M., 2003 - *Microtehnică botanică*. Ed. Niculescu, Bucureşti
2. CANDAN F., SIK L., 2006- Comparative morphological research on *Anemone blanda* Schott & Kotschy and *Anemone coronaria* var. *coccinea* (Jord.) burn occurring in West Anatolia, Turkey. *J. Fac. Sci.*, **29**: 1-12
3. CIOCÂRLAN V., 2000 - Flora ilustrată a României. Edit. Ceres, Bucureşti
4. DAVIS L. S., 2002, Allocation to floral structures in *Thalictrum pubescens* (*Ranunculaceae*), a cryptically dioecious species. *Annals of Botany*, **90**: 119-126
5. EZELARAB G. E., DORMER K. J., 1963, The organization of the primary vascular system in *Ranunculaceae*. *Annals of Botany*, **27**: 23-38, 1963
6. FILIPESCU G., 1973- Anatomia organelor vegetative la *Aconitum romanicum* Wol. unitate taxonomică endemică. *Anal. Şt. ale Univ. „Al. I. Cuza" din Iaşi*, S. II^{a} (*Biol. veget.*), **19** (2): 311-315
7. FRIEDMAN W. E., MOORE R. C., PURUGGANAN M. D., 2004- The evolution of plant development. *Ann. of Bot.*, **91**(10): 1726-1741
8. HEIMSCH CH., SEAGO J. L. JR., 2008- Organization of the root apical meristem in angiosperms. *Am. J. of Botany*, **95**(1): 1–21
9. KÖKDİL G., İLÇİM A., ÖZBİLGİN B., UYGUN C., 2006- Morphology and stem anatomy of some species of genus *Nigella* L. in Turkey. *J. Fac. Pharm.*, **35** (1) 19-41
10. MARDARI C., 2008 – Aspects of the floristic diversity in Neagra Broştenilor river basin (Eastern Carpathians) (I), *Journal of plant development*, 15: 63-68
11. METCALFE C. R., CHALK L., 1972- *Ranunculaceae*, **1**: 1-7; In *Anatomy of the Dicotyledons*, Clarendon Press, Oxford
12. OPREA A., 2005- *Lista critică a plantelor vasculare din România*. Ed. Univ. „Al. I. Cuza" Iaşi
13. ÖZDEMIR C., ALTAN Y., BARAN P., AKTAS K., 2008- Morphological and anatomical studies on medicinally and economically important *Anemone narcissiflora* L. subsp. *narcissiflora* (*Ranunculaceae*). *Res. J. of Agric. and Biol. Sci.*, **4**(6): 875-880
14. PÂRVU C., 2006- *Universul plantelor*, Ed. Asab, Bucureşti
15. ŞERBĂNESCU-JITARIU G., ANDREI M., MITROIU-RĂDULESCU N., PETRIA E., 1983- *Practicum de biologie vegetală.* Ed. Ceres, Bucureşti

Explanation of plates

PLATE I:
Aconitum degenii (Figs. 1 and 2),
Cross section through a thin root (Figs. 3-5)
Cross section through a thicker root (Figs. 6-11)
PLATE I:
Aconitum degenii (Figs. 1 and 2),
Cross section through a thin root (Figs. 3-5)
Cross section through a thicker root (Figs. 6-11),
PLATE II:
Cross section through the upper level of the stem (Figs. 12-14)
Cross section through the middle level of the stem (Figs. 15-17)
Cross section through the lower level of the stem (Figs. 18-20)
Leaves from the upper level of the stem: cross section through the petiole (Figs. 21 and 22),
PLATE III:
Upper epidermis (Fig. 23),
Lower epidermis (Fig. 24) and cross sections through the foliar limb (Figs. 25 and 26)
Leaves from the upper level of the stem: cross section through the petiole (Figs. 27 and 28),
Upper epidermis (Fig. 29),
Lower epidermis (Fig. 30)
Cross sections through the foliar limb (Figs. 31 and 32)
PLATE IV:
Leaves from the upper level of the stem: cross section through the petiole (Figs. 33-35),
Upper epidermis (Fig. 36),
Lower epidermis (Fig. 37)
Cross sections through the foliar limb (Figs. 38-40)

Fig. 1


Fig. 2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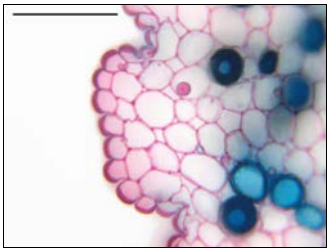
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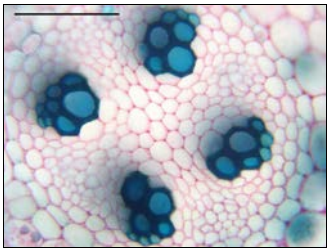
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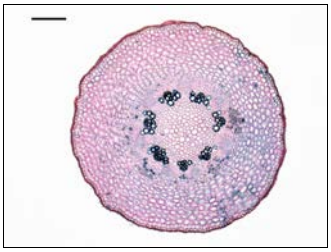
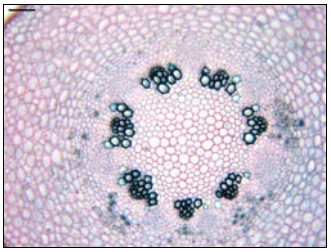


Fig. 6


Fig. 7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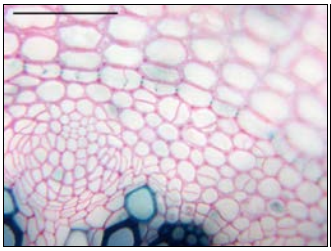
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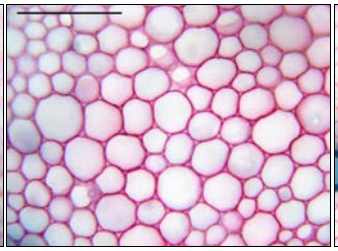
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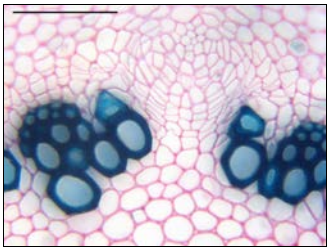
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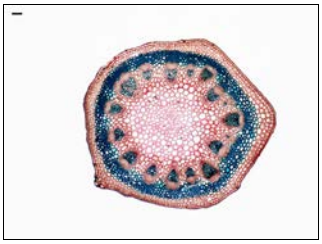

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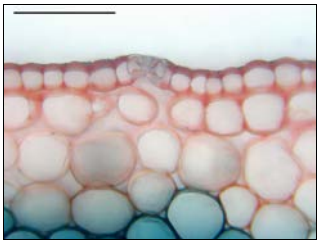

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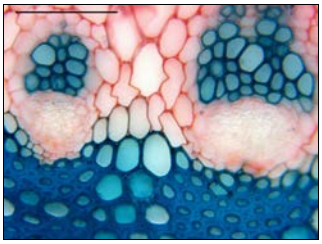

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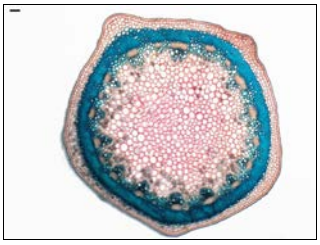

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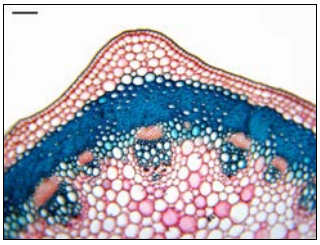

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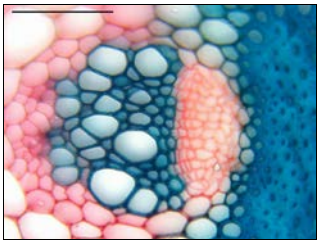

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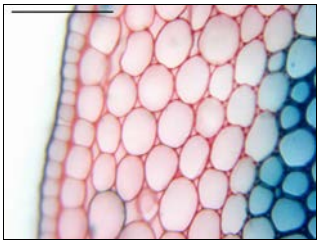
Fig. 18



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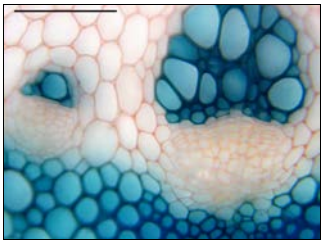

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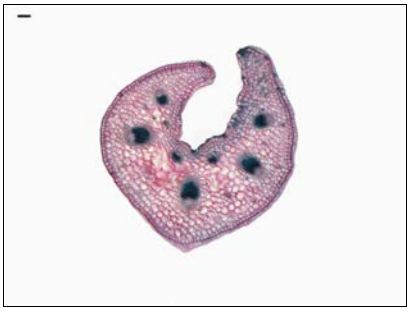

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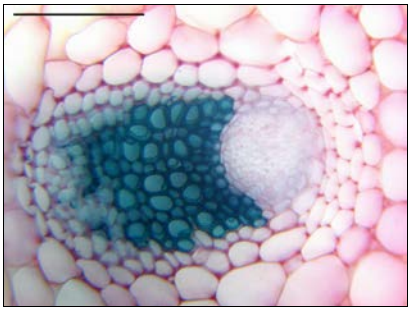

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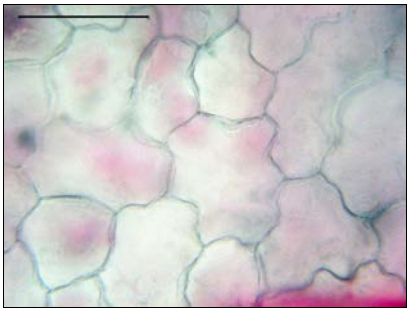

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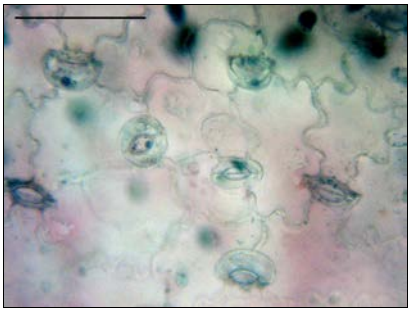

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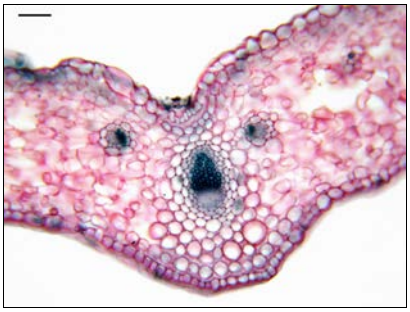

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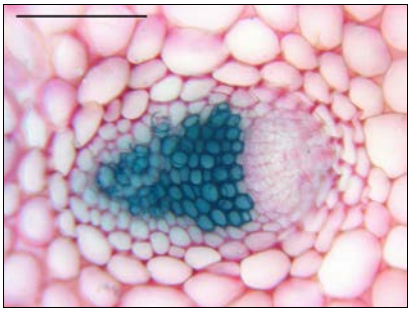

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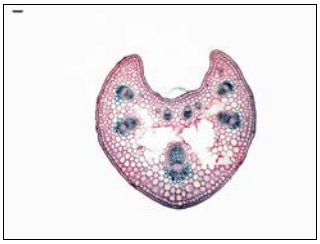

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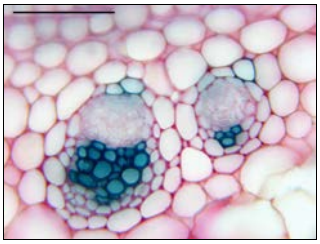

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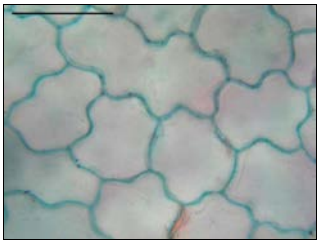

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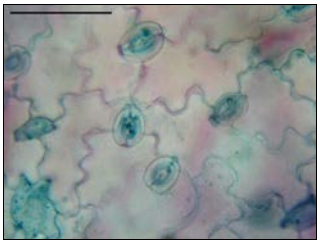

Fig. 30

Fig. 31

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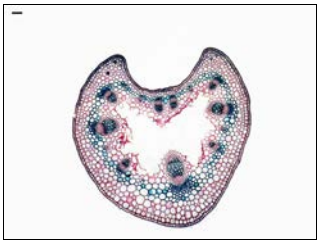

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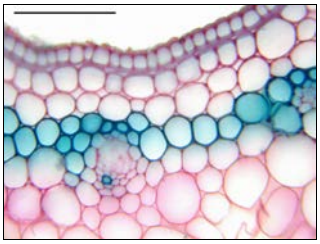

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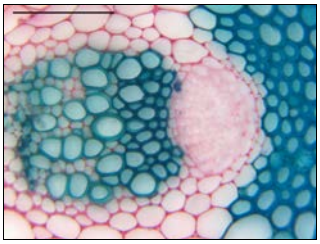

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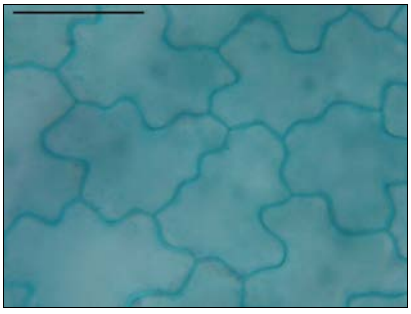

Fig. 36

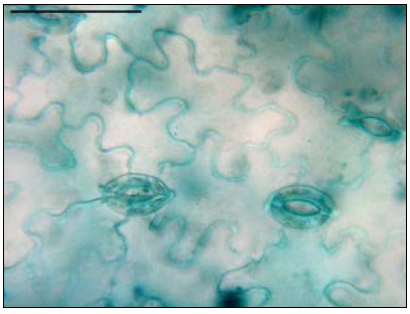

Fig. 37

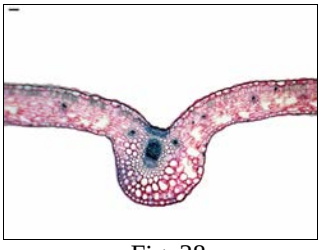

Fig. 38

Fig. 39

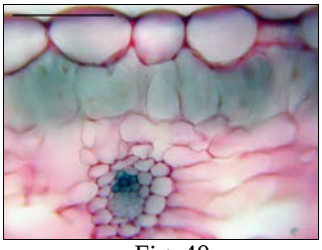

Fig. 40