Analele Ştiinţifice ale Universităţii „Al. I. Cuza” Iaşi
s. II a. Biologie vegetală, 2019, **65**: 44-54
http://www.bio.uaic.ro/publicatii/anale_vegetala/anale_veg_index.html
ISSN: 1223-6578, E-ISSN: 2247-2711

CONTRIBUTION TO THE KNOWLEDGE OF VEGETATIVE ORGANS STRUCTURE AT *ECHIUM RUSSICUM* J.F. GMELIN

Alexandra-Roxana SAVA[1*], Irina BOZ[2,3], Naela COSTICĂ[1,3]

Abstract: In this study the vegetative organs (the rhizome, stem – lower, middle and upper level, as well as the leaf blade) are analysed, from a structural point of view, of individuals of *Echium russicum* J.F. Gmelin collected from ROSCI0221`Sărăturile din Valea Ilenei` nature reserve (county Iași). Simultaneously with the histo-anatomical description of the mentioned vegetative organs, measurements of histological parameters are made, with the highlighting of their values, in the conditions of growth and development reached by individuals of this species, in May of 2016.

Keywords: *Echium russicum*, anatomy, vegetative organs.

Introduction

Echium russicum J.F. Gmelin, syn. *Echium rubrum* Jacq., non Forssk. (Gibbs, 1972), syn. *Pontechium maculatum* (L.) Böhle & Hilger (Hilger and Böhle, 2000; Valdés, 2011), syn. *Echium maculatum* L. (Sârbu et al., 2013) is a species of conservative interest at national and European level (Mihăilescu et al., 2015).

In Europe, this species is widespread with stable populations in Hungary, Serbia and Russia and with low risk of disappearance. Nevertheless, on some national lists, this species is considered threatened due to the abandonment of traditional grazing activities, the extension of agriculture, mining, eutrophication and inadequate management, protection and conservation measures being necessary (Bernhardt et al., 2011).

In Romania, *Echium russicum* has populations in the habitats: 62C0* Ponto-Sarmatic steppes, 6240* Sub-Pannonic steppic grasslands, 6210* Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) and 6250* Pannonic loess steppic grasslands (Bădărău, 2013). It has a large distribution in the Transylvanian and Moldavian Plateau, in Dobrogea and limited in Bucovina and the Romanian Plain. According to Natura 2000 - Standard Data Forms (2012 - 2016), *Echium russicum* is present in 45 sites of community importance from Romania, having, in most cases, unfavorable conservation status.

In ROSCI0221 `Sărăturile din Valea Ilenei` nature reserve from county Iași, this species is represented by populations with a small number of individuals.

In this context, this study intends to realize a histo-anatomical analysis of individuals collected from ROSCI0221 `Sărăturile din Valea Ilenei`, and to make measurements of some histological parameters.

[1] Faculty of Biology, ”Alexandru Ioan Cuza” University, 20A Carol I Blvd., 700506, Iași, Romania
[2] Department of Experimental and Applied Biology, NIRDBS - Institute of Biological Research, 47 Lascăr Catargi Street, 700107, Iași, Romania
[3] Integrated Centre for Environmental Science Studies in the North-East Development Region – CERNESIM, ”Alexandru Ioan Cuza” University, 11 Carol I Blvd., 700506, Iași, Romania
[*] Corresponding author. E-mail address: shealex95@gmail.com

The treatise on dicotyledons anatomy (Metcalfe and Chalk, 1983) presents general characteristics regarding the structure of the vegetative organs at Boraginaceae and insular information about anatomy of the genus *Echium*.

In a synthesis article on the evolution of plant phytomorphology research at University "Alexandru Ioan Cuza" (Toma and Toniuc, 2008) classical histo-anatomy researches of vegetative organs from species of the genera *Anchusa*, *Cerinthe* and *Echium* from Romania were mentioned (Ifrim and Toniuc, 2006; Toma et al., 1972). Also, in a thesis structure of vegetative organs of species from genera *Anchusa*, *Cerinthe*, *Nonea* and *Echium* were studied; they were collected from `Fânețele seculare Valea lui David` nature reserve (Sofian, 2003).

Concerning glandular structures, identified studies have taken in analysis their micromorphology at *Echium vulgare* (Weryszko-Chmielewska and Chwil, 2008), but also the nectar secretion at *Echium russicum* (Chwil and Weryszko-Chmielewska, 2007).

Morphological studies take into account endemic species of *Echium*, for example from Cape Verde Islands, the species *E. hypertropicum* Webb, *E. stenosiphon* Webb and *E. vulcanorum* A. Chev. (Romeiras et al., 2008), or includes molecular analyses to identify phylogenetic relationships between the studied taxa (Cohen, 2013).

The wood structure of Macaronesian endemic species of *Echium* was studied to establish the phylogenetic pathways within the group (Carlquist, 1970; Aldridge, 1981).

Morphology and anatomy of the vegetative organs from plants belonging of other genera than *Echium*, as *Anchusa*, *Nonea* and *Cynoglossum*, were topics for qualitative and quantitative histological analyses (Akçin and Baki, 2007; Akcin et al., 2010; Akçin et al., 2012; Yeșil, 2017).

From the above, it appears that there are few studies exclusively dedicated for the study of vegetative organs anatomy at *Echium russicum*. On the other side, from these studies the outlined trend of the authors is to realize anatomical descriptive analysis, accompanied by quantitative data, trough measurements that were made on some histological parameters.

As a result, the aim of this study is to contribute to the description of the vegetative organs of *Echium russicum*, by filling in the information about this species, including the thesis of Sofian (2003), with quantitative anatomy data.

Materials and methods

The plant material, originated from the *Echium russicum* species has been collected from ROSCI0221 `Sărăturile din Valea Ilenei` nature reserve (county Iași), in May of 2016. For histo-anatomical study, the vegetal material was fixed in ethanol 70% The cross sections through the vegetative organs of the plant were made with the hand microtome and with the help of botanic razor. Obtained sections were coloured, using the double colouring method: green iodine and red ruthenium, following to be analysed at Novex microscope and photographed with Sony Cyber-shot DSC-W730.

Simultaneously, measurements of histo-anatomical parameters (thickness: peridermis, epidermis, cortex, phloem and xylem) were made using Fiji ImageJ software. For each histo-anatomical analysed parameter 10 measurements were conducted, processed in Excel 2016.

Identification of the vegetative material was made by lecturer dr. Mihai Costică, Faculty of Biology, University "Alexandru Ioan Cuza" from Iași (voucher no. I 184515, Herbarium, Faculty of Biology, University "Alexandru Ioan Cuza" from Iași).

Echium russicum is a perennial plant, erect, stiff, and hispid, without ramifications, high of 30-90 cm, with cylindrical stem, covered with white, stiff and soft setiform hairs (Grințescu, 1960). The rhizome is fusiform and branched (Beldie and Chiriță, 1967).The basal leaves are linear lanceolate, forming rosette. Lower stem leaves are linear lanceolate, poorly sharpened, long of 7-10 cm and wide of 5-10 cm; superior stem leaves have the same shape, but decrescent. Inflorescence is cylindrical, long of 25-30 cm, formed by numerous short scorpioid cymes, cramped and bracteated. The flowers are short pedicellate, of a dark red colour, rare white. Calyx's laciniae are linear lanceolate, acuminate, covered with long and setiform hairs. Corolla has a tubular shape, poorly infundibuliform, long of 12-17 mm, poorly curved and bilabiate, with 5 lobes almost equal; corolla's tube is twice or/and longer than calyx. The stamens are in a number of 5, with filament, hairless and reddish, longer than corolla. The style is long, pubescent, and much longer than corolla, with subcapitate stigma (Grințescu, 1960) (Plate I, Figs. 1a, 1b).

Results and discussions

The histo-anatomy of the vegetative organs (rhizome, stem at lower, middle and upper level, and leaf blade right at median nervure), on transversal sections are described with measurements that highlights the space occupied by different types of tissues in the aggregated structure of each analysed organ.

The histo-anatomical analysis realized by us at *Echium russicum*, in the present study confirms data regarding the specificity of the vegetative organs structure from Boraginaceae (Metcalfe and Chalk, 1983).

In addition to the study that includes the histo-anatomical analysis of the *Echium russicum* realized by Sofian (2003), our anatomical description of vegetative organs contribute to the understanding of rhizome structure, and it is supplemented with a series of quantitative anatomical data.

Rhizome (Plate I, Figs. 2-4, Table 1)

At sectioned level, the rhizome has secondary structure. The secondary protecting tissue (peridermis) is thick and consists of cork, phellogen and phelloderm. The thickness of peridermis is of 0.568 ± 0.181 mm. At the peridermis exterior, remains of epidermis are undergoing exfoliation. *Echium*'s peridermis is forming on the base of pericycle (Metcalfe and Chalk, 1983). A characteristic colouration is present, at the level of peridermis that diffuses into the layers of cells from under it, probably given by a specific pigment synthesized at this level. The central cylinder is thick and has secondary structure. The area of secondary xylem (0.793 ± 0.086 mm) is thicker than that of secondary phloem (0.625 ± 0.101 mm). Between the secondary xylem and phloem, 3-4 layers of cambium are present. In the wideness of the secondary xylem, an external layer, richer in xylem fibers and an internal layer, richer in a woody cellulose parenchyma, are noticeable. The pith is made of a cellulose parenchyma, arranged in disorganized patches.

Table 1. Measurements of different tissues at the rhizome level (value ± standard deviation)

Rhizome (thickness – mm)	Peridermis	Cortex (ensemble)	Secondary xylem	Secondary phloem
	0.568 ± 0.181	0.231 ± 0.066	0.793 ± 0.086	0.625 ± 0.101

Regarding the rhizome, at the sectioned level, and based on the effectuated measurements it can be seen a developed protecting tissue, the cortex being relatively thin and the central cylinder is thick, with a good representation of the xylem conductive tissue (Table 1).

Although in classical studies of taxonomy and morphology the underground organ is considered to be a root (Grințescu, 1960; Sârbu et al., 2013); Beldie and Chiriță (1967) mention the morphology of the rhizome at this species.

In a study dedicated to some species from Boraginaceae, including *Echium russicum*, the structure of the rhizome is not anatomically described, but the attention is focused on the structure of the root, as an underground organ (Sofian, 2003).

In this context, our histo-anatomical investigations allowed the description of the secondary structure of the rhizome at *Echium russicum*, with mentions on the peridermis, as well as the central cylinder.

The stem (Plate I, Figs. 5-7; Plate II, Figs. 1-5; Table 2)

At the lower level, the stem presents uni-layered epidermis, with isodiametric cells having thick external walls, with the presence of the trichomes. The cortex is obviously thicker, having an external area, formed by small cells, with the walls less thickened, a median area, more extended and an internal area formed by cells that are predominating tangentially elongated. The central cylinder has a secondary structure, the pith being thicker that the precedent level (the rhizome); instead, the phloem and xylem ring is thinner than at the rhizome level.

At the middle level, the stem presents the epidermis with generally isodiametric cells, having the external walls relatively thickened, with the trichomes that are visible from place to place. The cortex includes approximately 4 external layers of assimilator cells and 7-8 internal layers, with bigger cells, without chloroplasts. The central cylinder includes a ring of secondary phloem and a ring of secondary xylem.

The stem, *at the upper level*, presents the epidermis with cystolithic trichomes, simple and supported by a multicellular stalk formed by epidermal cells and with stomata being slightly located under the level of epidermis. The cortex presents the first 3-4 layers, formed from isodiametric cells, which belong to the assimilator type. The next 7-8 cell layers are bigger, with cellulosic walls, slightly thickened. The last layer of the cortex formed by smaller cells that are tangentially elongated, which forms an endodermoid. The thickness of phloem is of 0.244 ± 0.059 mm. The thickness of xylem is of 0.505 ± 0.131 mm, and the pith is parenchymatic, formed from relatively big cells, on disorganized patches. The phloem is formed by sieve elements and companion cells, forming and continuous ring of phloem, and, the xylem is formed by xylem vessels arranged radially, separated by cells of xylem parenchyma.

Table 2. Measurements of different tissues at the stem level (value ± standard deviation)

The stem – lower level						
Epidermis (mm)	Cortex (mm)				Central cylinder	
Ensemble	ensemble	external area	median area	internal area	secondary phloem	secondary xylem
0.068 ± 0.009	0.625 ± 0.094	0.160 ± 0.047	0.229 ± 0.028	0.073 ± 0.016	Thickness (mm)	Thickness (mm)
					0.125 ± 0.023	0.416 ± 0.097
The stem – middle level						
Epidermis (mm)	Cortex (mm)				Central cylinder	
Ensemble	ensemble	external area	median area	internal area	secondary phloem	secondary xylem
0.043 ± 0.007	0.626 ± 0.070	0.116 ± 0.029	0.228 ± 0.043	0.221 ± 0.028	Thickness (mm)	Thickness (mm)
					0.139 ± 0.025	0.465 ± 0.09
The stem – upper level						
Epidermis (mm)	Cortex (mm)				Central cylinder	
Ensemble	ensemble	external area	median area	internal area	secondary phloem	secondary xylem
0.092 ± 0.021	1.830 ± 0.169	0.274 ± 0.059	1.211 ± 0.158	0.303 ± 0.053	Thickness (mm)	Thickness (mm)
					0.244 ± 0.059	0.505 ± 0.131

In the stem, at the sectioned levels (lower, middle and upper), based on the effectuated measurements it can be observed that the cortex in ensemble occupies the most part of the cross sections, and the central cylinder is thinner than the cortex. At the upper level of the stem, the median part of the cortex is the best represented – the measurements are given in the Table 2.

Regarding the structure of the aerial stem, studied in the individuals of the *Echium russicum*, collected from the site ROSCI0221 `Sărăturile din Valea Ilenei` as compared with those investigated by Sofian (2003) from the `Fânețele seculare Valea lui David` nature reserve – both located in west of Iași, the following considerations can be made: it is confirmed the existence of the same structural pattern, the same way of differentiation of the cortex (external, median and internal areas). It is confirmed the existence of the endodermoid, as the last internal layer of the cortex. The same configuration of the central cylinder can be observed, with a high number of vascular bundles that are continuous, forming a continuous ring of phloem and xylem. In addition, our study brings data regarding the large area that the cortex is occupying in relation to the central cylinder, in particular the median area at the upper level of the stem.

The leaf blade (Plate II, Figs. 6-9; Table 3)

It presents bifacial-heterofacial structure, with normal dorsi-ventrality (with palisade tissue under the upper epidermis and spongy tissue above the lower epidermis). The mesophyll is formed by 2 layers of palisade cells, under the upper epidermis (the lower layer being formed by cells that are smaller than the outer layer) and a few layers of spongy

tissue that is formed by tangential elongated cells or with irregular shape (lower epidermis). In the both epidermis (upper and lower) stomata are present; in this case, the leaf blade is amphistomatic.

The midvein is prominent on the lower part of the leaf blade. At this level, the epidermic cells are radially elongated and on the rest of the leaf blade surface, the epidermic cells are isodiametric. The type of the vascular bundle is collateral.

The thickest epidermis (upper and lower) it is in the median part of the leaf blade, with a thickness of 0.063 ± 0.012 mm for the upper epidermis and 0.051 ± 0.009 mm for the lower epidermis.

The palisade tissue it is thicker at the median part of the leaf blade, having 0.216 ± 0.023 mm.

The spongy tissue is also thickest in the median part of the leaf blade, having 0.17 ± 0.046 mm.

Table 3. Specific measurements of the leaf blade

The leaf blade (different sectioned levels)				
Base	Epidermis (mm)		Palisade tissue (mm)	Spongy tissue (mm)
	Upper	Lower		
	0.062 ± 0.016	0.047 ± 0.007	0.147 ± 0.045	0.151 ± 0.042
Median	Epidermis (mm)		Palisade tissue (mm)	Spongy tissue (mm)
	Upper	Lower		
	0.063 ± 0.012	0.051 ± 0.009	0.216 ± 0.023	0.17 ± 0.046
Top	Epidermis (mm)		Palisade tissue (mm)	Spongy tissue (mm)
	Upper	Lower		
	0.059 ± 0.006	0.05 ± 0.049	0.165 ± 0.02	0.124 ± 0.03

Regarding the leaf blade structure, sectioned right at the midvein, the existence of a specific prominence from the adaxial surface and of the deep and narrow trench, at the abaxial surface can be observed; the existence of a collateral vascular bundle, but with the collenchyma caps poorly differentiated, contrasting with the observations made by Sofian (2003). Probably the development stage of the leaf blade at which we did the analysis was earlier in comparison with that analyzed by Sofian (2003); this would explain the surprisingly greater degree of differentiation of the tissues from this organ.

Our observations confirms, as well, the data from the literature (Sofian, 2003) regarding the leaf blade, this has bifacial-heterofacial structure, with normal dorsi-ventrality.

Stomata type is ranunculaceous (anomocytic) and they are situated on both surfaces of the leaf blade; thus, the leaf is amphistomatic. However, we have identified, on analyzed cross sections stomata that are situated easily under the level of the epidermal cells, compared to Sofian (2003) who identifies stomata at the level of the epidermis or easily above it. The position of the stomata in relation with the level of the epidermis is correlated to the availability of the water in the soil. In the case of our collected individuals from the site ROSCI0221 `Sărăturile din Valea Ilenei` nature reserve, the position of the stomata would correlate to the specificity of the soil salinity (Grigore and Toma, 2014), with the climatological conditions of the year 2016: mean values of temperature 11.46°C, humidity of 61.75% rh and precipitations of 331.1 mm (Stația Meteorologică Iași-UAIC). The individuals of *Echium russicum* analysed by Sofian (2003) were collected from the

`Fânețele seculare Valea lui David` nature reserve, Iași county, located at about 7 km West from our site. The types of soil present in the reservation are slope chernozems, costal saliferous soils (dry or wet and in evolution) and colluvial (Sofian, 2003), compared to the soils from the site ROSCI0221, where the soil is characterized by salt-rich soils (solonchaks) and haplic chernozems (Stoica et al., 2012). The climate for both areas is continental temperate. In the `Fânețele seculare Valea lui David` nature reserve, the annual mean temperature mean is of 10° C and the annual mean precipitations are of 500 mm (Sofian, 2003).

The identified trichomes are simple, cystolitic with walls that are impregnated with calcium carbonate, some of them have a basal rosette of epidermic cells, in accord to Bramwell (1972) who identified 3 basic types of trichomes for *Echium* species.

Conclusions

The study brings additions for description of the structure of the species *Echium russicum* J.F. Gmelin, with the analysis on rhizome, stem (at the lower, middle and upper level) and leaf blade - in the right of the median nervure (at the base, at the middle and at the top of the blade); several quantitative parameters related to the anatomical structure were added, in the conditions of vegetation from ROSCI0221 `Sărăturile din Valea Ilenei` nature reserve in May of 2016.

At the sectioned level of the rhizome, the structure is in totality secondary, with developed vascular tissue (with secondary structure) and the protective structures. Overall, at this level, the cortex is thinner than the central cylinder.

About the leaf blade structure, sectioned in the right of median nervure (at the base, middle and to the top of the blade), it can be observed the same structural pattern, but with variations of the thickness of the epidermis (upper and lower) and of the mesophyll at the mentioned 3 levels (in the way of the growth from the base to the middle of the blade and the decrease from its middle to the top).

In comparison with the studies for other genera than *Echium* (Akçin and Baki, 2007; Akcin et al., 2010; Akçin et al., 2012; Yeşil, 2017), measurements were made at different organs levels of the stem and the leaf blade. Beside the thesis (Sofian, 2003) where the anatomy of *Echium russicum* was taken in attention, we made a description of the rhizome, the stem and leaf blade with measurements at different levels and tissues.

Data from this study confirms and completes, with quantitative information, the description of the vegetative organs at *Echium russicum*. Furthermore, the structure of rhizome is described and data regarding the higher place the cortex occupies in relation to the central cylinder of the stem, in particular at the upper level are added. This study gives explications about the stomata position from the leaf blade, in rapport with the environmental conditions of areas where from analyzed individuals were collected.

Acknowledgements

This work was supported by CERNESIM – POS CCE-O 2.2.1, SMIS-CSNR 13984-901, No. 257/28.09.2010 and Romanian Ministry of Research and Innovation (Program NUCLEU/project no. PN 18180301).

REFERENCES

Akçin, Ö.E., Baki, H., 2007. Micromorphology and anatomy of the three *Symphytum* (Boraginaceae) taxa from Turkey. Bangladesh J. Bot. **36**, 2: 93-103.

Akçin, Ö.E., Çoşkunçelebi, K., Şenel, G., 2012. Foliar anatomy of *Cynoglossum* L. (Boraginaceae) from North Anatolia, Turkey. Bangladesh J. Plant Taxon. **19**, 2: 101-108.

Akcin, T.A., Ulu, S., Akcin, A., 2010. Morphological, anatomical and numerical studies on some *Anchusa* L. (Boraginaceae) taxa from Turkey. Pak. J. Bot. **42**, 4: 2231-2247.

Aldridge, E.A., 1981. Anatomy and Evolution in Macaronesian *Echium* (Boraginaceae). Plant Syst. Evol. **138**: 9-22.

Bădărău, A.S., 2013. Habitate, Plante, in Mănoiu, T. (il.), Brînzan, T. (red.). *Catalogul habitatelor, speciilor și siturilor Natura 2000 în România*. Edit. Fundația Centrul Național pentru Dezvoltare Durabilă. Exclus Prod. București, p. 140.

Beldie, A., Chiriță, C., 1967. *Flora indicatoare din pădurile noastre*. Edit. Agro-Silvică, București, p. 57.

Bernhardt, K.G., Dostalova, A., Király, G., Petrova, A., 2011 - *Echium russicum*. The IUCN Red List of Threatened Species 2011: e.T162105A5538499.

Bramwell, D., 1972. A revision of the Genus *Echium* in Macaronesia. Lagascalia **2**, 1: 37-115.

Carlquist, S., 1970. Wood anatomy of *Echium* (Boraginaceae). Aliso: A Journal of Systematic and Evolutionary Botany **7**, 2: 183-199.

Chwil, M., Weryszko-Chmielewska, E., 2007. Nectary structure and nectar secretion of *Echium russicum* J.F. Gmel. flowers. Acta Agrobotanica **60**, 1: 25-33.

Cohen, J.I., 2013. A phylogenetic analysis of morphological and molecular characters of Boraginaceae: evolutionary relationships, taxonomy, and patterns of character evolution. Cladistics: 1-31.

Gibbs, P.E., 1972. *Echium* L., in Tutin, T. G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M., Webb, D.A. (Eds.), assist. by Ball, P.W., Chater A.O., DeFilipps R.A., Ferguson I.K., Richardson I.B.K. *Flora Europaea*. Vol. 3. Diapensiaceae to Myoporaceae. Cambridge University Press, p. 99.

Grigore, M-N., Toma, C., 2014. Integrative ecological notes on halophytes from "Valea Ilenei" (Iași) nature reserve. Memoirs of the Scientific Sections of the Romanian Academy **XXXVII**: 19-36.

Grințescu, I., 1960. *Echium* L., in Săvulescu, T. (Ed.). *Flora Republicii Populare Romîne*. Vol. VII. Edit. Academiei Republicii Populare Romîne, București: 230-237.

Hilger, H.H., Böhle, U.-R., 2000. *Pontechium*: a new genus distinct from *Echium* and *Lobostemon* (Boraginaceae). Taxon **49**: 737-746.

Ifrim, C., Toniuc, A., 2006. Câteva considerații histo-anatomice la patru taxoni din familia Boraginaceae. Lucrări Științifice: Seria Horticultură, USAMV Iași **49**, 1: 347-352.

Metcalfe, C.R., Chalk, L., 1983. *Anatomy of the dicotyledons*, Vol. 2, 2nd ed. Clarendon, Oxford, England.

Mihăilescu, S., Strat, D., Cristea, I., Honciuc, V., 2015. *Raportul sintetic privind starea de conservare a speciilor și habitatelor de interes comunitar din România*. Edit. Dobrogea, București.

Romeiras, M.M., Ascensão, L., Duarte, M.C., Diniz, M.A., Pais, M.S., 2008. Taxonomy of *Echium* (Boraginaceae) species from Cape Verde Islands. Australian Systematic Botany **21**: 26-38.

Sârbu, I., Ștefan, N., Oprea, A., 2013. *Plante vasculare din România*. *Determinator ilustrat de teren*. Edit. Victor B Victor, București.

Sofian, A., 2003. Structura organelor vegetative de la unele specii de Boraginaceae din rezervația naturală Fânețele seculare Valea lui David. Lucrare de licență, Universitatea "Alexandru Ioan Cuza" Iași.

Stoica, D.L., Patriche, C.V., Sîrbu, C., Pîrnău R., Roșca, B., 2012. GIS and RS soil-vegetation correlations for continental salt-lands in NE Romania. Eurasian Journal of Soil Science **2**: 75-80.

Toma, C., Toniuc, A., 2008. Dezvoltarea cercetărilor de fitomorfologie în ultima jumătate de secol la Universitatea din Iași. An. Șt. Univ. "Al. I. Cuza" Iași, supl., s. II a. Biol. Veget. **54**, 1: 5-41.

Toma, C., Toniuc, A., Flenchea, G., 1972. Observații histo-anatomice asupra unor specii de *Cerinthe*. L. An. Șt. Univ."Al. I. Cuza" Iași, sect. II a. Biol. Veget. **43**, 1: 57-72.

Valdés, B., 2011. Boraginaceae. In: Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity.

Weryszko-Chmielewska, E., Chwil, M., 2008. Micromorphology of glandular structures in *Echium vulgare* L. flowers. Acta Agrobotanica **61**, 2: 25-34.

Yeşil, Y., 2017. Anatomical investigations of *Nonea dumanii* (Boraginaceae). Marmara Pharmaceutical Journal **21**, 4: 804-809.

* * * Stația meteorologică Iași-UAIC, Facultatea de Geografie si Geologie, Universitatea"Alexandru Ioan Cuza" din Iasi http://meteouaic.meteomoldova.ro/wxtempdetail.php (accessed 27 October 2019).

EXPLANATION OF THE PLATES:

PLATE I

Fig. 1 (a, b): *Echium russicum* J. F. Gmelin (original photo);
Fig. 2: Transversal section through rhizome: ensemble image (ob. 4x);
Fig. 3: Transversal section through rhizome: detail central cylinder (ob. 10x);
Fig. 4: Transversal section through rhizome: details epidermis, cortex and phloem (ob. 10x);
Fig. 5: Transversal section through stem (lower level): ensemble image (ob. 10x);
Fig. 6: Transversal section through stem (lower level): central cylinder (ob. 20x);
Fig. 7: Transversal section through stem (lower level): trichome, epidermis and cortex (ob. 40x).

PLATE II

Fig. 1: Transversal section through stem (middle level): ensemble image (ob. 20x);
Fig. 2: Transversal section through stem (middle level): central cylinder (ob. 20x);
Fig. 3: Transversal section through stem (middle level): epidermis and cortex (ob. 40x);
Fig. 4: Transversal section through stem (upper level): detail central cylinder (ob. 40x);
Fig. 5: Transversal section through stem (upper level): epidermis and cortex (ob. 40x);
Fig. 6: Transversal section through leaf blade (top): principal midvein (ob. 20x);
Fig. 7: Transversal section through leaf blade (top): area between veins (ob. 20x);
Fig. 8: Transversal section through foliar lamina (middle area): area between midveins (ob. 20x);
Fig. 9: Transversal section through foliar lamina (basal area): area between midveins (ob. 20x).

PLATE I

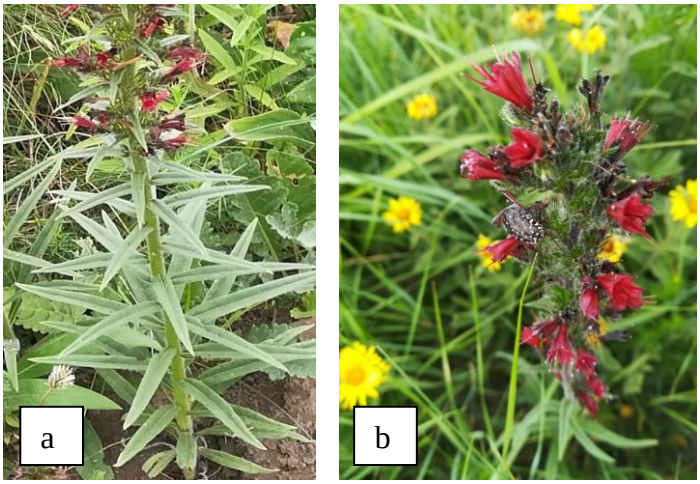

Figure 1

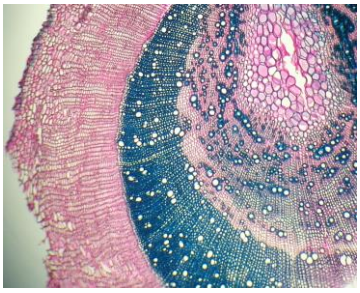

Figure 2

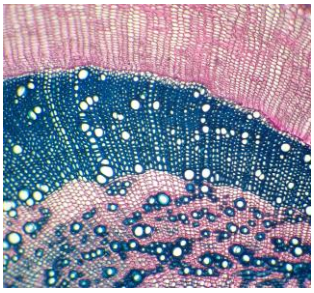

Figure 3

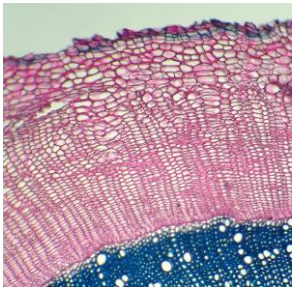

Figure 4

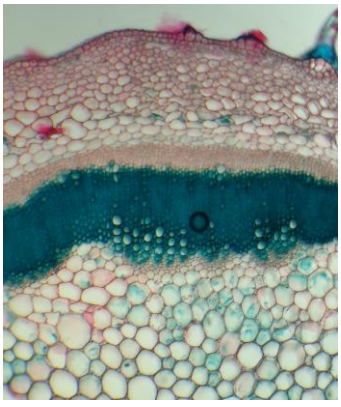

Figure 5

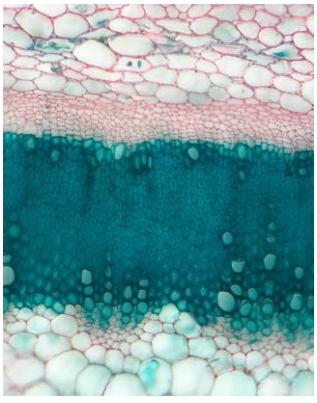

Figure 6

Figure 7

PLATE II

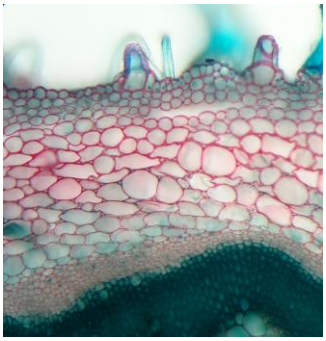

Figure 1

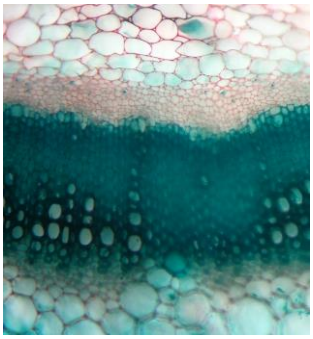

Figure 2

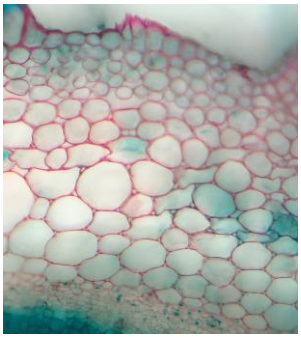

Figure 3

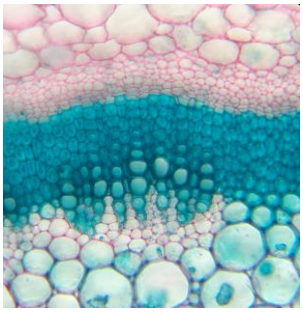

Figure 4

Figure 5

Figure 6

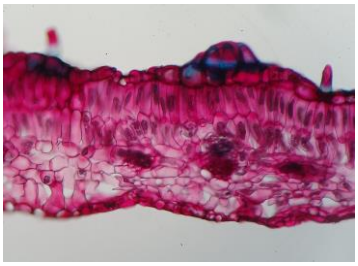

Figure 7

Figure 8

Figure 9