

ABSTRACT

Key words: perennial plants, geophytes, *Hemerocallis*, *Eremurus*, ornamental value

In the category of the perennial (vivid) flower plants there is a large number of types, with a great diversity of species and cultivations. Due to the ecologic plasticity and to the ornamental qualities, they were and still are widely used, not only in ornamental purpose, but also in other activity fields (alimentary and pharmaceutical industry, cosmetic industry and perfume business, industry of colorants, etc.).

The perennial flower plants are spread all over the world, from field areas, banks of waters and lakes, up to the highest mountain areas.

The rusticity and the great diversity of the perennial flower plants determine their use in the most varied ways. We meet them in the green spaces, both in assemblies of the round type, rectangular gardens, margins, platbands, colorful spots, and also in alpine gardens, on flowery walls or around waters. Some of them have a long flowering period and assure the décor in the parks and in the gardens since spring until late in the autumn. Also, we must remind the fact that many perennial flower plants fulfill the necessary conditions of using them as cut flowers in the florists' preferences in the bouquet art.

The *Hemerocallis* and *Eremurus* types include perennial plants from the category of geophytes, with underground organs of tuberous roots and rhizome type.

Eremurus M. Bieb. (the candle of the desert, the fox's tail) is part of the Asphodelaceae family and contains approximately 45 species distributed on large areas in Central Asia, Afghanistan, Iran, Pakistan, Iraq, Turkey, Lebanon, India and China.

Hemerocallis L. (yellow lily, summer lily, "one day beauty") contains approximately 15 species and was initially placed in the Liliaceae family, but more recently in the Asphodelaceae. The natural areas where the *Hemerocallis* species are met are the temperate and sub-tropical Asia, but they are focused, especially, in China, Korea and Japan.

The thesis entitled "***The behavior of some species and the cultivation of perennial flower plants in the ecological conditions of the North-East of Romania***" aims to bring in the forefront two types of flower plants – *Hemerocallis* and *Eremurus* – which can represent exceptional variants in the landscape and floral art. The detailed presentation, from an ornamental point of view, of an important number of species and varieties belonging to the two types (17 of *Hemerocallis* and 6 of *Eremurus*) is considered to excite the interest of the flowers lovers and to encourage the cultivation of these plants.

The variety of perennial plants subject to the study was compound of 17 cultivations of *Hemerocallis* ('Arctic Snow', 'Aten', 'Black Prince', 'Bumble Bee', 'Campfire Embers',

'Cartwheels', 'Chicago Cardinal', 'Chicago Picotee Memories', 'Cologne Rocket', 'Custard Candy', 'El Desperado', 'Frans Halls', 'Mikado', 'Pandora's Box', 'Spits Beauty', 'Stella de Oro', 'Strawberry Candy'), and six species and cultivations of *Eremurus* (*E. himalaicus*, *E. robustus*, *E. stenophyllus*, *E. 'Cleopatra'*, *E. 'Pinokkio'*, *E. 'Romance'*).

The studies were organized and made in the experimental field of the Floriculture from the Horticulture Faculty in the "Ion Ionescu de la Brad" University of Agricultural Sciences and Veterinary Medicine from Iasi. The physiological and biochemical determinations were made both in the "Prof. univ. Dr. Gica Gradinariu" Laboratory of Fruit Tree Research within the Horticultural Research Centre, and in the Oenology Laboratory of the Romanian Academy.

The thesis is structured in two parts and contains ten chapters, at which the bibliography is added.

Part I - Documentary study - represents the bibliographic documentation and contains two chapters divided into five sub-chapters, which aim at the general presentation of the genera *Hemerocallis* and *Eremurus* (brief history, importance, origin and area of spread, botanical and biological features, systematics, ecological requirements, technological features and cultivation methods). This part occupies a percentage of 24% of the entire thesis, respecting thus the requirements regarding the pro rata between the documentary part and the own contributions part.

Part II – Own Contributions – contains seven chapters and represents 76% of the total volume of the thesis.

Chapter 3 summarizes the activity carried out in the thesis, by specifying the main purpose and objectives, as well as the materials used in the experiments (plant material, technical materials, devices, equipment, etc.) and the methodology used in the undertaken research.

Chapter 4 presents the study of the conditions of natural and administrative environment specific to the "V. Adamachi" didactic horticultural farm, where the experiments were made. The chapter is divided in seven sub-chapters where the following aspects are analyzed: the geographical set up, the structure of the relief, the geologic and pedologic structure, the hydrologic structure, the climatic characterization of the experimental period between 2013-2020 (with details regarding the thermal regime, the precipitations regime, the relative humidity, the speed and direction of the wind) and the characterization of the organizing and institutional environment. From the effectuated analysis resulted the fact that in the experimental field are fulfilled the pedo-climatic conditions necessary for the cultivation of the studied flower species, and the administrative conditions permitted the carrying on of the research activities according to the purpose and to the proposed objectives.

Chapter 5 is a comparative study of *Hemerocallis* cultivars in the collection, referring to a series of quantitative features (number of leaves per shoot and their size, biometric features of floral stems, bracts, inflorescences and flowers) and qualitative (flower colour, main phenophases, flowering period and duration). The results indicate a diversity of the features of the analyzed hybrids and a special ornamental value, with extensive possibilities of capitalization.

Chapter 6 examines, similarly to Chapter 5, the ornamental features specific to *Eremurus* taxa. And in this case, a good adaptation of the plants to the given cultivation conditions and the very good decoration capacity was highlighted. In both genera, the biometric data recorded for

each taxon were compared with the mean of the variants (considered control). The bigger or lesser differences between the variants are related, first of all, to the specific features of the taxa (the data correlating with the description made by the authors) and less to the eco-pedological conditions of culture, this supporting the recommendation to extend their cultivation.

Chapter 7 contains a study of the variability of the main features of ornamental interest found at *Hemerocallis* cultivars divided into two categories, depending on the destination of their use (as cut flowers or as potted plants), calculating the coefficients of variability (cv%) for the main features of ornamental interest. Eight hybrids corresponding to the requirements for use as cut flowers ('Arctic Snow', 'Athens', 'Campfire Embers', 'Cartwheels', 'Chicago Cardinal', 'Cologne Rocket', 'El Desperado', 'Mikado') and two varieties that can be used as potted plants were analyzed ('Pandora's Box' and 'Stella de Oro'). For hybrids of cut flowers, the height of the flower stem, the diameter of the flower and the number of flowers/stem were analyzed, and for those four pots the number of leaves, the length and width of the leaves, the height of the flower stems, the number of flowers / stems and the diameter of the flower were analyzed. In the case of hybrids for the cut flowers, of the three features evaluated, the flower diameter proved to be more uniform, with low variability (cv% <10%), except for the varieties 'Cartwheels' and 'El Desperado', but also for them the value of the coefficient of variability is close to the lower limit, towards low variability. The height of the floral stem registered a medium to small variability, and the number of flowers on the stem a medium variability, with values towards the upper limit. In the cultivars for pot cultivation, the number of leaves, the width of the leaves, the height of the floral stem, the number of flowers per stem had average variability, with cv% between 10-20%. Only the leaf length at 'Pandora's Box' and the flower diameter at 'Stella de Oro' had a small variability (cv% <10%).

Chapter 8 presents the results obtained from physiological and biochemical analyzes performed on the leaves of *Eremurus* and *Hemerocallis* plants.

The physiologic analysis regarding the determination of the photo-synthetic pigments at the *Eremurus* type emphasizes a great content of assimilating pigments at the species *E. himalaicus* and *E. robustus* and a more reduced content of photo-synthetic pigments at the cultivars subject of the study ('Cleopatra', 'Romance' and 'Pinokkio'). The report between the chlorophyllian and carotenoid pigments showed more reduced values, fact that suggests that the *Eremurus* plants presented at the physiologic level a stress caused by the modifications of the abiotic factors, such as the temperature and the precipitations which induce the stress condition of the plants at the physiologic level. At the *Hemerocallis* type, the reduction of the photo-synthetic pigments content with evidence at the cultivations of 'Cartwheels', 'Campfire Embers' and 'Chicago Picotee'. At these cultivations, through the correlation of the reduced values regarding the photo-synthetic pigments content with the increased values of the carotenoid pigments content, it was emphasized that the plants presented a physiologic stress caused by the climatic conditions from the vegetation period (very reduced precipitations and high temperatures). The reports chlorophyll a / chlorophyll b and chlorophyllian pigments / carotenoid pigments presented more reduced values at the cultivations 'Campfire Embers', 'Cartwheels', 'Chicago Picotee' and 'Spits Beauty'.

The biochemical analysis regarding the activity of the ascorbate peroxidase (APX) and of the catalase (CAT) within the type *Eremurus* show a slight stress that could be caused both by the water deficit, and by the increase of the temperatures in the period the plants carried on their flourishing. The presence of more reduced values at *E. robustus* and *E. himalaicus* are explainable taking into consideration that at these two varieties the flourishing was made in the period when the temperatures were not very high. The more intense enzymatic activity at the cultivations 'Romance' and 'Pinokkio' is caused both by the increase of the value of the temperatures, and by the lack of precipitations from the flourishing period. At the *Hemerocallis* type, the values of the enzymatic activity (APX, CAT) from the leaves is correlated with the photo-synthetic pigments content, so that at the cultivations which showed an increase of the enzymatic activity was emphasized a decrease of the chlorophyllian pigments.

Chapter 9 is dedicated to the study of the influence of the various preservation solutions on the life span of the cut flowers of *Eremurus* and *Hemerocallis*.

For the preservation of *Hemerocallis* flowers, characterized by their short lifespan, e.g. the rapid opening of the flower bud and the death of the floral tissues within 24 hours rapid (hence the name "day lilies" or "day beauty"), Cytokinin solutions were used, which slow down the senescence process (0.5mM kinetin and 0.5mM 6 benzyl-amino-purine). Distilled water was used as a control. Flowers were kept in the bud stage, detached from the flower stalk the day before anthesis, and observations were made 16 hours, 24 hours and 32 hours after harvest. Regardless of the solutions in which the flowers were kept, in no variant and in no cultivar was the storage extended beyond one day from the opening, so that, after 32 hours from the harvest, respectively 24 hours from the opening, all the flowers were in the stage of senescence.

Preservation of *Eremurus* cut flowers was analyzed in *E. robustus* and *E. stenophyllus*. Distilled water (M), commercial preservative *Flower Care* 0.4% (V1), mixture of AgNO₃ 20 ppm + commercial preservative *Flower Care* 0.4% (V2) and solution of AgNO₃ 20 ppm were used as storage solutions (V3). In addition to the observations based on the visual assessment of the quality of the flowers (the degree of flowering of the inflorescences, the color of the flowers and flower buds, the achievement of the flowering stage), laboratory determinations were performed on the enzymatic activity. Both visual observations and laboratory determinations have shown that the storage of *Eremurus* cut flowers in AgNO₃ solutions is not recommended, the best results being recorded in commercial preservative, which favoured more uniform flower opening and prolongation of life duration. At the biochemical level, AgNO₃ induced an increase in enzymatic activity, while the commercial preservative caused a reduction in enzymatic activity.

Chapter 10 – presents the main conclusions which were drawn as a consequence of the effectuated morphologic, physiologic and biochemical studies. Also, a series of recommendations is formulated for those who intend to cultivate or to study species and varieties of *Hemerocallis* and *Eremurus*, in view of their use both in the floral art and in the landscape assemblies.

The **bibliography** closes the thesis and contains the list of the bibliographic sources and materials consulted in view of the documentation and elaboration of this thesis (215 bibliographic references from Romania and from abroad).