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EFFECT OF GIBBERELLIC ACID ON THE POST-HARVEST FLOWER LONGEVITY OF *Zantedeschia elliottiana* (W. WATS) ENGL.

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Abstract. Two experiments were carried out to determine the effect of gibberellic acid on the longevity of cut flowers of two *Zantedeschia elliottiana* (W. Wats./Engl.) cultivars: 'Black Magic' and 'Florex Gold'. The flowers were conditioned for 2, 4 and 20 hours in water solutions of 8-hydroxyquinoline citrate at concentrations of 200 mg l^{-1}, and then kept in water and gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1}. Gibberellic acid enhanced the post-harvest longevity of *Z. elliottiana* flowers. Those of the 'Black Magic' cultivar lasted the longest when not conditioned, but merely stored in gibberellic acid solutions. 8-hydroxyquinoline citrate shortened their longevity by a week. The post-harvest longevity of flowers of the 'Florex Gold' cultivar significantly depended on the concentration of gibberellic acid and conditioning time. The longest-lasting flowers were those conditioned in 8-hydroxyquinoline citrate for 2 hours.

Keywords: *Zantedeschia*, gibberellic acid, cut flowers, vase-life

INTRODUCTION

The longevity of cut flowers and leaves is an important problem today. Due to sharp competition, the basic condition of the acceptance of flowers by buyers is their top quality. Apart from the external appearance, the length of their vase-life is now one of the chief criteria of evaluation of their quality. Research is being carried out throughout the world on how to improve post-harvest flower longevity. Formulas are being constantly altered and perfected to meet the different demands of individual species and cultivars. This means that each plant needs an individualised approach, and at the same time one as simple as possible. To prolong the vase-life of cut flowers, special practices and preparations are employed to ensure their maximum post-harvest longevity.

A study on the longevity of cut *Zantedeschia elliottiana* leaves has shown gibberellic acid to prolong their post-harvest life [Janowska and Jerzy 2003]. That is why a research has been undertaken to determine the effect of GA_3 on the longevity of cut *Z. elliottiana* flowers.

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MATERIAL AND METHODS

In 2001 and 2003, experiments were carried out in the Department of Ornamental Plants of the Agricultural University in Poznań to investigate the effect of gibberellic acid on the longevity of cut flowers of two cultivars of the golden calla lily (*Zantedeschia elliottiana* /W. Wats./ Engl.): 'Black Magic' and 'Florex Gold'.

The experiments were conducted at a temperature of 18–20°C and a 12 h photoperiod, employing luminescence light with a quantum irradiance of 25 µmol m^{-2} s^{-1}. The relative air humidity was maintained at 70%.

Unconditioned flowers were placed in water or gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1}. The remaining ones were conditioned for 2, 4 and 20 h in water solutions of 8-hydroxyquinoline citrate (8HQC) at a concentration of 200 mg l^{-1}. The reaction of the solution was slightly acidic (pH 5.0). After conditioning the flowers were kept in water or gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1}. Use was made of Gibrescol containing 98% of gibberellic acid (GA_3).

Water was changed every day and gibberellic acid solutions, every three days.

A single experiment consisted of 12 combinations with three replications carried out on 5, 10 and 15 July 2001 for 'Black Magic' cultivar and on 5, 12 and 19 June 2003 for 'Florex Gold' cultivar. On each date the longevity of 5 flowers was tested. Each treatment included a total of 15 flowers.

The post-harvest longevity of the flowers was determined in days. The loss of ornamental qualities was set at that point in time when one third of the spathe had dried and/or wilted. The results were examined statistically in terms of the analysis of variance using Federer-Zelen's test.

RESULTS

The post-harvest longevity of flowers of the 'Black Magic' cultivar depended on both, the concentration of gibberellic acid used for storage and the time of conditioning in solutions of 8-hydroxyquinoline citrate (tab. 1). The conditioning of the flowers, irre-

Table 1. Effect of conditioning time and vase solution on post-harvest flower longevity of the 'Black Magic' cultivar (days)

Tabela 1. Wpływ długości kondycjonowania i stężenia roztworu GA_3 na pozbiorową trwałośc kwiatów odmiany Black Magic (dni)

Conditioning, h Kondycjonowanie, h 8HQC (200 mg l^{-1})	Vase solution – concentration of GA_3, mg l^{-1} Stężenie roztworu GA_3, mg l^{-1}			Mean for conditioning time Średnia dla długości kondycjonowania
	0	50	100	
0	20.0 cd	28.3 e	29.3 e	25.9 b
2	14.7 abc	18.3 bc	18.6 c	17.2 a
4	13.0 ab	19.0 c	19.0 c	17.1 a
20	11.7 a	24.7 de	19.0 c	18.3 a
Mean for GA_3 concentration Średnia dla stężenia GA_3	14.7 *a*	22.6 *b*	21.6 *b*	

Means followed by the same letters do not differ significantly – Średnie oznaczone tą samą literą nie różnią się istotnie

Table 2. Effect of conditioning time and vase solution on post-harvest flower longevity of the 'Florex Gold' cultivar (days)

Tabela 2. Wpływ długości kondycjonowania i stężenia roztworu GA_3 na pozbiorówą trwałośc kwiatów odmiany Florex Gold (dni)

Conditioning, h Kondycjonowanie, h 8HQC (200 mg l^{-1})	Vase solution – concentration of GA_3, mg l^{-1} Stężenie roztworu GA_3, mg l^{-1}			Mean for conditioning time Średnia dla długości kondycjonowania
	0	50	100	
0	21.1 a	25.6 bc	29.7 cd	25.5 a
2	28.5 bc	33.8 d	32.2 d	31.5 b
4	21.6 a	29.4 cd	27.5 bc	26.2 a
20	25.7 bc	32.5 d	24.6 bc	27.6 ab
Mean for GA_3 concentration Średnia dla stężenia GA_3	24.2 *a*	30.3 *b*	28.5 *b*	

Means followed by the same letters do not differ significantly – Średnie oznaczone tą samą literą nie różnią się istotnie

spective of how long they were held in solutions of 8-hydroxyquinoline citrate, shortened their longevity by 7-8 days. When comparing the longevity of flowers kept in water and gibberellic acid solutions, it turned out that irrespective of the conditioning time, those stored in gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1} lasted longer by a few days. Flowers which had not been conditioned and kept in gibberellic acid preserved their ornamental qualities the longest.

The post-harvest longevity of flowers of the 'Florex Gold' cultivar also depended on the concentration of gibberellic acid and the time of conditioning in an 8HQC solution (tab. 2). The longest-lived flowers were those conditioned in solutions of 8-hydroxyquinoline citrate for 2 hours. When comparing the longevity of flowers kept in water and gibberellic acid solutions, it was found that irrespective of the conditioning time, those held in gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1} lasted longer by a few days.

DISCUSSION

In the experiment described, the conditioning of flowers of the 'Black Magic' *Zantedeschia* cultivar in water solutions of 8-hydroxyquinoline citrate was unfavourable to their post-harvest longevity. The flowers of this cultivar that had not been conditioned but merely kept in gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1} lasted the longest and preserved their ornamental qualities for about a month. In the 'Florex Gold' cultivar, the conditioning in an 8-hydroxyquinoline citrate solution was not detrimental to the longevity of cut flowers. However gibberellic acid in both of researched concentrations extended their vase life. When analysing the means of conditioning time, it was found that the longest-preserved flowers were those that had been conditioned in a solution of 8-hydroxyquinoline citrate for 2 hours.

So far only a few studies have been made concerning cut *Zantedeschia* flowers. Tjia and Funnell [1986] claim that flowering stems of *Z. aethiopica* and *Z. elliottiana* placed in pure water tend to split. To prevent this, they suggest adding sugar and 8-hydroxyquinoline citrate to the medium. According to them, calla lilies should be conditioned in

Fig. 1. The flowers of 'Florex Gold' cultivar at the beginning of experiment
Ryc. 1. Kwiaty odmiany Florex Gold na początku doświadczenia

Fig. 2. Greening flowers of 'Florex Gold' cultivar during keeping in vase solution
Ryc. 2. Zieleniejące kwiaty odmiany Florex Gold przetrzymywane w roztworze GA_3

such a solution for one night at a temperature of 5–10°C. However, the solution does not lengthen the vase-life of flowers. The authors state that the post-harvest longevity of *Z. aethiopica* is limited to 6–7 days, while in *Z. elliottiana* the spathes start to turn green after as few as 7–8 days, which decreases their decorativeness. Funnell and Downs [1987] count calla lilies among species insensitive to ethylene, and that is perhaps why 8-hydroxyquinoline citrate had a negligible effect on improving the longevity of *Z. elliottiana* flowers in the study reported here. Funnell [1993] as well as Łukaszewska and Kokosa [1997] emphasise that in *Z. aethiopica* sugar added to the medium leads to rapid desiccation of tissue and spathe necrosis.

In the present study stem splitting was not observed, and spatha greening was only observed in the 'Florex Gold' cultivar (fig. 1 and 2). Moreover, flowers kept in water preserved their ornamental qualities for three to four weeks. However, stem ends tended to rot in the 'Black Magic' cultivar conditioned in an 8-hydroxyquinoline citrate solution. This development was counteracted by storing the flowers in gibberellic acid solutions. In the opinion of Łukaszewska [1978, 1980], the shorter life of flowers after cutting is caused by the depletion of assimilates, while the addition of sugar mixed with a fungicidal and bactericidal preparation extends the longevity and ornamental qualities of the flowers. This is corroborated by experiments on *Gladiolus*. In the 'Oscar' cultivar, treatment with saccharose combined with 8-hydroxyquinoline sulphate extended flower longevity and increased the number of open buds by 40–60%. In *Dianthus*, the use of saccharose and glucose combined with 8-hydroxyquinoline sulphate extended the longevity of the flowers and had a beneficial effect on their size [Łukaszewska 1978, 1980]. However, 8-hydroxyquinoline esters are not effective in all cases. In *Helianthus*, 8-hydroxyquinoline citrate improved post-harvest longevity, but reduced it in *Achillea filipendulina*. The addition of sugar, in turn, had an adverse effect on the longevity of *Celosia argentea* and *Helianthus*, while *Achillea* flowers responded well to its presence in the medium [Redman et al. 2002]. In the case of geophytes, the use of media to enhance the longevity of cut flowers is not always effective, because the sugar in them is often used up by elements other than the perianth. An example is *Narcissus*, in which the medium sugar is taken up by the ovary to enhance its growth, while the perianth has to do without this additional source of energy. The medium has a beneficial effect when gibberellic acid has been added; it not only extends the vase-life, but also lengthens the cupped in 'Trumpet' cultivars [Łukaszewska and Kokosa 1997] and the 'Carlton' cultivar [Goszczyńska et al. 1989]. Studies on *Tulipa* show that the best medium is one including 8-hydroxyquinoline citrate, gibberellic acid and ethrel, which prevents excessive growth of stems and excessive opening of the bud [Pisulewski et al. 1989, Łukaszewska 1995, Łukaszewska and Kokosa 1997]. In *Hippeastrum hybridum* and *Hippeastrum* × *chmielii*, gibberellic acid significantly extends the post-harvest longevity of flowers [Łukaszewska and Ilczuk 2001].

CONCLUSIONS

1. The post-harvest longevity of *Zantedeschia elliottiana* flowers depended on both, the cultivar and its post-harvest handling.

2. Gibberellic acid extended the post-harvest longevity of flowers of 'Black Magic' and 'Florex Gold' *Zantedeschia* cultivars.

3. In the 'Black Magic' cultivar, unconditioned flowers kept in gibberellic acid solutions at concentrations of 50 and 100 mg l^{-1} preserved their ornamental qualities the longest.

4. In the 'Florex Gold' cultivar, both concentrations of gibberellic acid prolonged the post-harvest longevity of flowers.

5. In the 'Florex Gold' cultivar, 2-hour conditioning of flowers in a solution of 8-hydroxyquinoline citrate extended their longevity by an average of 6 days.

6. The conditioning of 'Black Magic' flowers in 8-hydroxyquinoline citrate solutions shortened their longevity by a week and reduced their quality.

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WPŁYW KWASU GIBERELINOWEGO NA POZBIORCZĄ TRWAŁOŚĆ CANTEDESKII ELLIOTA (*ZANTEDESCHIA ELLIOTTIANA* /W. WATS./ ENGL.)

Streszczenie. Przeprowadzono dwa doświadczenia mające określić wpływ kwasu giberelinowego na trwałość ciętych kwiatów dwóch odmian cantedeskii Elliota (*Zantedeschia elliottiana* /W. Wats./ Engl.): 'Black Magic' i 'Florex Gold'. Kwiaty kondycjonowano przez 2, 4 i 20 godzin w wodnych roztworach cytrynianu 8-hydroksychinoliny o stężeniu 200 mg l^{-1}, a następnie przetrzymywano w wodzie i roztworach kwasu giberelinowego o stężeniu 50 i 100 mg l^{-1}. Kwas giberelinowy korzystnie wpłynął na pozbiorczą trwałość kwiatów cantedeskii Elliota. Kwiaty odmiany Black Magic miały największą trwałość, gdy nie były kondycjonowane, a jedynie przetrzymywane w roztworach kwasu giberelinowego. Cytrynian 8-hydroksychinoliny obniżył trwałość kwiatów tej odmiany o tydzień. Pozbiorcza trwałość kwiatów odmiany Florex Gold istotnie zależała od stężenia kwasu giberelinowego i czasu kondycjonowania. Najtrwalsze były kwiaty, które kondycjonowano w roztworze cytrynianu 8-hydroksychinoliny przez 2 godziny.

Słowa kluczowe: cantedeskia Elliota, kwas giberelinowy, kwiaty cięte, trwałość

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