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Original paper

Study of some foxtail lilies species (*Eremurus* M. Bieb.) grown in the North-East of Romania

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Abstract Three species of *Eremurus* M. Bieb. grown at UASVM Iasi, Romania, were studied: *E. himalaicus* Baker, *E. robustus* Regel and *E. stenophyllus* (BOISS. & BUHSE) Bak. Some ornamental (morphologic and phenologic) features were analyzed and also the anatomic structure of the leaf, the content of photosynthetic pigments and the enzymatic activity of the leaves. The biometrical and phenological determinations indicate a good ecological adaptability of the plants, in accordance with similar reports. The anatomical differences between the three species are not very great, but the stomata in *E. stenophillus* and *E. himalaicus* are arranged at the same level as the epidermal surface while in *E. robustus* they are arranged a little lower, and the assimilating parenchyma layer is more developed in *E. stenophillus* and *E. himalaicus* than in *E. robustus*. At *E. robustus* and *E. himalaicus* a larger content of assimilatory pigments and a more reduced enzymatic activity were observed.

Keywords Desert candle, ornamental, anatomy, APX, photosinthetic pigments.

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Introduction

Eremurus M. Bieb. (foxtail lily, desert lily or desert candle) is a genus of Asphodelaceae family, with centre of diversity in Central Asia (HEDGE & WENDELBO, cited by NADERI & al [1]) and distributed over large area in Central Asia, Caucasia, Afghanistan, Iran, Pakistan, Iraq, Turkey, Lebanon, India and China (WENDELBO & FURSE, cited by NADERI & al [1]).

Foxtail lilies are geophyte plants, with tuberous roots and a corm-like crown with renewal buds (SCHIAPPACASSE & al [2]). Roots are shaped like an octopus, are fragile and do not like to be disturbed after planting. Linear leaves forming tufts or rosettes. Leaves die back in mid-summer after flowering as the plant goes into dormancy (CANTOR & al [3]; HORŢ & al [4]). The inflorescences are racemes, usually dense, elongated, not branched, with many flowers in copper, bright yellow, snow white, pastel pink, orange or any combination of those colors. The perianth has six tepals, with conspicuous stamens. Fruit a dehiscent loculicidal capsule. Seeds irregularly 3-angled (POLLOCK & GRIFFITHS [5]; BRICKELL & CATHEY [6]). The harsh conditions of the place of origin have given these plants a very high resistance to lack of water and strong insolation, as well as the ability to withstand, through their underground organs, the low temperatures during the winter.

Although there are studies on the taxonomy, ecology, morphology, cytology, anatomy, decorative traits etc. (NADERI SAFAR & al [1] [7] 2009, 2014; KUMARI & al [8]; SCHIAPPACASSE & al [2]; MUSHTAQ & al [9]; TIAN & MA [10]), the literature on the genus *Eremurus* is not very extensive. In Romania, the literature makes less reference to foxtail lilies, although they are mentioned, long ago, in the floral assortment (KISELEV [11]; PREDA [12]; PREDA [13]; ŞELARU [14]); TOMA [15]; BAHRIM & al [16], [17]).

The objectives of this study were to analyze some morphological, phenological, biochemical and anatomical aspects in three *Eremurus* species grown in the ecological conditions of Iasi, Romania.

Material and Methods

Plant material

The study was carried out at University of Agricultural Sciences and Veterinary Medicine, Faculty of Horticulture, of Iasi, Romania. Three species of *Eremurus* have been studied: *E. himalaicus* Baker, *E. robustus* Regel and *E. stenophyllus* (BOISS. & BUHSE) Bak. Establishment of experimental cultures in the field was made during the autumn of the year 2013, with underground organs purchased from the company JUB HOLLAND (Holland).

The experience included three variants (each species representing a variant) distributed in a randomized blocks design with three repetitions (10 plants/repetition). All plants were grown under the same management of fertilization, watering, soil and disease control.

Local conditions

The experimental field is located in NE of Romania, Iasi area, at 47°11' North latitude and 27°33' East longitude, in temperate-continental climat, with excessive nuances, on a chernozem cambic soil with sandy-loam texture and pH 7.8. The investigations were carried during 2014-2020 period. The meteorological conditions from the analyzed period (especially the spring and summer beginning temperatures) registered differences from one year to another. In the years 2014-2020, the averages of the temperatures from March, when the foxtail lily start in vegetation, were, in most cases, over the multi-annual average (3.9°C), with values between 1.9 and 7.2°C. Only in 2018, the average temperature of March was under the multi-annual average (with 2.8°C). Also, April has the same tendency of exceeding the multi-annual temperature which characterized the conditions from Iasi (10.5°C), but with smaller differences (0.2-4.8°C). The months of April from 2015 and 2017 were colder. Regarding the precipitations, in March, precipitations exceeded the multi-annual only in 2015, 2017 and 2018, in other years the weather was droughty. The biggest deficit was registered in 2019 (8.1 mm as opposed to 30.9 mm the multi-annual average). April was more droughty, especially during the last three years (6.4 mm, in 2018, 6.9 mm, in 2019 and 1.8 mm in 2020, as opposed to the multi-annual of 46.1 mm).

Biometrical and phenological investigations

The examination of the morphological and phenological characters was done on the plants from the collection. The morphometric determinations were: total height of the floral stem, length and diameter of inflorescence, number of flowers in inflorescence, and flower diameter. The results were compared to the average of the variants (considered control) and the interpretation was made using the variance analysis, with the LSD test (SĂULESCU & SĂULESCU [18]).

The main phenological stages analyzed were: starting in the vegetation, the appearance of floral stems, the beginning of flowering, and end of flowering.

Anatomical study

Performing anatomical sections were done by using the technique by freezing of the tissues. A part of the samples (leaves) were placed in a freezing microtome (CM 1325; Leica, Germany) and sliced into sections of 20-30 µm. The sections were stained with FSA (Basic Fuchsin, Safranin and Astra Blue) for 5 min, washed with water and mounted for observation under optical microscopy (OLYMPUS Provis AX 70 optical microscope),

equipped with an infinity 2-3C Lumenera® digital camera and analyzed with "Infinity Analyze" Software v.6.5.5 at the Plant Anatomy Laboratory "Julio Iranzo", in the Botanical Garden of the University of Valencia. On the other hand, another part of the leaves, fixed in FAA, were washed three times with 0.01 M PBS, pH 7.4, for 15 min each. Thereafter, dehydrated at room temperature in a graded series of ethanol, starting at 50% and increasing to 70%, 95% and 100%, for no less than 20-30 min at each step. The fixed and dehydrated samples were embedded in Spurr's resin, according to the manufacturer's instructions (http://www.emsdiasum.com/microscopy/technical/datasheet/14300.aspx). For light microscopy analyses, 1-2 μm sections were cut from samples embedded in Spurr's resin using a diamond knife (DIATOME Histo 45°) and an ultramicrotome (Ultratome Nova LKB Bromma). The sections were stained with 1% toluidine blue and observed with an Olympus Provis AX 70 microscope equipped with an Infinity 2-3C Lumenera® digital camera and ''Infinity Analyze" Software v.6.5.5. at the Plant Anatomy Laboratory "Julio Iranzo", in the Botanical Garden of the University of Valencia (SANTAMARINA SIURANA & al [19]; [20]).

Physiological and biochemical analysis

The biological material was represented by leaves that were harvested during the blooming period and stored until the analysis were performed at -20°C.

Assay of assimilative pigments by spectrophotometric method according to LICHTENTHALER [21]. The extraction of photosynthetic pigments was performed from plant material, from the leaves of the studied species according to the Current Protocols in Food Analytical Chemistry (HARTMUT & al [22]). For the preparation of the samples, in order to extract the photosynthetic pigments, fresh material was weighed with a mass between 0.03-0.05 g. After weighing, the samples were placed in a grinding mortar and then quartz sand and $CaCO_3$ (in powder form) were added to prevent the conversion of chlorophylls to porphyrins, a phenomenon encountered in the acidic plant material.

To grind the tissue, 2-3 ml of pure acetone is added to the mortar in several stages until the vegetable material has been well ground, after which the liquid has been passed in a graduated cylinder. The process was repeated until the acetone was no longer colored, the volume of the filtrate was finally brought to 10 ml and then centrifuged for 10 minutes at 10,000 rpm. After extraction of the samples, the extracted samples were read using the UV-VIS spectrophotometer at E661.6 for *a* chlorophyll, E644.8 for *b* chlorophyll and E470 for carotenoid pigments. Sampling was performed using the T70 UV/VIS Spectrophotometer PG.

The determination of ascorbate peroxidase (APX) by spectrophotometric method

To determine the activity of ascorbate peroxidase (APX), 0.5 g of plant material was ground on ice in K phosphate buffer with a pH of 7.0. To obtain the supernatant from which the enzymatic activity was analyzed, the extract obtained from milling was centrifuged at 12,000 rpm for 20 minutes, at 4°C.

The APX activity was determined according to the method of CHEN & ASADA [23] by monitoring the decrease in absorbance at 290 nm. The reaction mixture (3 ml) consisted of 1.5 ml of phosphate buffer (pH 7.0), 300 μl of ascorbic acid, 600 μl of H_2O_2 and 600 μl of enzyme extract.

One unit of enzyme activity was calculated as the amount of enzyme required for the oxidation of 1.0 mM ascorbate/min/g fresh substance. The enzymatic activity was calculated according to the following equation:

Enzymatic activity (units/min/g fresh substance) =
change in absorbance/minutes * total volume (ml)
extinction coefficient * volume of taken sample (ml)
Extinction coefficient t = $2.8 mM^{-1}cm^{-1}$

Statistical analyses

Experiments were performed in triplicate and data for APX were presented as mean values with standard deviations.

Results and Discussions

Morfological characters

One of the representative characters of *Eremurus* species is constituted from the height of the floral stems, which frequently exceed 1 m, even reaching 2 m, a significant share having the florescence itself. At the three analyzed species, the total height of the floral stem (Table 1), calculated from the level of the ground up to the top of the florescence fitted in a average value of 136.3 cm, with variations between 168.5 cm (*E. himalaicus*) and 107.5 cm (*E. stenophyllus*).

An indicator of the ornamental value is represented by the length of the inflorescences, respectively the share occupied by the flowers from the total height of the floral stem. The length of the inflorescences was between 83.3 cm (*E. himalaicus*) and 52.2 cm (*E. stenophyllus*), at these species the differences as opposed to the average (65.8 cm) being statistically ensured (Table 1). From the total length of the floral stem, the share occupied by the flowers was 49,4% at *E. himalaicus,* 46.6% at *E. robustus* and 48.6% at *E. stenophyllus*.

Table 1. Morphological characters of *Eremurus* species

Variants (species)	Total height of the floral stem (cm)	Length inflorescence (cm)	Inflorescence diameter (cm)	Number of flowers in inflorescence	Flower diameter (mm)
V_1 - *E. himalaicus*	168.5^{xxx}	83.3^{x}	$8,3^{ns}$	768^{xxx}	28^{x}
V_2 - *E. robustus*	132.8^{0}	61.9^{ns}	$7,5^{ns}$	674^{xx}	23^{ns}
V_3 - *E. stenophyllus*	107.5^{000}	52.2^{0}	$6,1^{ns}$	478^{000}	17^{0}
Average (control)	136.3	65.8	7.3	640	22.7
LSD 5%	2.8	10.8	1.6	18.2	4.7
LSD 1%	4.6	17.9	2.6	30.1	7.8
LSD 0.1%	8.5	33.4	4.8	56.2	14.6

The symbols: ns = non significant; o/x = negative/positive significant difference; oo/xx = negative/positive distinct significant difference; ooo/xxx = negative/positive very significant difference.

The diameter of the inflorescence was the feature that did not make a substantial difference between the species of *Eremurus* in report to the threshold. But if we compare the species between them, we will find out that the inflorescences of *E. stenophyllus* have the diameter with approximately 25% smaller than those of *E. himalaicus* (Table 1).

The number of flowers is usually correlated to the size of the inflorescences. Taking into account that the average length of the inflorescences varied between 83.3 cm and 52.2 cm, the differences which appeared regarding the number of flowers are also justified.

At this it can also add the dimension of the flowers which, although they are between quite small limits (the diameter included between 17 and 28 mm), contribute at a certain density of the inflorescence.

Present results were in accordance with HORŢ & al. [4] who observed at *Gladiolus* cultivars that the length of the inflorescence and the number of flowers depend on the variety studied The most numerous and the biggest flowers were registered at *E. himalaicus* (768 flowers/ inflorescence and 28 mm in diameter), followed by *E. robustus* (674 flowers/ inflorescence and 2.3 mm in diameter) and *E. stenophyllus* (478 flowers/inflorescence and 17 mm in diameter) (Table 1).

The foxtail lilies are plants with early blooming (April-June). The onset of vegetation takes place in March, approximately from the second decade until the end of the month, the first to start being *E. himalaicus* and *E. robustus* (Table 2).

Table 2. The main phenological data recorded in *Eremurus* species

Variants (species)	Starting in the vegetation	The appearance of floral stems	The beginning of flowering	End of flowering
V_1 - *E. himalaicus*	14-21 March	5-12 April	30 April - 5 May	20-26 May
V_2 - *E. robustus*	12-20 March	14-22 April	17-25 May	10-16 June
V_3 - *E. stenophyllus*	16-23 March	6-14 May	5-10 June	22-28 June

The appearance of flower stems more uneven and differs from one species to another. The first stems appear in *E. himalaicus*, followed by *E. robustus* and *E. stenophyllus* in order (Table 2). The blooming (Figure 2) takes place at the end of April (*E. himalaicus*) and ends at the end of June (*E. stenophyllus*). The three *Eremurus* species ensure a flowering period of approx. two months, the peak season being from the last decade of April to the second decade of June (Table 2). This development of phenophases can be followed in the diagram of phenological stages (Figure 1).

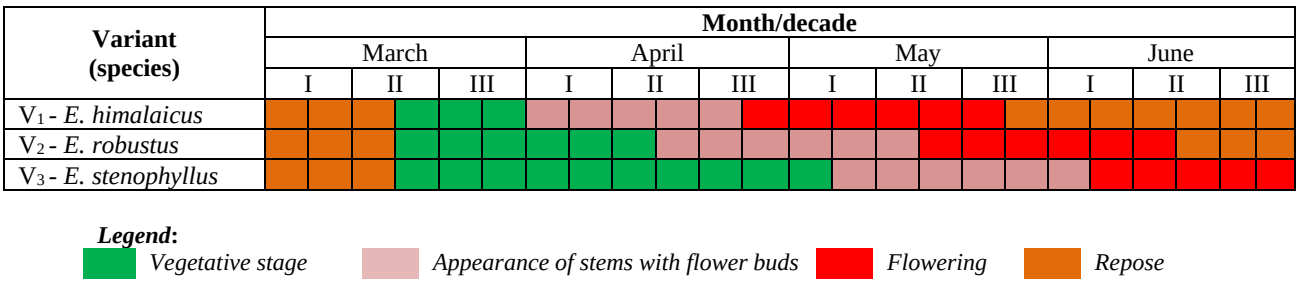

Figure 1. The phenological diagram at *Eremurus* species

a) *E. himalaicus* **b)** *E. robustus* **c)** *E. stenophyllus*

Figure 2. Flowering foxtail lilies (original photo)

The duration of the main phenophases varies from one species to another. Thus, the time required from the onset of vegetation to the appearance of flower stem varies between 22 days in *E. himalaicus*, and 51 days, in *E. stenophyllus*. The shortest time interval was recorded by *E. himalaicus*, which also has the earliest blooming. With a period of less than 30 days is *E. stenophyllus*, but it should be noted that this species had the longest period from the start of vegetation to the appearance of flower stem. Regarding the duration of blooming, calculated from the beginning until the complete senescence of the flowers, it was approx. three weeks (19-23 days). In line with the results CRIȘAN & al. (2018) [24] showed that some *Iris* species manifest either a delay or precocious blooming under the influence of the continental climatic conditions of Cluj county and also noted that colder spring months will delay the flowering period of many *Iris* species.

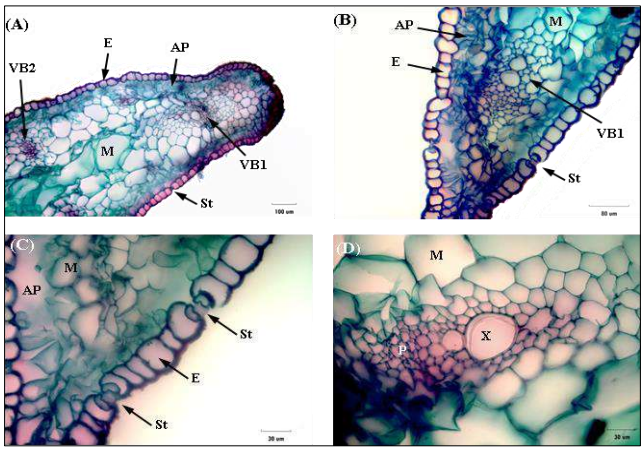

Figure 3. Cross section of a frozen section of leave of *E. robustus* stained with FSA. (**A** and **B**) Detail of the end of the leaf (A, x10; B, x20); (**C**) Detail of the epidermis and mesophyll (x40); (**D**) Detail of a primary inverted vascular bundle (x40).

Abbreviations: AP, assimilating parenchyma; Ep, epidermis; M, mesophyll; P, phloem; St, stomata; VB1, primary vascular bundle; VB2, secondary vascular bundle; X, xylem.

Study of anatomical structure

In general, the three species present leaves of phyllodic anatomy with inverted vascular bundles. The epidermis is monostratified with a fine cuticle and abundant stomata (Figures 3 to 6). The central zone of the mesophyll is formed by large cells of a rounded shape and between which the vascular bundles are arranged (Figures 3B, 4A, 5B, 5C, 6B and 6E). In the innermost zone of the mesophyll there are very voluminous cells, with large vacuoles and irregular morphology (Figures 4A, 5E). Assimilating-type parenchyma cells (chlorophyllic parenchyma) of very irregular morphology are located on the periphery and below the epidermis, arranged perpendicular to the epidermis and leaving large intercellular spaces between them. We could say that it is a sponge-assimilating parenchyma (Figures 3B, 4B, 4D, 5C, 5D, 6B and 6D).

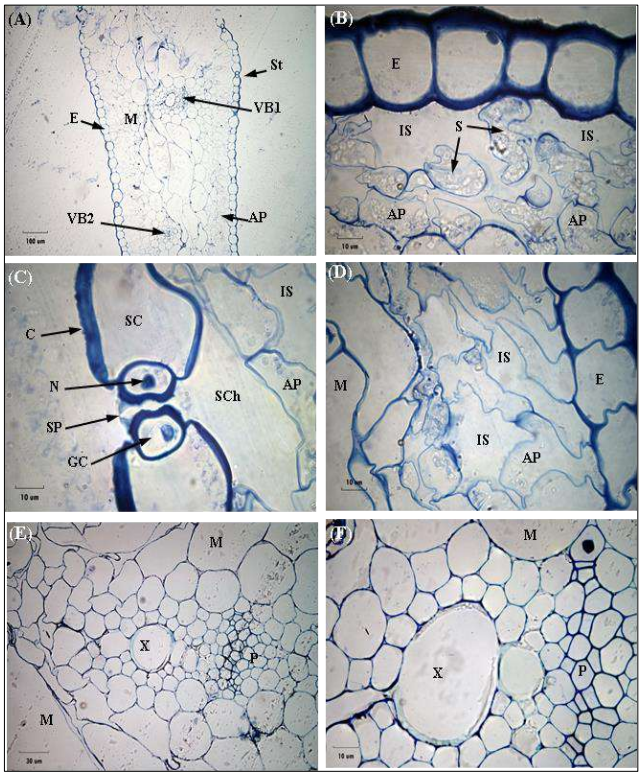

Figure 4. Cross semi-fine section of a leave of *E. robustus* stained with toluidine blue. (**A**) General view of the leave (x10); (**B**) Detail of the epidermis and the assimilating parenchyma (x100); (**C**) Detail of a stomata; (**D**) Detail of the assimilating parenchyma (x100); (**E**) Detail of a secondary vascular bundle (x40); (**F**) Detail of a primary vascular bundle (x100).

Abbreviations: AP, assimilating parenchyma; C, cuticle; Ep, epidermis; GC, guard cells; IS, intercellular space; M, mesophyll; N, nucleus; P, phloem; SC, subsidiary cells; SCh, substomatic chamber; SP, stomatal pore; St, stomata; VB1, primary vascular bundle; VB2, secondary vascular bundle; X, xylem.

The vascular bundles are inverted. The bundles are arranged those of medium and small diameter alternately, always presenting the xylem towards the inside of the leaf. The xylem has between 2 and 3 large tracheae in the major vessels, while the phloem is made up of abundant sieve tubes and companion cells (Figures 3D, 4E, 4F, 5E, 5F, 6E and 6F).

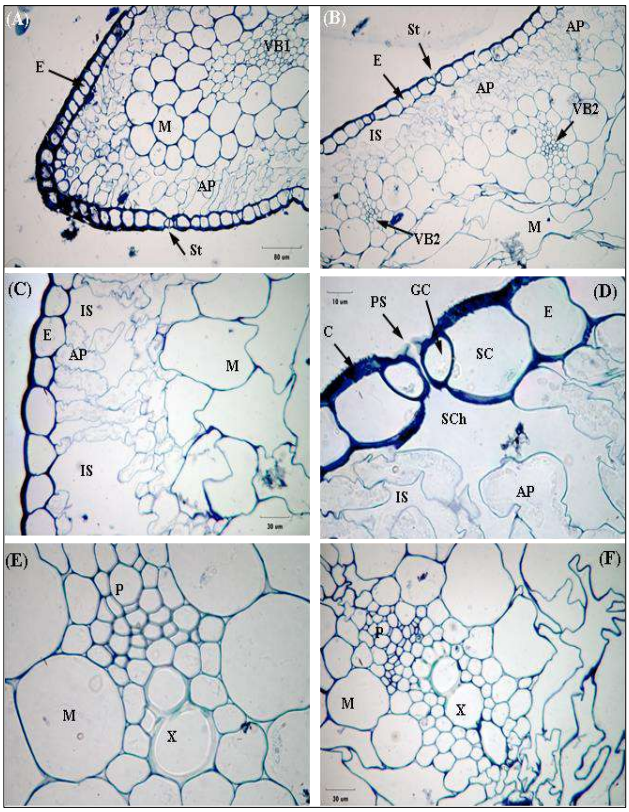

Figure 5. Cross semi-fine section of a leave of *E. himalaicus* stained with toluidine blue. (**A**) General view of the end of the leave (x10); (**B**) Detail of the epidermis, assimilating parenchyma and mesophyll (x20); (**C**) Detail of the assimilating parenchyma (x100); (**D**) Detail of a stomata; (**E**) Detail of a secondary vascular bundle (x100); (**F**) Detail of a primary vascular bundle (x40).

Abbreviations: AP, assimilating parenchyma; C, cuticle; Ep, epidermis; GC, guard cells; IS, intercellular space; M, mesophyll; P, phloem; SC, subsidiary cells; SCh, substomatic chamber; SP, stomatal pore; St, stomata; VB1, primary vascular bundle; VB2, secondary vascular bundle; X, xylem.mesophyll; P, phloem; SC, subsidiary cells; SCh, substomatic chamber; SP, stomatal pore; St, stomata; VB1, primary vascular bundle; VB2, secondary vascular bundle; X, xylem.

The anatomical differences between the three species are not very great. The stomata in *E. stenophillus* and *E. himalaicus* are arranged at the same level as the epidermal surface (Figures 4C and 5D), while in *E. robustus* they are arranged a little lower (Figure 6C). The assimilating parenchyma layer is more developed in *E. stenophillus* and *E. himalaicus* (Figures 5B, 5C, 6B and 6D) than in *E. robustus* (Figure 4B and 4D), although in all cases very irregular cells appear and leaving large intercellular spaces.

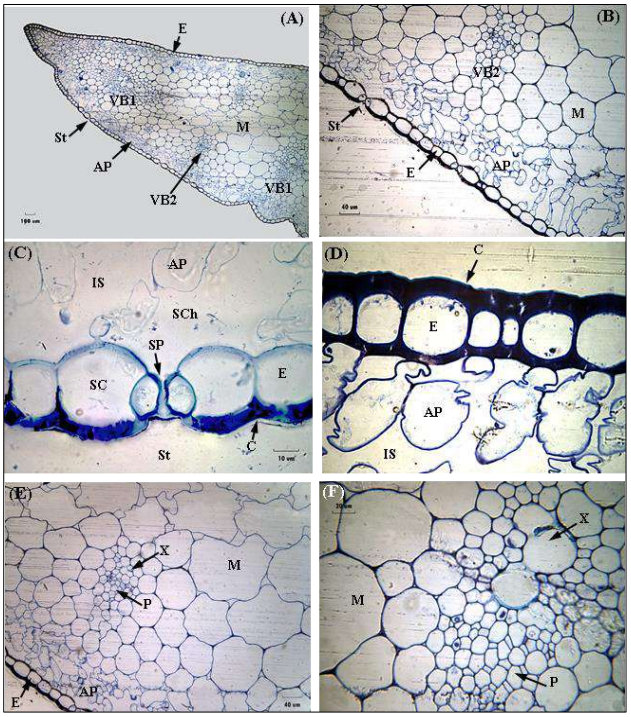

Figure 6. Cross semi-fine section of a leave of *E. stenophyllus* stained with toluidine blue. (**A**) General view of the end of the leave (x10); (**B**) Detail of the epidermis, assimilating parenchyma and mesophyll (x20); (**C**) Detail of a stomata; (**D**) Detail of the epidermis and assimilating parenchyma (x100); (**E**) Detail of a secondary vascular bundle (x20); (**F**) Detail of a primary vascular bundle (x40).

Abbreviations: AP, assimilating parenchyma; C, cuticle; Ep, epidermis; GC, guard cells; IS, intercellular space; M, mesophyll; P, phloem; SC, subsidiary cells; SCh, substomatic chamber; SP, stomatal pore; St, stomata; VB1, primary vascular bundle; VB2, secondary vascular bundle; X, xylem.

Photosynthetic pigments

Chlorophyll is the pigment that regulates many physiological functions in plants, therefore, changes in chlorophyll content is considered to be an important indicator in highlighting the stress caused by climatic factors (WANG & al [25]) or plant nutrition (CARTER & al [26]; WU & al [27].).

The main pigments of the leaves are represented by chlorophylls and carotenoids, pigments that provide valuable information on the installation of physiological stress in plants. The values of chlorophyll content in the leaves are closely correlated to environmental conditions, high temperatures and drought causing a decrease in the total content of photosynthetic pigments. In addition to the decrease in the total content of photosynthetic pigments, the stress caused by environmental conditions also induces the increase in the content of carotenoid pigments in the leaves.

In *E. spectabilis*, the values of different pigments (Chlorophyll *a* (Cha), chlorophyll *b* (Ch b), total chlorophyll (TC) and carotenoids (Cx) is influenced by climatic conditions, the results obtained showing statistically significant differences between these parameters. Regardless of the area, in *E. spectabilis* it was shown that the plants always had a higher chlorophyll *a* content than the chlorophyll content *b*.

In order to highlight the adaptation of the genus *Eremurus* to the culture conditions in Iași, during the research period, the content of assimilating pigments was analyzed by the spectrophotometric method. In order to obtain the most conclusive results regarding the content of assimilating pigments, the harvesting of the vegetal material represented by leaves that have reached maximum maturation was performed at the same time of day.

Following the determinations performed, in the *Eremurus* genus, a higher content of assimilative pigments was observed in *E. himalaicus* and *E. robustus* (Table 3). By comparing the results of the three species, the total content of chlorophyll pigments increased in *E. stenophyllus* by 4.78% compared to *E. himalaicus* and by 9.12% compared to *E. robustus*.

The literature mentions that, under normal ecophysiological conditions, the ratio of chlorophyll *a*/ chlorophyll *b* is around 3:1 (LICHTENTHALER & al [21]; STREIT & al [28]).

The plants that were exposed to intense light, presented an increase in the ratio of chlorophyll *a*/chlorophyll *b* compared to plants grown in shade conditions (LICHTENTHALER & al [29], [30]).

As for the *Eremurus* species, the plants are performing their blooming period during the months with high light intensity, the values obtained for this ratio increased in *E stenophyllus* by 1.99% compared to *E. himalaicus* and by 3.53% compared to *E. robustus*. (Table 3). The stress caused by climatic factors, which induces physiological changes, can be highlighted by achieving the ratio of chlorophyll/carotenoids pigments (HENDRY & PRICE [31]).

The highest value of the chlorophyll/carotenoids pigments ratio was registred by *E. stenophyllus* and the smallest value one at *E. robustus*.

It was observed that the values obtained are smaller compared to the results of specialized studies, which states that under normal ecophysiological conditions, the value of chlorophyll/carotenoids pigments is 4.8:1.

The decreased values of the ratio of chlorophyll pigments/carotenoids suggests that *Eremurus* plants have been physiologically stressed due to changes in abiotic factors such as light and humidity. This stress caused both the decrease in chlorophyll pigment content and the decrease of chlorophyll *a*/chlorophyll *b* ratio (CROFT & al [32]).

Table 3. Average content of photosynthetic pigments (mg g^{-1} F.W)

Variants (species)	Cl. a mg/g F.W.	Cl. b mg/g F.W.	x+c mg/g F.W.	Σ	Chl./Car	Chl.a/ Chl.b.
V_1 - *E. himalaicus*	1.42±0.03	0.59±0.02	0.50±0.05	2.51	4.02	2.41
V_2 - *E. robustus*	1.52±0.02	0.58±0.04	0.53±0.02	2.63	3.96	2.63
V_3 - *E. stenophyllus*	1.41±0.03	0.52±0.02	0.47±0.04	2.41	4.10	2.70

Each value is shown as the mean ± S. D.; FW-fresh weight

The impact of abiotic stress on both the whole plant and at the level of cells is inevitable due to the plant growth environment. APX are distinct enzymes designed to metabolize stress-induced by H_2O_2 and to control their potential impact to maintain the cellular H_2O_2 concentration to a necessary level for all aspects of normal plant growth and development (GILL & TUTEJA [33]; RAY & al [34]; ANJUM & al [35]). In combination with other cellular antioxidants, APX help plants to combat accumulated H_2O_2 deficiencies in cellular organites and redox homeostasis (GILL & TUTEJA [33]; MHAMDI & al [36]; SOFO & al [37]). APX are enzymes known to be different regarding their affinity for H_2O_2 and their requirement for power reduction during H_2O_2 metabolism (GILL & TUTEJA [33]). Ascorbate peroxidase is a key enzyme that regulates ROS levels that acts in different subcellular compartments (CAVERZAN & al [38]). In different plant species, the expression of genes encoding APX is differentially modulated by abiotic stress factors. All research results in the literature strongly indicate that APX isoforms play important and direct roles as elements of protection against adverse environmental conditions. When plants are exposed to stress caused by drought, antioxidants performs as a mechanism of protection against free radicals and increase the activity and amount of antioxidant enzymes in plant cells, such as superoxide dismutase (SOD), catalase (CAT), peroxidase (POX) and the amino acid proline (RAHIMIZADEH & al [39]). At *Narcissus*, the stress caused by the drought induces a significant increase in the activity of antioxidant enzymes

(ZANGENEH & al [40]). Studies have shown that water deficiency induces a much higher increase in antioxidant enzymes in the tolerant plants than in the sensitive ones (BERGMANN & al [41]; GOGORCENA & al [42]; MAFAKHERI & al [43]; SHAO & al [44]).

In order to study the adaptation of the genus *Eremurus* to the ecological conditions in Iași, biochemical determinations were performed regarding the enzymatic activity in the leaves. Since it is known in the literature that both catalases and ascorbate peroxidases tend to increase their activity under conditions of abiotic stress, during the blooming period of the plants, determinations were made to quantify these enzymes.

The results obtained on APX at the three species of *Eremurus* were compared both with each other and with the average. Differences in the increase on ascorbate peroxidase activity can be considered a practical measure for assessing the level of stress, which causes an imbalance in plant growth. In this case, the increase of ascorbate peroxidase activity was correlated with biometric measurements, the results obtained highlighting a good adaptation of this genus at the climatic conditions of Iasi.

The comparison of the results showed the highest increases in APX activity in the *E. stenophyllus.*Within the genus, the lowest values were obtained for the *E. robustus* and *E. himalaicus* (Figure 7).

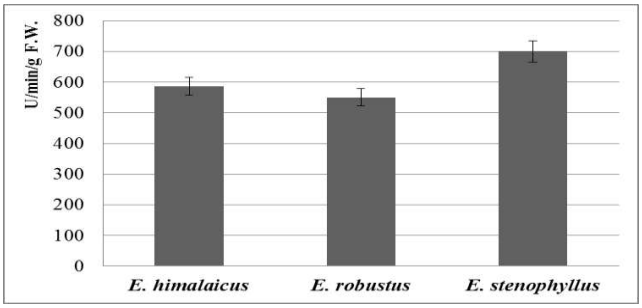

Figure 7. The ascorbate peroxidase activity determined in the leaves of *Eremurus* (U/min/g F.W.)

By comparing the results with the average, increases of APX activity by 14.43% were obtained by the *E. stenophyllus*. Decreases in APX activity compared to the average were observed at the *E. robustus* (10.12%) and *E. himalaicus* (4.3%). The increase and decrease of APX activity does not indicate an abiotic stress, the values obtained being specific to each species.

Comparing the results obtained at the enzymatic activity (APX) during the blooming period of the plants with the biometric determinations and the vegetation phenophases, it is concluded that the plants showed a good growth and development, presenting the ornamental value specific to the genus.

The increase and decrease of APX activity within the genus *Eremurus* indicates a slight stress caused by both water deficiency and rising temperatures during flowering. The presence of lower values at *E. robustus* and *E. Himalaicus* can be explained given that blooming of these two varieties occurs earlier (May and first decade of June).

Conclusions

The foxtail lilies species studied had a normal developed and specific ornamental characters. They can be used successfully in landscaping design or as cut flowers.

The three foxtail lilies species ensure a flowering period of approx. two months, from the last decade of April to the second decade of June.

The anatomical differences between the three species are not very great. The three species present leaves of phyllodic anatomy with inverted vascular bundles, monostratified epidermis, the central zone of the mesophyll formed by large and rounded cells, and a sponge-assimilating parenchyma.

The stomata in *E. stenophillus* and *E. himalaicus* are arranged at the same level as the epidermal surface while in *E. robustus* they are arranged a little lower. Although in all cases very irregular cells appear and leaving large intercellular spaces, the assimilating parenchyma layer is more developed in *E. stenophillus* and *E. himalaicus* than in *E. robustus.*

A larger content of assimilatory pigments was observed at *E. robustus* and *E.himalaicus*. The reports chlorophyll *a*/*b* and chlorophyll/carotene pigments showed valued which fit within the theoretical limits, the values obtained at all the experimental variants do not indicate a physiological accentuated stress of these species.

The more reduced content of photosynthetic pigments at *E. stenophyllus* can be correlated to the more intense enzymatic activity.

The growth of the ascorbate peroxidase activity within the *Eremurus* type indicate a slight stress which could be caused also by the water deficit, and by the growth of the temperatures from the period in which the plants developed their flowering. The presence of the more reduced values at *E. robustus* and *E. himalaicus* can be explained taking into consideration the fact that at these two species the flowering was made during the period in which the temperatures were not very high.

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Conflict of Interest

The authors have no conflict of interest to declare.

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