THE EFFECTS OF DIFFERENT PRESERVATIVE SOLUTIONS ON VASE LIFE OF *ERYNGIUM PLANUM* AND *ECHINOPS RITRO* CUT FLOWERS

EFECTUL DIFERITELOR SOLUȚII DE PĂSTRARE ASUPRA DURATEI FLORILOR TĂIATE DE *ERYNGIUM PLANUM* ŞI *ECHINOPS RITRO*

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Abstract*. The species of the Eryngium and Echinops genera, by their ornamental characters and their ability to adapt to the most diverse ecological conditions, can provide valuable opportunities for enriching the floral range of plants for landscaping or cut flowers. In this paper, the effect of different chemical agents used as preservative solutions to improve the keeping quality of Eryngium planum and Echinops ritro cut flowers had been studied. Five variants were obtained for each analyzed species: silver nitrate (0.002%); potassium benzoate (0.03%); boric acid (0.01%); Fleur Vital (40 g/L) and distilled water as control. The vase life of the cut flowers of Eryngium planum was not influenced by the substances used in the storage solutions, but for Echinops ritro, the longer storage time was in water and boric acid. In both Eryngium planum and Echinops ritro, the shortest duration of leaf retention was in Fleur vital.*
Key words: *Eryngium planum, Echinops ritro,* cut flowers, preservative solutions, vase life

Rezumat. *Speciile genurilor Eryngium şi Echinops, prin caracterele ornamentale şi prin capacitatea bună de adaptare la cele mai diverse condiții ecologice, pot reprezenta variante valoroase în îmbogățirea sortimentului de plante floricole pentru amenajări peisagere sau pentru flori tăiate. În lucrare este studiat efectul unor substanțe chimice asupra duratei de păstrare a florilor tăiate de Eryngium planum and Echinops ritro. La fiecare specie s-au constituit cinci variante: azotat de argint (0,002%); benzoat de potasiu (0,03%); acid boric (0,01%); Fleur Vital (40 g/L) şi apă distilată (martor). Durata de păstrare a florilor tăiate de Eryngium planum nu a fost influențată de soluțiile de păstrare, dar la Echinops ritro durata cea mai mare s-a înregistrat în acid boric şi apă. Atât la Eryngium planum, cât şi la Echinops ritro durata cea mai scurtă de păstrare a frunzişului a fost în conservantul comercial Fleur vital.*
Cuvinte cheie: *Eryngium planum, Echinops ritro,* flori tăiate, soluții de păstrare, durata păstrare

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INTRODUCTION

The intersection of art, design, and horticulture represented by the ornamental plant industry has led to the use of a very wide variety of plant organs and taxa for ornamental purposes (Reid and Jiang, 2012).

A wide variety of plant materials are grown and harvested for their ornamental value. The products that we think of as ornamentals include those that are cut for their flowers and/or foliage, and those that are sold as potted flowering plants or potted foliage plants. Whether cut or intact, ornamentals are complex plant organs, in which loss of quality may result in rejection in the marketplace (Reid, 2009). Harvesting and marketing of cut flowers vary according to crops, growers and marketing systems. The principal goal is should be so as to maximize postharvest life of the flowers (Reid, 2009).

Postharvest senescence is an integral part of normal developmental cycle of plants and it is highly regulated process that involves structural, biochemical and molecular changes in the plant tissue (Shahri, 2011, quoted by Biniam *et al.*, 2012).

The relatively brief postharvest life of most cut flowers can be extended by a range of technologies and the various chemical solutions used after harvest to improve the quality of cut flowers usually have specific purposes.

In order to preserve the cut flowers in time, substances are used to prolong the life of flowers, have in their composition carbohydrates, which serve as an energy substrate for the cut flowers, antimicrobial substances, which have the role of stopping the development of pathogenic microorganisms usually formed at the base of the stems storage water. Storage solutions used in the flower industry vary from one species to another, depending on their sensitivity. The use of solutions is aimed at fortification or strengthening of flowers after they have suffered from lack of water, for blooming or for longer storage for the consumer (Amariuței, 1987).

In the art of bouquets, the last years have brought to the wishes of art consumers, flowers that until now were not considered ornamental. The requirement for unusual flowers comes both for the interesting aspect and for the resistance in the vase, which is intended to be as long as possible (Ohana *et al.*, 1994).

Unusual plants, such as the *Eryngium* and *Echinops* genres, are increasingly appreciated and used for ornamental particularities, in modern flower gardens or in floral art. These plants, with moderate ecological requirements and a good adaptability, can be grown in sunny, poor, salt or low-water areas.

Eryngium planum and *Echinops ritro* show blue inflorescences and are used in floral workshops as a secondary part in arranging arrangements and bouquets, due to their color and appearance, but also for the time resistance of floral rods (Ondra, 2009). The aesthetic aspect of these plants is equally important for embellishing gardens or floral arrangements (Armitage, 1993).

In this paper, the effect of different chemical agents used as preservative solutions to improve the keeping quality of *Eryngium* and *Echinops* cut flowers had been studied.

MATERIAL AND METHOD

The present investigation was conducted at Floriculture lab of Faculty of Horticulture, University of Agricultural Sciences and Veterinary Medicine of Iasi, Romania. The experimental material for the present investigation comprised of two ornamental species of *Eryngium* and *Echinops (Eryngium planum* and *Echinops ritro).* The two perennial species are known mostly as the immortals, but are as interesting as the fresh flowers.

Eryngium planum is a plant originated in Central Europe, Yugoslavia, Caucasus, Western Siberia, Central Asia (Armitage *et al*., 2003). It has a height between 70 and 100 cm and the pale blue flowers grouped in umbels (fig. 1a), blooms from July to August.

Echinops ritro, a species originated from the Iberian Peninsula, France, Italian Peninsula, Balkan Peninsula, East Central Europe, Turkey, Caucasus, Western Siberia, Central Asia (Hill *et al.*, 2012), has heights between 40 and 60 cm. The inflorescences are solitary, spherical, blue-grey (fig. 1b), blossoming from July to September.

a)

b)

Fig. 1 The general aspect of plants: *Eryngium planum* (a) and *Echinops ritro* (b) (original)

The experiment was subjected to analysis of variance, used randomized design with 3 replication. The treatments were performed with four storage solutions ($AgNO_3$ - silver nitrate, $C_7H_5KO_2$ - potassium benzoate, H_3BO_3 - boric acid, Fleur Vital - commercially preserved), to which was added, as a control, the distilled water. Thus, five variants were obtained for each analyzed species: V_1 - silver nitrate (0.002%); V_2 - potassium benzoate (0.03%); V_3 - boric acid (0.01%); V_4 - Fleur Vital (40 g/L) and V_5 - distilled water (control).

The harvesting of inflorescences was done in the morning hours (9 to 10 a.m.) with the help of a scissors. The cut inflorescences were immediately placed in storage solutions (fig. 2).

Observation was recorded by keeping the harvested inflorescences at green buds stage, in holding solution at room temperature (22-24ºC). Both water and

storage solutions were changed at two days, and the basal cut was refreshed. For each variant, a 0.25 L container of the storage solution was used.

The assessment of the flowers storage period was measured from the day when the cut flower was kept into the storage solution to the stage where the flowers have lost their characteristic color and decorative appearance.

a) b)

Fig. 2 Storage of *Eryngium* and *Echinops* flowering stems in conservation solutions (original)

Also, the influence of storage solutions on the duration of leaf preservation (to yellowing of the leaves) was evaluated.

The data was processed using analysis of variance, by testing the difference between variants with LSD test (Săulescu and Săulescu, 1967). As a control was considered the variant V_5 (storage in distilled water) and the average of experience. The symbols used to indicate the significance of the differences from the control are: ns=insignificant; o/x=negative/positive significant difference; oo/xx= negative/positive distinct significant difference; ooo/xxx=negative/positive very significant difference.

RESULTS AND DISCUSSIONS

The experience of *Eryngium planum* cut flowers, in the first stage proposed for harvesting, highlights the rusticity of these flowering species. Inflorescences harvested in the green buds stage resisted in the 5 storage solutions a statistically insignificant number of days, compared to the control (distilled water). The solutions that present in their component silver nitrate and potassium benzoate (tab. 1), extend the life of the flowers by two days, and the boric acid with another day. Compared to the average of the experience (18 days), the results obtained for all variants are statistically insignificant.

The inflorescences of *Echinops ritro*, harvested in the green buds stage used in the experience of cut flowers, have registered values for solutions based on silver nitrate, potassium benzoate and Fleur Vital, smaller than the control

(distilled water) by 3 days, which means distinctly significant differences in the negative sense (tab. 2). Compared to the average of the experience, the results are also statistically unsecured, with the exception of the flowers kept in boric acid and water, which register significant differences in the positive sense, the preservation time being higher with 1.8 days.

Table 1

The influence of the preservation solutions on *Eryngium planum* cut flowers

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	19	2.0	ns.	1.0	ns
V_2-$C_7H_5KO_2$	19	2.0	ns.	1.0	ns
V_3 - H_3BO_3	18	1.0	ns.	0.0	ns
V_4 - Fleur Vital	17	0.0	ns.	-1.0	ns
V_5 - distilled water (**control)**	17	-	control	-1.0	ns
Average	18	-	-	0.0	control
		$LSD_{5\%}$ = 2.5 $LSD_{1\%}$ = 3.6 $LSD_{0,1\%}$ = 5.4		$LSD_{5\%}$ = 2.1 $LSD_{1\%}$ = 3.1 $LSD_{0,1\%}$ = 4.7	

Table 2

The influence of the preservation solutions on *Echinops ritro* cut flowers

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	24	-3.0	oo	-1.2	ns
V_2-$C_7H_5KO_2$	24	-3.0	oo	-1.2	ns
V_3 - H_3BO_3	27	0.0	ns.	1.8	*
V_4 - Fleur Vital	24	-3.0	oo	-1.2	ns
V_5 - distilled water (**control)**	27	-	control	1.8	*
Average	25.2	-	-	0.0	control
		$LSD_{5\%}$ = 1.8 $LSD_{1\%}$ = 2.6 $LSD_{0,1\%}$ = 3.9		$LSD_{5\%}$ = 1.6 $LSD_{1\%}$ = 2.3 $LSD_{0,1\%}$ =3.5	

From a commercial point of view, the flower stems have to look aesthetically, both in terms of the quality of the flowers but also of the foliage. In the case of *Eryngium planum* stems, they resist about the same as flowers (tab. 3). The foliage that has resisted the least is in the case of the solution in which Fleur vital was used, this one resisting only 16 days, with 4 days less than the other variants (tab. 3), and with 1 day less than the flowers of the same variant. Compared to the average of experience, the values of the other

experimental variants are not statistically insured, the difference from these being 0.8 days.

Table 3

The influence of storage solutions on the foliage of *Eryngium planum*

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	20	0.0	ns.	0.8	ns.
V_2-$C_7H_5KO_2$	20	0.0	ns.	0.8	ns.
V_3 - H_3BO_3	20	0.0	ns.	0.8	ns.
V_4 - Fleur Vital	16	-4.0	ooo	-3.2	oo
V_5 - distilled water (**control)**	20	-	control	0.8	ns.
Average	19.2	-	-	0.0	control
		$LSD_{5\%}$ = 1.8 $LSD_{1\%}$ = 2.6 $LSD_{0,1\%}$ = 3.9		$LSD_{5\%}$ = 2.0 $LSD_{1\%}$ = 3.0 $LSD_{0,1\%}$ =4.5	

The foliage on the flowering stems of *Echinops ritro* lasts on average more with 3 days compared to the flowers on the same stems used in the experiment. The variants in which silver nitrate, potassium benzoate and boric acid have been used have significantly positive values compared to the control value, the difference being 3 days. With distinctly significant differences in the negative sense from the same control, it records the variant in which Fleur vital was used, the foliage being aesthetic only 20 days, with 4 days less than the flowers is the same rods. Compared to the average of the experience (25 days), the values significantly positive are also in the case of variants V_1, V_2 and V_3 and very significant in the negative sense in the variant of the storage solution with Fleur Vital (tab. 4).

Table 4

The influence of storage solutions on the foliage of *Echinops ritro*

Variants (preservation solution)	Vase life (days)	Comparison with control (distilled water)		Comparison with average	
		d (±) days	Signif. of diff.	d (±) days	Signif. of diff.
V_1- $AgNO_3$	27	3.0	*	2.0	*
V_2-$C_7H_5KO_2$	27	3.0	*	2.0	*
V_3 - H_3BO_3	27	3.0	*	2.0	*
V_4 - Fleur Vital	20	-4.0	oo	-5.0	ooo
V_5 - distilled water (**control)**	24	-	control	-1.0	ns.
Average	25	-	-	0.0	control
		$LSD_{5\%}$ = 2.1 $LSD_{1\%}$ = 3.1 $LSD_{0,1\%}$ = 4.7		$LSD_{5\%}$ = 1.5 $LSD_{1\%}$ = 2.2 $LSD_{0,1\%}$ =3.3	

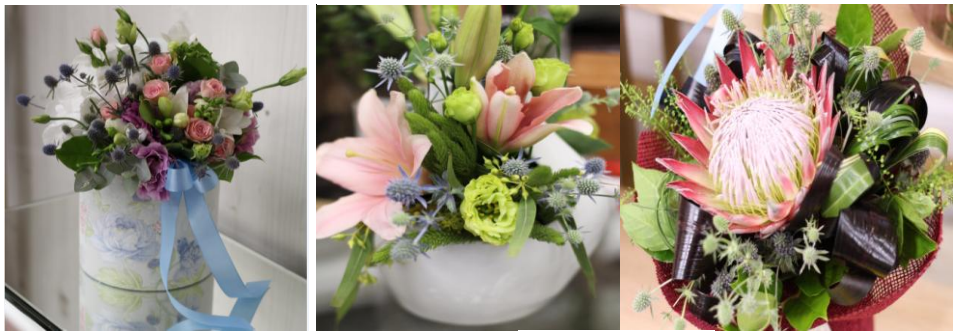

Fig. 3 Fresh cut *Eryngium planum* flowers in beautiful bouquets and arrangements (original)

Uses of *Eryngium planum* (fig. 3) and *Echinops ritro* (fig. 4) are numerous due to their long-lasting resistance, but also to the aesthetic aspect of the inflorescences alongside the blue color.

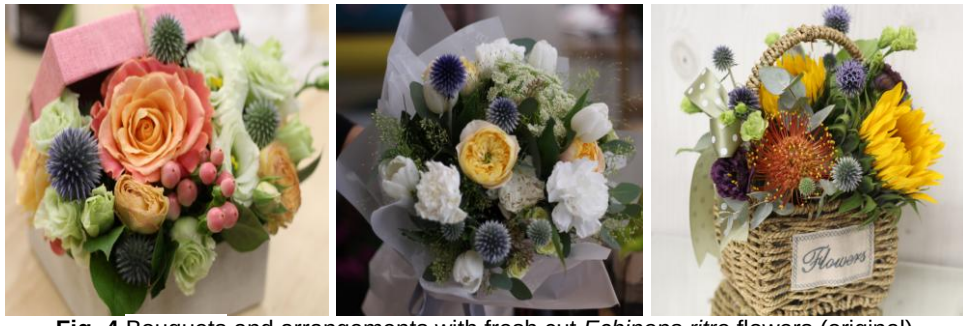

Fig. 4 Bouquets and arrangements with fresh cut *Echinops ritro* flowers (original)

CONCLUSIONS

1. The longevity of the cut flowers for both the species *Eryngium planum* and *Echinops ritro*, it justifies their use in floral design.

2. The vase life of the cut flowers of *Eryngium planum* was not influenced by the substances used in the storage solutions, the results are not conclusive to affirm the importance of a substance to keep the inflorescences longer in the vase. But, for *Echinops ritro*, the longer storage time was in water and boric acid.

3. The foliage in the case of the *Eryngium planum* rods was not positively influenced by any of the variants, very little in the positive sense was the foliage of the *Echinops ritro* species, especially in the case of the use of silver nitrate, potassium benzoate and boric acid. In both *Eryngium planum* and *Echinops ritro*, the shortest duration of leaf retention was in Fleur vital.

4. Even with the slight influence of the substances proposed in the experiment, the species taken into study have a special ornamental importance and with a remarkable life span for the use in a fresh state in the floral art.

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