STUDIES REGARDING THE POSTHARVEST CARE OF CUT FLOWERS FOR SOME ORANAMENTAL *ALLIUMS*

STUDII PRIVIND PĂSTRAREA FLORILOR TĂIATE LA UNELE SPECII ŞI CULTIVARE ORNAMENTALE DE *ALLIUM*

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Abstract. *This study presents some results regarding the behavior of some Allium species and cultivars cut flowers, which were treated with giberelic acid (GA_3) and cycocel (CCC). The floral stems of A. giganteum, A. moly and A.`Purple Rain` were harvested in three different flowering stages (at the opening of 1/4, 1/2 and 3/4 from the total flower number of the inflorescence) and were treated with GA_3 and CCC solutions, in 250, 500 and 1000 ppm concentrations. The control was preserved in water. The average of vase resistance is 23,9 days for A. giganteum, 21,3 days for A. 'Purple Rain' and 11,4 days for A. moly. The flower stems which were harvested at the stage of 1/4 and 1/2 open florets had the longest resistance. The most efficient solutions were GA_3 500 ppm and CCC 250 ppm for A. giganteum, GA_3 (all concentrations) and CCC 250 ppm for A.'Purple Rain' and only water for A. moly.*
Key words: *Allium, cut flowers, cutting stages, preserving.*

Rezumat. *Lucrarea prezintă rezultate privind comportarea florilor tăiate la specii şi cultivare de Allium păstrate în soluții de acid giberelic (GA_3) şi cycocel (CCC). Tijele florale de la A. giganteum, A. moly şi A. 'Purple Rain' au fost recoltate în diferite stadii de deschidere (la 1/4, 1/2 și 3/4 flori deschise în inflorescență) şi au fost păstrate în soluții de la cele două produse, în concentrații de 250, 500 și 1000 ppm. La martor păstrarea s-a făcut în apă. În medie, inflorescențele tăiate la A. giganteum au rezistat 23,9 zile, la A. 'Purple Rain', 21,3 zile, iar la A. moly, 11,4 zile. Inflorescențele recoltate la deschiderea a 1/4 şi 1/2 din numărul de flori au înregistrat cea mai bună rezistență. Soluțiile conservante cele mai eficiente au fost cele de GA_3 500 ppm şi CCC 250 ppm la A. giganteum, cele de GA_3 (în toate cele trei concentrații) şi CCC 250 ppm la A. 'Purple Rain' şi numai apa la A. moly.*
Cuvinte cheie: *Allium, flori tăiate, faze de recoltare, păstrare.*

INTRODUCTION

Known mostly as vegetables, the *Alliums* have also important ornamental traits, which completed by the environmental resistance and the great colour range, make them easy to be used in landscape architecture, floral or interior design (Fritsch and Friesen, 2002). Through the first and the most used ornamental *Alliums* are: *A. giganteum* Regel, *A. moly* L. or *A.*

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sphaerocephalon L., plants witch are more and more used today (Davies, 1992; Cottrell, 1999; Kamenetsky and Fritsch, 2002; cited by Harding, 2004).

The interest of the romanian florists for these plants is increasing at the moment and this work is giving some informations about the vase resistance of *Allium* cut flowers, using some different stages and postharvesting treatments with growth regulators (giberelic acid and cycocel). The growth regulators have very large range of using in horticuture, like to reduce the bulb sprouting or to incease the flower number for many ornamental plants, including some Alliums (Pogroszewska *et al.*, 2007; Sardoei, 2014; Toma and Jităreanu, 2007). Krzyminska (2009) highlight that the *Allium* cut flowers postharvest life is different betwen the species: 15-20 days for *A. aflatunense* L., 21-29 days for *A. christophii* L., 28-35 days for *A. giganteum* Regel and 15-19 days for *A. rosenbachianum* L. and that the cutting stage is very important for the postharvest life.

MATERIAL AND METHOD

The study was realised in may – june, 2015, the material was represented by three *Allium* cultivars *Allium*: *A.* 'Purple Rain'*, A. moly* L. and *A. giganteum* Regel, cultivated in the experimental field of Floriculture, from University of Agricultural Sciences and Veterinary Medicine Iași. The inflorescences were harvested in three flowering stages, as 1/4, 1/2 and 3/4 open florets. There were used different solutions with giberellic acid (GA_3) and cycocel (CCC), in 250, 500 and 1000 ppm concentrations, to preserve the cut flowers. The control was kept in distilled water. The preservation solutions were changed at every two days. Every variant had three replications, each one having three flower stems. For every cultivar studied, the experimental factors were represented by the preservation solution (7 graduations) and the cutting stage (three graduations), the experiment accumulating 21 variants (tab. 1).

Table 1

Experimental variants

Experimental factors	Specification	Variant/Graduations
Storage solutions	Distilled water	**V_1 (control)**
	GA_3	V_2 - 250 ppm
		V_3 - 500 ppm
		V_4 - 1000 ppm
	CCC	V_5 - 250 ppm
		V_6 - 500 ppm
		V_7 - 1000 ppm
Flowering stage	% open florets	S_1 - 1/4
		S_2 - 1/2
		S_3 - 3/4
		Average (control)

The cutting flower stem length was different, depending on the natural height of the plants: *A.* 'Purple Rain' – 40 cm, *A. moly* – 20 cm, *A. giganteum* – 60 cm. The flowers were preserved in about 22-24^{0}C and about 1000 lx daily illuminance. The obtained data and the results were processed using the variant analysis and the LSD method (Săulescu and Săulescu, 1967).

RESULTS AND DISCUSSIONS

The cut flowers from the three *Allium* taxa registered a very good vase resistance, especially *A. giganteum* and *A.* 'Purple Rain' (the average longevity - 21.2-23.9 days); at *A. moly* the postharvest longevity was lower with 50% than the other two taxa (11,3 days). The cut flowers resistance was influenced by the both experimental factors (the postharvest treatment and the cutting stage), but it was different betwen the species. From the individul analysis of those two experimental factors, could be observed that each one had an influence over the logevity of the *Allium* cut flowers.

Regarding the *A. giganteum* species, the storage solutions (different like product and concentration) had different influence comparing with the control (water), most of the results being statistically insured, excepting GA_3 250 ppm solution (tab. 2).

Table 2

The influence of the preservation solution over the *A. giganteum* cut flower storage time

Variant (preservation solution)	Storage time (days)	Difference toward the control (±)	Significance of difference
V_1 – water (control)	**24.1**	-	**-**
V_2 – GA_3 250 ppm	24.2	+0.1	ns
V_3 - GA_3 500 ppm	25.8	+1.7	***
V_4 - GA_3 1000 ppm	23.7	-0.4	o
V_5 – CCC 250 ppm	25.0	+0.9	***
V_6 – CCC 500 ppm	22.9	-1.2	ooo
V_7 – CCC 1000 ppm	22.4	-1.7	ooo

LSD 5% = 0,3 LSD 1% = 0,4 LSD 0,1% = 0,6

The GA_3 500 ppm solution had a good influence over the longevity of the cut flowers, extending the vase life with about 2 days, folowed by the V_5 variant (CCC 250 ppm) with an extension about 1 day. The CCC solutions with big concentrations (500 and 1000 ppm) have determined the reducing of the flower longevity with 1-2 days, the differences toward the control were very negative significant (tab. 2). Regarding the cutting stage, the results registred differences very significant positives in the stages S_1 and S_2 (at the stage at 1/4 and 1/2 open florets). The more late harvesting, at 3/4 open florets, shorten the storage time with 1-2 days toward the average of the variants with about 3 days comparing with S_1 (tab. 3).

Table 3

The influence of the cutting stage over the *A. giganteum* cut flower storage time

Variant (open florets stage)	Storage time (days)	Difference toward the control (±)	Significance of difference
S_1 - ¼ open florets	25.1	+1.2	***
S_2 - ½ open florets	24.7	+0.8	***
S_3 - ¾ open florets	22.3	-1.6	ooo
Average (control)	**23.9**	-	-

LSD 5% = 0,3 LSD 1% = 0,5 LSD 0,1% = 0,6

At *A.* 'Purple Rain', the longevity of the cut flowers, even if it outrun 20 days, it is a bit reduced but *A. giganteum*. Between those 7 variants which regards the storage solution, all the GA_3 solutions were favorable (with very significant differences) and also the CCC 250 ppm solution (with distinct significant differences). The V_6 and V_7 variants registered values closed to the control, with positives and negative differences, but without statistically insure (tab. 4).

Table 4

The influence of the preservation solution over the *A.* 'Purple Rain' cut flower storage time

Variant (preservation solution)	Storage time (days)	Difference toward the control (±)	Significance of difference
V_1 – water (control)	**20.4**	**-**	**-**
V_2 –ppm	21.3	+0.9	***
V_3 - GA_3 500 ppm	22.8	+2.4	***
V_4 - GA_3 1000 ppm	22.2	+1.8	***
V_5 – CCC 250 ppm	21.0	+0.6	**
V_6 – CCC 500 ppm	20.7	+0.3	ns
V_7 – CCC 1000 ppm	20.2	-0.2	ns

LSD 5% = 0,4 LSD 1% = 0,5 LSD 0,1% = 0,8

Regarding the cutting stage (tab. 5), the best variant is S_1, the 1/4 open florets cutting stage, which insure positive differences, very significant toward the average (it extend with 1-2 days the storage time). The harvesting when most of the florets are open, reduce the storage time with almost 2 days toward the average. In S_2 stage, the differences are positives but insignificant (tab. 5).

Table 5

The influence of the cutting stage over the *A.* 'Purple Rain' cut flower storage time

Variant (open florets stage)	Storage time (days)	Difference toward the control (±)	Significance of difference
S_1 - ¼ open florets	22.8	+1.6	***
S_2 - ½ open florets	21.4	+0.2	ns
S_3 - ¾ open florets	19.5	-1.7	ooo
Average (control)	**21.2**	**-**	**-**

LSD 5% = 0,3 LSD 1% = 0,5 LSD 0,1% = 0,6

Table 6

The influence of the preservation solution over the *A. moly* cut flower storage time

Variant (preservation solution)	Storage time (no. of days)	Difference toward the control (±)	Significance of difference
V_1 – water (control)	**13**	**-**	**-**
V_2 – GA_3 250 ppm	10.1	-2.9	ooo
V_3 - GA_3 500 ppm	9.9	-3.1	ooo
V_4 - GA_3 1000 ppm	9.8	-3.2	ooo
V_5 – CCC 250 ppm	12.7	-0.3	ns
V_6 – CCC 500 ppm	12.6	-0.4	ns
V_7 – CCC 1000 ppm	11.2	-1.8	o

LSD 5% = 1.4 LSD 1% = 2.0 LSD 0,1% =2.9

The *A. moly* species has a different behavior toward *A. giganteum* and *A.* 'Purple Rain', especially regarding the storage solution. From the results presented in Table 6, the preservation in water in the most favorable. The GA_3 solutions are not suitable, no matter the concentration, they decrease the flower longevity with more than 3 days. The CCC also has negative effect, but the differences toward the control is smaller, insignificant at 250 and 500 ppm or significant at 1000 ppm. The storage time at *A. moly* cut flowers is very less influenced by the cutting stage, is oscillating between 11 and 11.6 days, with the average between the variants by 11.3 days (tab. 7). Between the three variants, the best results registered the cutting stage 1/4 and 1/2 open florets (positive significant differences toward the average).

Table 7

The influence of the cutting stage over the *A. moly* cut flower storage time

Variant (open florets stage)	Storage time (days)	Difference toward the control (±)	Significance of difference
S_1 - ¼ open florets	11.6	+0.3	*
S_2 - ½ open florets	11.4	+0.1	*
S_3 - ¾ open florets	11.0	-0.3	o
Average (control)	**11.3**	**-**	**-**

LSD 5% = 0.1 LSD 1% = 0.4 LSD 0,1% = 0.9

Table 8

The combined influence of the experimental factors over the cut flower longevity (days)

Experimental factors		Species (cultivar)/significance of differences		
Preservation solution	**Inflorescences cutting stage**	***A. giganteum***	***A.* 'Purple Rain'**	***A. moly***
V_1 water	S_1-1/4 open florets	25.6**	21.3	13.0 ^{ns}
	S_2-1/2 open florets	25.0 *	21.3	13.0 ^{ns}
	S_3-3/4 open florets	21.6 ^{ooo}	18.6 ^{ooo}	13.0 ^{ns}
V_2 GA_3 250 ppm	S_1-1/4 open florets	25.0 *	23.3 ***	10.0 ^{ns}
	S_2-1/2 open florets	25.0 *	21.3	10.0 ^{ns}
	S_3-3/4 open florets	22.6 ^{oo}	19.3 ^{ooo}	10.3 ^{ns}
V_3 GA_3 500 ppm	S_1-1/4 open florets	27.6 ***	24.6 ***	10.0 ^{ns}
	S_2-1/2 open florets	26.6 ***	23.0 ***	9.6 ^{ns}
	S_3-3/4 open florets	23.0 ^{o}	20.6	10.0 ^{ns}
V_4 GA_3 1000 ppm	S_1-1/4 open florets	24.6	24.6 ***	10.0 ^{ns}
	S_2-1/2 open florets	23.6	21.3	9.6 ^{ns}
	S_3-3/4 open florets	22.6 ^{oo}	20.6	9.6 ^{ns}
V_5 CCC 250 ppm	S_1-1/4 open florets	26.3 ***	22.3 *	12.6 ^{ns}
	S_2-1/2 open florets	26.0 ***	21.3	12.6 ^{ns}
	S_3-3/4 open florets	22.6 ^{oo}	19.3 ^{ooo}	12.6 ^{ns}
V_6 CCC 500 ppm	S_1-1/4 open florets	23.3	22.3 *	12.6 ^{ns}
	S_2-1/2 open florets	23.3	20.6	12.3 ^{ns}
	S_3-3/4 open florets	22.0 ^{ooo}	19.0 ^{ooo}	12.6 ^{ns}
V_7 CCC 1000 ppm	S_1-1/4 open florets	22.6 ^{oo}	21.0	12.6 ^{ns}
	S_2-1/2 open florets	23.3	20.6	12.3 ^{ns}
	S_3-3/4 open florets	21.3 ^{ooo}	19.0 ^{ooo}	12.6 ^{ns}
Average		**23.9**	**21.1**	**11.4**
		LDS 5% = 0,90 LDS 1% = 1,21 LDS 0,1% =1,6	LDS5% =0,96 LDS1% =1,23 LDS0,1%=1,62	LDS 5% = 2,8 LDS 1% = 3,8 LDS0,1%=5,1

The interaction of the two experimental factors (tab.8), the best results were obtained at *A. giganteum* by harvesting blossoming in the early stages of opening (S1, S2) and preservation in GA3 500 ppm or CCC 250 ppm; for *A.* 'Purple Rain' is recommended either harvesting in stage 1 and preservation in GA_3 solution (250 and 1000 ppm), or harvesting in stage 1 and 2, preservation in GA_3 500 ppm. In all preservative solution and for all harvesting stages, *A. moly* longevity cut flowers presented a non significant differences, but better results in water (tab. 8).

CONCLUSIONS

1. The cut flower longevity of the three *Allium* (between 9.8 and 25.8 days) justify the possibility to use them in this way.

2. The most valuable as cut flowers (regarding the natural length of the floral stems and longevity) are *A. giganteum* and *A.* 'Purple Rain'.

3. In all cases, the optimum cutting stage of the inflorescences is S_1 (1/4 open florets) and S_2 (1/2 open florets).

4. As preservation solutions it can be recommended GA_3 500 ppm and CCC 250 ppm at *A. giganteum,* GA_3 (all concentrations) and CCC 250 ppm at *A.* 'Purple Rain' and only water for *A. moly.*

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