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THE EFFECT OF GROWTH REGULATORS AND PRESERVATIVE ON SENESCENCE OF CUT ORIENTAL LILY 'HELVETIA'

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Abstract. The quality of cut lily flowers during its postharvest life is important both for growers and customers. It is determined by two factors: longevity of flowers and a general appearance of the entire cut stem during its vase life. The aim of this work was to evaluate the effects of growth regulators (gibberellic acid and benzyladenine) and the preservative (200 mg·dm^{-3} 8HQC+2%S) on quality of cut oriental lily 'Helvetia,' a white blooming cultivar very popular on the Polish market. After cutting the flowers were treated for 20 h with growth regulators (GA_3 or BA, 500 mg·dm^{-3}) and then placed into distilled water. Non pulsed flowers were kept in a preservative solution composed of 200 mg·dm^{-3} 8HQC and 2% sucrose. Untreated flowers held in distilled water served as a control. During the senescence of cut lily flowers the soluble protein and free proline contents were determined. As the major problem in the postharvest handling of lilies is leaf yellowing, the effects of postharvest treatments on quality of leaves and their chlorophyll contents were also studied. The preservative increased vase life of cut lily flowers while gibberellic acid improved the quality of leaves. In leaves treated with GA_3 the chlorophyll level was 25% higher than in leaves on stems placed into distilled water directly after harvest. The level of soluble protein in petals dropped while free proline accumulated during flower senescence. Flowers treated with GA_3 and those placed into 8HQC + 2%S solution showed a delayed protein degradation: the concentrations of soluble proteins after 12 day of vase life was over 3-fold higher than in control flowers. Also the proline accumulation was delayed in flowers on stems placed in the preservative solution, however, no effect of GA_3 on the proline level was observed. The soluble protein level correlated with a flower position on the stem being lower in lower flowers as compared to the upper ones.

Key words: gibberellic acid, benzyladenine, preservative, vase life, free proline, soluble proteins, chlorophyll

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INTRODUCTION

Longevity of cut lilies depends on a cultivar, growing conditions as well as the conditions during all the stages of the market chain. The first visual symptom of lily senescence is leaf yellowing and browning. Chlorosis begins in basal leaves and proceeds up the stem. Some of the flower buds do not develop and dry, thus decreasing decorative values and vase life of the whole lily stem.

Shortening of vase life results from the water and hormonal imbalance occurring after flower detachment from a mother plant. Petals of some flowers wilt prematurely due to the disturbed water balance. A low water potential in a cut stem results from xylem blockage and a lower hydraulic conductivity of conductive vessels. The nature of this phenomenon may be mechanical, microbiological, physiological or an embolism may occur. But even if no blockage appears in cut stems the cells of senescing tissues loose their ability to hold water. Their cytoplasmic membranes cease being semi-permeable what leads to water and ions efflux from cells and the irreversible petal damages [Jones and Hill 1993].

Senescence of cut flowers can be delayed by application of a preservative composed of an antimicrobial compound preventing vessel blockage and of a sugar which contributes to the endogenous carbohydrate pool in petals and enhances respiration thus increasing flower longevity [Song et al. 1996]. However, trials on several lily cultivars showed that use of sucrose (0.5–2%) together with 8HQC (200–400 $mg \cdot dm^{-3}$) hastens leaf yellowing [van Doorn 2008]. Such a negative sugar effect can be minimized by growth regulators. Gibberellins and cytokinins effectively delay leaf senescence in many plant species [Hicklenton 1991, van Doorn et al. 1992, Pemberton et al. 1997]. Spraying leaves with a mixtures of these compounds either before [Heins et al. 1996] or after harvest [Han 1997, Han 2003] prevents chlorosis and increases postharvest longevity of cut lilies.

The aim of the work was to analyze certain senescence-related processes in cut lilies 'Helvetia' in order to elaborate methods for proper handling of lilies during harvest, storage and transport, ensuring their best postharvest quality.

MATERIAL AND METHODS

The oriental lilies 'Helvetia' were cut when the first bud in an inflorescence was fully developed and colored but yet unopened. Stems were recut to 70 cm and placed into beakers filled with respective solutions after the basal leaves had been removed from the stems. Growth regulators: gibberellic acid (GA_3) and benzyladenine (BA) were applied in concentration 500 $mg \cdot dm^{-3}$ as 20 h puls treatment after which stems were transferred to distilled water. One of the treatments included stems held continuously in the preservative solution combined of 200 $mg \cdot dm^{-3}$ 8-HQC and 2% sucrose. Stems placed into distilled water served as a control. Neither the preservative nor water were exchanged during the experiment – they were replenished if needed. The experiment was carried out in a room with controlled temperature 20°C ± 1°C, relative humidity 60%, quantum irradiance of 35 $\mu mol \cdot m^{-2} \cdot s^{-1}$, under the 12 h day and 12 h night regime.

Each treatment contained 20 stems, individually tagged and treated as single replicates. Longevity of individual flowers in an inflorescence was assessed according to their appearance. The end of vase life was marked by flower wilting, petal abscission and/or petal color changes while in case of leaves – by blade color fading, yellowing or drying on 30% of leaf surface. Every fourth day of the vase life – four times during the experiment – the plant material was sampled for analyses. Total soluble proteins and free proline were determined in the first, the second and the third flower while contents of chlorophyll $a + b$ were measured in leaves. For each compound analyzed three extracts were prepared for each treatment on each sampling date. Results were calculated on a dry matter basis. Dry weight of petals and leaves was obtained after drying samples at 105°C according to Strzelecka et al. [1982]. Chlorophyll was determined after extraction with dimethylformamide (DMF) according to Moran and Porath [1980] as modified by Inskeep and Bloom [1985]. Soluble proteins were determined according to Bradford [1976] and free proline by the method of Bates et al. (1973).

Results were statistically evaluated by ANOVA 1 or ANOVA 2 using the StatGraphics Plus program. Duncan's test at $\alpha = 0.05$ was applied to assess the significant differences between the means.

RESULTS AND DISCUSSION

Changes occurring during flower senescence in oriental lily 'Helvetia'. Senescence processes include degradation of macromolecules, including a decrease in protein level due to activation of proteases and carbohydrate losses resulting from activation of β-glucosidases [Rubinstein 2000]. Also in cut lilies the soluble proteins were being degraded and the rate of these changes was related to the flower position on the stem (fig. 1). The most intensive proteolysis was occurring in the first flower, i.e. that situ-

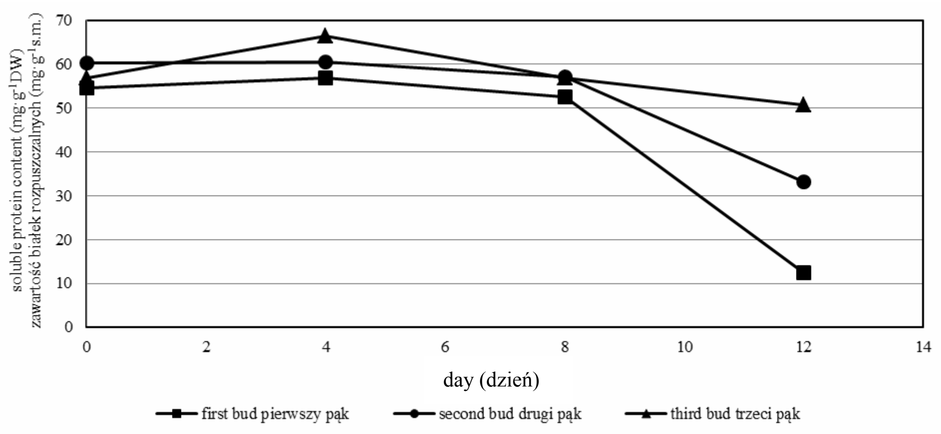

Fig. 1. The soluble protein content in petals of the first, second and third bud of cut oriental lily 'Helvetia'

Rys. 1. Zawartość białek rozpuszczalnych w płatkach pąka pierwszego, drugiego i trzeciego ciętych lilii orientalnych 'Helvetia' ated lowermost in the inflorescence where on the 12th day of vase life the soluble protein content was more than 4-fold lower than the initial level (tab. 3). Proteolysis in younger flowers was less intensive with protein content falling on the 12th day by 50% and 11% in the second and third flower, respectively (tab. 4 and 5).

Senescence of cut plant material is closely related to water imbalance after flower detachment from a mother plant. Under the lowered water potential a synthesis of certain amino acids occurs, such as alanine, glicine, serine and proline [Nigwekar and

Table 1. The effect of growth regulators and standard preservative (8HQC + 2%S) on the vase life of flowers and longevity of leaves of cut lily flowers
Tabela 1. Wpływ regulatorów wzrostu i pożywki standardowej (8HQC + 2%S) na trwałość kwiatów i dekoracyjność liści ciętych lilii

Treatment Traktowanie	Vase life (days) of cut flowers: Trwałość (dni) kwiatów rzędu:					Leaves longevity (days) Trwałość liści (dni)
	I	II	III	IV	V	
H_2O	11.8 b[1]	12.4 bc	13.2 a	15.0 ab	16.0 a	17.0 b
8HQC + 2%S	14.2 c	14.8 d	16.6 b	18.8 c	21.6 b	17.0 b
GA_3; 20h→ H_2O	12.2 b	13.4 c	15.2 b	16.2 b	18.4 a	23.0 c
BA; 20h→ H_2O	10.2 a	10.4 a	12.2 a	14.6 ab	17.2 a	10.6 a
GA_3 + BA; 20h→ H_2O	10.0 a	11.2 ab	11.8 a	13.8 a	16.8 a	27.0 d

[1] Means followed by the same letter do not differ significantly at α = 0.05 (Duncan's test).
[1] Wartości oznaczone tą samą literą nie różnią się statystycznie przy α = 0,05 (test Duncana).

Table 2. The effect of growth regulators and standard preservative on chlorophyll *a* + *b* content in leaves during the senescence of cut oriental lily 'Helvetia'. The initial value: 11.51 $mg \cdot g^{-1}$ DW
Tabela 2. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość chlorofilu *a* + *b* w liściach podczas starzenia ciętych kwiatów lilii orientalnej 'Helvetia'. Zawartość początkowa: 11,51 $mg \cdot g^{-1}$s.m.

Treatment Traktowanie	Chlorophyll *a* + *b* content ($mg \cdot g^{-1}$ DW) on day: Zawartość chlorofilu *a* + *b* ($mg \cdot g^{-1}$ s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	12.98 gh[1]	11.82 ef	10.29 d	11.70 b
8HQC + 2%S	12.59 g	12.74 gh	6.38 b	10.57 b
GA_3; 20h→ H_2O	15.03 i	15.79 j	13.04 h	14.62 c
BA; 20h→ H_2O	10.38 d	7.55 c	4.65 a	7.52 a
GA_3 + BA; 20h→ H_2O	11.99 f	11.55 e	11.43 e	11.66 b
Mean for a date Średnia dla terminu	12.59b	11.89 b	9.16 a	

[1] Explanations as in table 1 – Objaśnienia jak w tabeli 1

Chavan 1990]. Water stress induces accumulation of free proline which is regarded as a defense response as the amino acid increases the cell tolerance to dessication and stabilizes phospholipids of the cell membranes [Kapchina et al. 1991]. Also in petals of cut lilies the free proline content increased (fig. 2) being the highest on the second sampling date (tab. 6) – twice as high as at the beginning of the experiment. Later this content kept decreasing, remaining however 50% higher than the initial level. According to Karolewski [1996] such a drop in free proline content at the end of lily vase life may indicate a process of tissue decomposition. In younger flowers (II and III) the highest proline level was found on the last sampling date, i.e. on the 12th day of vase life (fig. 2) what may confirm their slower senescence rate as compared to the oldest flower. At the end of the experiment both flowers accumulated more proline that found initially in their petals – 63% and 100% more in the second (tab. 7) and third (tab. 8) flower, respectively.

Table 3. The effect of growth regulators and standard preservative on soluble protein content in petals of the first bud during the senescence of cut oriental lily 'Helvetia'. The initial value: 54.54 $mg \cdot g^{-1}$DW

Tabela 3. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość białek rozpuszczalnych w płatkach pąka pierwszego podczas starzenia ciętych kwiatów lilii orientalnej odmiany 'Helvetia'. Zawartość początkowa: 54,54 $mg \cdot g^{-1}$s.m.

Treatment Traktowanie	Soluble protein content ($mg \cdot g^{-1}$ DW) on day: Zawartość białek rozpuszczalnych ($mg \cdot g^{-1}$ s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	56.87 gh[1]	52.62 ef	12.46 a	40.65 a
8HQC + 2%S	55.56 gh	50.71 e	40.42 c	48.70 b
GA_3; 20h→ H_2O	65.98 i	54.08 fg	43.56 d	54.54 b
BA; 20h→ H_2O	64.50 i	38.26 c	14.17 a	38.98 a
GA_3 + BA; 20h→ H_2O	70.94 j	57.18 h	22.25 b	50.13 b
Mean for a date Średnia dla terminu	62.77 c	50.57 b	26.57 a	

[1] Explanations as in table 1 – Objaśnienia jak w tabeli 1

One of the lily senescence symptoms is leaf yellowing which considerably decreases decorative values of the whole cut stems. This color changes are due to degradation of chlorophyll responsible for the leaf green color. During 12 days of vase a small but significant decrease in chlorophyll content occurred: from 11.51 $mg \cdot g^{-1}$ DW to 10.29 $mg \cdot g^{-1}$ DW (tab. 2).

Effect of the preservative on senescence of cut oriental lilies 'Helvetia'. A standard preservative used to prolong vase life of many cut flowers is a mixture of citrate or sulphate of 8-hydroxyquinoline (8HQC and 8HQS) with sucrose. It has an antimicrobial properties, decreases transpiration rate and provides a respiratory substrate [Halevy and Mayak 1981]. Application of the preservative containing 2% sucrose increased considerable flower longevity in lilies 'Helvetia' as compared to control flowers held in water:

this of the first flower by 20% while in the fifth flower by 35% (tab. 1). The longer vase life was related to a slower proteolysis: at the end of the experiment the protein level in the oldest flowers on stems held in the preservative was threefold of that in control flowers (tab. 3). The effect of the preservative was less pronounced in the second flower where the protein level was only 32% higher than in control (tab. 4). The third flower was less metabolically active and evidently did not "profit" from sugar in the preservative as the protein content in its petals dropped even below the level determined in the water-held flowers (tab. 5).

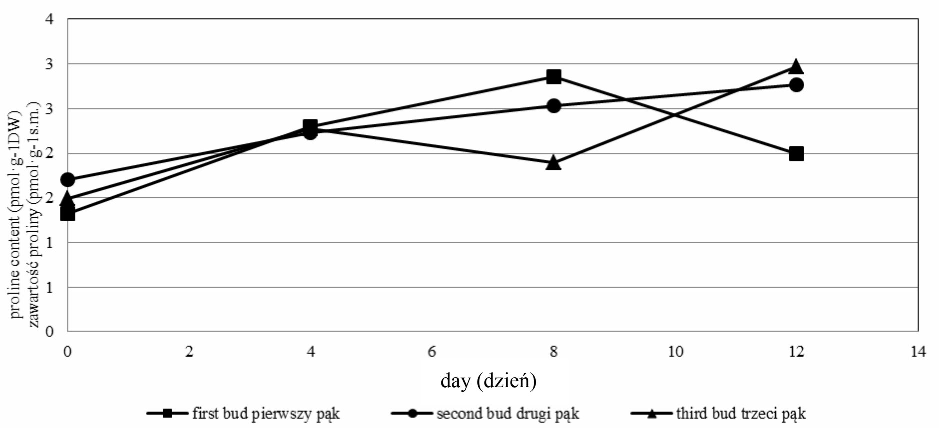

Fig. 2. The proline content in petals of the first, second and third bud of cut oriental lily 'Helvetia'

Rys. 2. Zawartość proliny w płatkach pąka pierwszego, drugiego i trzeciego ciętych lilii orientalnych 'Helvetia'

The preservative limited the increase in free proline contents in senescing lily petals: on 12^{th} day its level was by 14%, 43% and 12% lower in the first, second and third flower as compared to the flowers from the control treatment (tab. 6, tab. 7, tab. 8).

However, presence of sucrose in the holding solution negatively affected leaf longevity and hastened chlorosis as compared to stems held in water. A higher sucrose concentration (5%) caused leaf blackening due probably to an excessive sugar accumulation in leaf blades and their dessication. These results confirm Han's [2003] observations of a negative sucrose effects on cut lily foliage. In leaves on lily stems fed with the preservative the chlorophyll $a + b$ content increased up to 8^{th} day of vase life, falling thereafter to 55% of the initial level (tab. 2). At the end of the experiment this pigment content was by 38% lower than in control treatment and a visual symptom of the chlorophyll degradation was leaf darkening.

Effect of growth regulators on flower senescence in cut oriental lilies 'Helvetia'. Plant senescence is under control of phytohormones, especially cytokinins and gibberellins. In most plants gibberellins are less effective in delaying the senescence-related processes, however Han [2000] showed that application of GA_{4+7} to lily leaves is more efficient than treating them with benzyladenine. Other studies also confirmed that in lily

Table 4. The effect of growth regulators and standard preservative on soluble protein content in petals of the second bud during the senescence of cut oriental lily 'Helvetia'. The initial value: 60.29 $mg \cdot g^{-1}$DW

Tabela 4. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość białek rozpuszczalnych w płatkach pąka drugiego podczas starzenia ciętych kwiatów lilii orientalnej odmiany 'Helvetia'. Zawartość początkowa: 60,29 $mg \cdot g^{-1}$s.m.

Treatment Traktowanie	Soluble protein content ($mg \cdot g^{-1}$ DW) on day: Zawartość białek rozpuszczalnych ($mg \cdot g^{-1}$ s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	60.46 e[1]	57.06 e	33.10 b	50.21 b
8HQC + 2%S	64.93 g	47.45 d	43.83 c	52.07 b
GA_3; 20h→ H_2O	70.04 h	64.89 g	57.42 e	64.12 c
BA; 20h→ H_2O	49.98 d	48.79 d	27.48 a	42.08 a
GA_3 + BA; 20h→ H_2O	64.37 fg	60.93 ef	35.01 b	53.43 b
Mean for a date Średnia dla terminu	61.96 c	55.10 b	40.09 a	

[1] Explanations as in table 1. – Objaśnienia jak w tabeli 1

Table 5. The effect of growth regulators and standard preservative on soluble protein content in petals of the third bud during the senescence of cut oriental lily 'Helvetia'. The initial value: 56.96 $mg \cdot g^{-1}$DW

Tabela 5. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość białek rozpuszczalnych w płatkach pąka trzeciego podczas starzenia ciętych kwiatów lilii orientalnej odmiany 'Helvetia'. Zawartość początkowa: 56,96 $mg \cdot g^{-1}$s.m.

Treatment Traktowanie	Soluble protein content ($mg \cdot g^{-1}$ DW) on day: Zawartość białek rozpuszczalnych ($mg \cdot g^{-1}$ s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	66.42 g[1]	56.78 e	50.72 d	57.97 b
8HQC + 2%S	78.44 j	57.63 ef	39.95 a	58.67 b
GA_3; 20h→ H_2O	75.89 i	65.48 g	66.51 g	69.29 c
BA; 20h→ H_2O	47.78 c	47.49 c	45.45 bc	46.91 a
GA_3 + BA; 20h→ H_2O	70.72 h	59.83 f	43.27 b	57.94 b
Mean for a date Średnia dla terminu	67.85 b	57.44 ab	49.18 a	

[1] Explanations as in table 1 – Objaśnienia jak w tabeli 1

hybrids gibberellins reduce leaf chlorosis [Ranwala and Miller 2002, van Doorn 2011]. Here the pulsing with gibberellic acid increased significantly longevity of leaves on cut stems in oriental lily 'Helvetia' (tab. 1), delaying chlorophyll degradation in leaf blades (tab. 2). On the 12^{th} day of vase life the chlorophyll content the GA_3 treated leaves was not only by 27% higher than in control treatment but it exceeded the initial pigment level determined immediately after harvest (tab. 2). Generally, the above treatment had no effect on flower longevity. Only in the third flower GA_3 increased its vase life as compared to water control (tab. 1). However, in spite of lack of visual differences the levels of soluble proteins varied between the GA_3 treated and untreated control flowers, being always higher in the former: by 34%, 28% and 20% in the first, second and third flower, respectively (tab. 3, tab. 4, tab. 5).

Table 6. The effect of growth regulators and standard preservative on proline content in petals of the first bud during the senescence of cut oriental lily 'Helvetia'. The initial value: 1.32 pmol·g^{-1}DW

Tabela 6. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość proliny w płatkach pąka pierwszego podczas starzenia ciętych kwiatów lilii orientalnej odmiany 'Helvetia'. Zawartość początkowa: 1,32 pmol·g^{-1}s.m.

Treatment Traktowanie	Proline content (pmol·g^{-1} DW) on day: Zawartość proliny (pmol·g^{-1} s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	2.30 f[1]	2.86 g	2.00 e	2.39 b
8HQC + 2%S	1.63 bc	1.63 bc	1.73 cd	1.67 a
GA_3; 20h→ H_2O	1.73 cd	2.76 g	2.30 f	2.27 b
BA; 20h→ H_2O	1.76 cd	3.60 i	1.57 b	2.31 b
GA_3+BA; 20h→ H_2O	1.80 d	3.13 h	1.07 a	2.00 ab
Mean for a date Średnia dla terminu	1.84 a	2.80 b	1.73 a	

[1] Explanations as in table 1 – Objaśnienia jak w tabeli 1

Table 7. The effect of growth regulators and standard preservative on proline content in petals of the second bud during the senescence of cut oriental lily 'Helvetia'. The initial value: 1.70 pmol·g^{-1}DW

Tabela 7. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość proliny w płatkach pąka drugiego podczas starzenia ciętych kwiatów lilii orientalnej odmiany 'Helvetia'. Zawartość początkowa: 1,70 pmol·g^{-1}s.m.

Treatment Traktowanie	Proline content (pmol·g^{-1} DW) on day: Zawartość proliny (pmol·g^{-1} s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	2.23 de[1]	2.53g	2.77 h	2.51 b
8HQC + 2%S	2.10 cd	1.60 b	1.57 b	1.75 a
GA_3; 20h→ H_2O	1.67 b	2.43 fg	2.30 ef	2.13 ab
BA; 20h→ H_2O	2.00 c	3.83 j	1.70 b	2.51 b
GA_3 + BA; 20h→ H_2O	1.70 b	3.30 i	1.40 a	2.13 ab
Mean for a date Średnia dla terminu	1.94 a	2.74 b	1.95 a	

[1] Explanations as in table 1 – Objaśnienia jak w tabeli 1

Pulsing with gibberellic acid reduced the free proline accumulation (tab. 7, tab. 8) but not in the oldest flower (tab. 6). Differences between control and pulsed flowers were well pronounced on the last sampling date when the proline contents in the GA_3 treated lilies were by 17% and 26% lower in the second and third flower, respectively.

In 1998 Ranwala and Miller showed that cytokinins had a considerable effect on longevity and quality of cut oriental lily 'Stargazer' but they did not protect leaves against yellowing. Contrary to Ranwala and Miller [1998] the application of benzyladenine on 'Helvetia' lilies in our trials did not exert any positive effects. Longevity of all flowers in an inflorescence was even lower after the BA treatment as compared to water control (tab. 1). Both, protein degradation in petals and increase in free proline contents were faster in the BA treated flowers (tab. 3–8).

Table 8. The effect of growth regulators and standard preservative on proline content in petals of the third bud during the senescence of cut oriental lily 'Helvetia'. The initial value: 1.49 $pmol \cdot g^{-1}$DW

Tabela 8. Wpływ regulatorów wzrostu oraz pożywki standardowej na zawartość proliny w płatkach pąka trzeciego podczas starzenia ciętych kwiatów lilii orientalnej odmiany 'Helvetia'. Zawartość początkowa: 1,49 $pmol \cdot g^{-1}$s.m.

Treatment Traktowanie	Proline content ($pmol \cdot g^{-1}$ DW) on day: Zawartość proliny ($pmol \cdot g^{-1}$ s.m.) w dniu:			Mean for a treatment Średnia dla traktowania
	4	8	12	
H_2O	2.27 f[1]	1.90 d	2.97 j	2.38 b
8HQC + 2%S	1.57 b	1.40 a	2.60 h	1.86 a
GA_3; 20h→ H_2O	1.80 c	2.03 e	2.20 f	2.01 a
BA; 20h→ H_2O	1.80 c	2.80 i	2.63 h	2.41 b
GA_3 + BA; 20h→ H_2O	1.50 b	2.47 g	1.80 c	1.92 a
Mean for a date Średnia dla terminu	1.79 a	2.12 b	2.44 c	

[1] Explanations as in table 1 – Objaśnienia jak w tabeli 1

Though the beneficial effect of BA on leaf status is generally recognized [Wingler et al. 1998] this cytokinin hastened the senescence-related processes in leaves of 'Helvetia' lilies. On the 10^{th} day chlorotic spots appeared on leaves which subsequently got twisted and dried up. Longevity of the cytokinin-treated leaves was by 38% lower than in control treatment (tab. 1) and the pigment level determined on the last sampling date was over two-fold lower than in leaves on untreated stems held in water (tab. 2). Surprisingly good results were obtained after a joint application of BA and GA_3 where leaves lasted 27 days, i.e. 10 days longer than in control treatment and 4 days longer than after pulsing with gibberellic acid alone (tab. 1). This result is in line with data gathered by van Doorn [2011] where, however, use of GA_{4+7} instead if GA_3 was advised.

Such a joint application of BA and GA_3 cannot be, however, recommended as this mixture negatively affected flowers whose longevity was shortened and quality decreased due to the appearance of brown spots from the 10^{th} day on.

In conclusion, having in mind that the quality of cut lily flowers during their postharvest life is determined by longevity of flowers and an appearance of leaves on cut stems the suitable treatments should be used – those including growth regulators protecting leaves against chlorosis and a preservative ensuring longer vase life of flowers.

CONCLUSIONS

1. In senescing lily flowers proteolysis and free proline accumulation occur; both processes are controlled by the postharvest treatments.
2. The preservative composed of 200 ppm 8-HQC and 2% sucrose increases flower longevity on cut stems of oriental lily 'Helvetia' while GA_3 in concentration 500 $mg \cdot dm^{-3}$ delays leaf yellowing.
3. Intensity of the senescence-related processes depends on the flower position in an inflorescence. The degradation is faster in lower flowers than in upper ones.

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ROLA REGULATORÓW WZROSTU I POŻYWKI W REGULACJI PROCESU STARZENIA CIĘTYCH KWIATÓW LILII ORIENTALNEJ 'HELVETIA'

Streszczenie. Jakość kwiatów ma istotne znaczenie tak dla producentów, jak i konsumentów. Wyznaczana jest ona przez dwa główne kryteria – ogólny wygląd całego pędu oraz trwałość kwiatów. Trwałość kwiatów może być regulowana przez zastosowanie różnych substancji chemicznych lub pożywek. Celem badań było określenie wpływu regulatorów wzrostu (kwasu giberelinowego i benzyloadeniny w stężeniu 500 mg·dm^{-3}) oraz pożywki (200 mg·dm^{-3} 8HQC + 2%S) na pozbiorczą trwałość ciętych kwiatów lilii orientalnej 'Helvetia'. Odmiana ta o białych kwiatach jest popularna w Polsce i uprawiana na kwiat cięty. Regulatory wzrostu podano w formie 20 h kondycjonowania, po czym kwiaty przełożono do wody destylowanej. Do pożywki kwiaty wstawiono na stałe. Kombinację kontrolną stanowiły kwiaty umieszczone bezpośrednio po zbiorze w wodzie destylowanej. W czasie starzenia kwiatów ciętych określono poziom białek rozpuszczalnych i wolnej proliny w płatkach pod wpływem ww. zabiegów pozbiorczych. Ze względu na problem, jakim jest często wcześniejsza utrata dekoracyjności przez liście, określono również ich trwałość oraz poziom chlorofilu w blaszkach liściowych. Zastosowanie pożywki istotnie wydłużyło pozbiorczą trwałość kwiatów, natomiast kondycjonowanie w kwasie giberelinowym opóźniło żółknięcie liści, co wiązało się z wyższym poziomem chlorofilu w tej kombinacji w stosunku do poziomu w liściach z kombinacji kontrolnej. Wykazano, iż w trakcie starzenia się kwiatów dochodzi do degradacji białek rozpuszczalnych i akumulacji wolnej proliny. Wstawienie kwiatów do pożywki oraz kondycjonowanie w GA_3 skutecznie opóźniło degradację białek rozpuszczalnych. W ostatnim terminie pomiaru (12 dzień) poziom białek w dolnych kwiatach z tych kombinacji był ponad 3-krotnie wyższy niż w kontroli. Wstawienie kwiatów do pożywki opóźniło również akumulację proliny, natomiast zastosowanie GA_3 nie było w tym przypadku tak skuteczne. Szybkość procesu starzenia uzależniona była od położenia kwiatu: najszybciej procesy degradacyjne zachodziły w kwiatach dolnych.

Słowa kluczowe: pożywki, pozbiorcza trwałość, kwas giberelinowy, benzyloadenina, wolna prolina, białka rozpuszczalne, chlorofil

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