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EFFECT OF RHIZOME SOAKING IN A MIXTURE OF Ba AND Ga_3 ON THE EARLINESS OF FLOWERING AND QUALITY OF THE YIELD OF FLOWERS AND LEAVES IN THE CALLA LILY (*Zantedeschia* Spreng.)

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Abstract. The effect of BA and GA_3 on the yield and the quality of flowers and leaves of *Zantedeschia* was assessed in researches. The aim of the present research was to assess the effect of a mixture of benzyladenine and gibberellic acid in a solution used for rhizome soaking as well as of various duration times of this practice on the growth and flowering of the 'Albomaculata' and 'Black Magic' cultivars. In the experiment water solution containing benzyladenine at concentrations of 100, 350 and 600 $mg \cdot dm^{-3}$ was used combined with gibberellic acid at a concentration of 150 $mg \cdot dm^{-3}$. Rhizomes, 15–18 cm in circumference in 'Black Magic' cultivar and 20+ cm in 'Albomaculata' cultivar, with leaf buds 0.5–2 cm in length, were soaked for 30 and 60 minutes. Rhizome soaking in a BA and GA_3 mixture increased the yield of flowers in the 'Black Magic' and 'Albomaculata' cultivars, but delayed their flowering, and the flowers developing from rhizomes had shorter peduncles. Besides, in 'Black Magic' cultivar the weight of flowers decreased. The application of a BA and GA_3 mixture reduced the yield of leaves in 'Albomaculata' cultivar. However, they had a higher greenness index and a higher protein and sugar content.

Key words: *Zantedeschia*, growth regulators, yield, sugars, protein, index of leaves greenness

INTRODUCTION

The species of the genus *Zantedeschia*, described already 180 year ago, belong to the arum family – Araceae, in which the inflorescence is a spadix with numerous tiny flowers, set on a succulent peduncle, and surrounded by a colourful spathe [Erhard et al. 2000]. Initially, in cultivation the dominant species was the common florist's calla (*Z. aethiopica* /L./ Spreng.). Today, however, its significance has declined, while culti-

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vars with colourful spathes have grown in importance. It was possible to obtain them owing to intensive breeding efforts, first in the United States of America and New Zealand, and later in South Africa and The Netherlands. A growing interest in the calla lily with colourful spathes is shown by the fact that at the start of 2000 it occupied 6th position, right after orchids, among cut flowers exported from New Zealand [Palmer 2001]. Flowering in the calla lily depends on the cultivar, the size of rhizomes, and the duration of their storage [Corr and Widmer 1991, Funnell 1993]. The research conducted in the world focuses on how to improve flowering with the use of growth regulators. For the calla lily, those shown to be effective are gibberellins, in particular gibberellic acid, and among preparations – Promalin, which contains GA_{4+7} and BA (100 mg·dm^{-3} GA_{4+7} + 100 mg·dm^{-3} BA) [Ranwala and Miller 1998, Rodriguez-Pérez et al. 2009]. Regrettably, this is an expensive preparation because of the costly synthesis of GA_{4+7}, hence in e.g. nursery production it is replaced with a cheaper one, Arbolin, containing GA_3 and BA [Kotański et al. 2005]. It should be noted, however, that those preparations are not registered in Poland.

The aim of the present research was to assess the effect of a mixture of benzyladenine and gibberellic acid in a solution used for rhizome soaking as well as of various duration times of this practice on the growth and flowering of the 'Albomaculata' and 'Black Magic' cultivars.

The application of mixtures of growth regulators in ornamental plants is only rarely employed as a method to improve their flowering. The study of the mixture of benzyladenine and gibberellic acid in the calla lily is based on the assumption that the effects of the growth regulators could add up or reinforce each other. It is worth emphasising, however, that the final effect of the mixture is determined, among other things, by the concentrations of its components.

MATERIAL AND METHODS

The research was conducted at the Department of Ornamental Plants of the University of Life Sciences in Poznań from 12 May to 4 November 2007 and from 18 April to 30 October 2011. The cultivars used were 'Albomaculata', deriving from *Zantedeschia albomaculata* /Hook./ Baill., and 'Black Magic', coming from a hybrid of *Zantedeschia elliottiana* /Wats./ Engl. × *Z. macrocarpa* Engl. The plants were grown in a plastic tunnel. Before planting, their rhizomes had been soaked in a mixture of benzyladenine and gibberellic acid.

In the experiment, water solution containing benzyladenine at concentrations of 100, 350 and 600 mg·dm^{-3} was used combined with gibberellic acid at a concentration of 150 mg·dm^{-3}. Rhizomes, 15–18 cm in circumference and 50–60 g in weight in 'Black Magic' cultivar and 20+ cm and 70–80 g in weight in 'Albomaculata' cultivar, with leaf buds 0.5–2 cm in length, were soaked for 30 and 60 minutes. Lightly dried rhizomes were planted into 18 cm pots into a medium consisting of peat with a pH of 6.2, enriched with a slow-release fertilizer Osmocote Plus (3–4 M) in the amount of 3 g per dm^{-3} and mixed with fresh, shredded pine bark at a rate of 3:1 (v:v). The plants, grown in a plastic tunnel, were fed starting with the fifth week of cultivation. Every 10–14

days, solutions of mixed fertilizers, Peters Professional and brown Superba, were applied at a concentration of 0.2%. At the start of vegetation, when the leaves were fully developed, lime saltpetre at a concentration of 0.2% was foliar applied once.

One treatment (concentration of growth regulators × time soaking of rhizomes) involved 5 plants in 3 replications.

The length of peduncles and spathes was measured. The yield of cut flowers developing from a single rhizome, the fresh flower weight, and the earliness of flowering as expressed by the weighted mean of days from rhizome planting to flower harvest, were determined.

The yield of leaves developing from a single rhizome was determined as well as their greenness index, in SPAD units, using a SPAD-502 Chlorophyll Meter [Gregorczyk and Raczyńska 1997, Gregorczyk et al. 1998]. In addition, their protein and sugar content was calculated.

The determination of soluble protein content was made with the help of Bradford's [1976] method. 2 ml of a solution of Coomassie Brilliant Blue G-250 (CBB) in 85% orthophosphoric acid was added to 100 μl of a diluted extract, with the extraction in a phosphorate-potassium buffer (pH 7.0). After 10 minutes absorbance was measured at a wavelength of 595 nm. Protein content was determined from a curve plotted for albumin.

Total saccharides were determined using the antron reagent [Björnesjö 1955]. The method is based that under the influence of sulphuric acid, all saccharides transform into derivatives of furfural, which, together with antron, yield blue-green products. The intensity of the colour is proportional to their content. Weighed portions (0.5 g) were crushed in a mortar with 5 cm^3 of distilled water and the homogenate was centrifuged for 20 minutes. 1 cm^3 of the supernatant thus obtained was added to 2 cm^3 of a cooled antron reagent (0.02% in concentrated H_2SO_4), and then the content of the test tubes was heated, while slowly mixed, on a water bath at 90°C for 14 minutes. After the tubes were cooled, the absorbance of the solutions was measured in a spectrophotometer at a wavelength of 620 nm. The content of saccharides was read from a standard curve prepared for glucose. The final results, which were means of four replications, were expressed in mg of glucose per g fresh weight.

The results, given as means from the two years of study, were processed with the help of a two-factor analysis of variance. The means were grouped using Duncan's test at the $\alpha = 0.05$ significance level.

RESULTS

A combined application of benzyladenine and gibberellic acid delayed flowering of cultivars under study (tab. 1). In 'Black Magic' cultivar, flowering was observed to be delayed a week in plants which rhizomes were soaked in gibberellic acid and benzyladenine at the highest concentration of 600 $mg \cdot dm^{-3}$ for 30 minutes. Rhizome soaking in solutions of both growth regulators for 60 minutes delayed flowering of this cultivar by 7–11 days. In cultivar 'Albomaculata' the combined application of benzyladenine and gibberellic acid delayed flowering by an average of 2–7 days, irrespective of whether the rhizomes were soaked for 30 or 60 minutes.

Table 1. Days to the first flowers of *Zantedeschia* (days) depending on concentration of growth regulators and time of rhizomes soaking

Cultivar	Concentration of BA + GA_3 ($mg \cdot dm^{-3}$)	Time of rhizomes soaking (minutes)		Mean for concentration of BA + GA_3
		30	60	
'Black Magic'	0	80.0 a	80.0 a	80.0 a
	100 + 150	83.0 b	91.0 d	87.0 c
	350 + 150	80.0 a	87.0 c	83.5 b
	600 + 150	87.0 a	88.0 c	87.5 c
'Albomaculata'	0	68.0 a	68.0 a	68.0 a
	100 + 150	73.0 c	70.0 b	71.5 b
	350 + 150	75.0 d	75.0 d	75.0 c
	600 + 150	77.0 e	74.0 d	75.5 c

Means followed by the same letter do not differ significantly at $\alpha = 0.05$

The yield of flowers, it was found that it depended significantly only on the concentration of the growth regulators (tab. 2). Irrespective of the duration of rhizome soaking, after the application of a BA + GA_3 mixture in the concentration variants studied, in 'Black Magic' cultivar the yield of flowers was 3–4 times higher. In 'Albomaculata' cultivar, the higher the concentration applied, the more flowers were harvested from a single rhizome.

The length of peduncles in the studied cultivars depended significantly on the concentration of the growth regulators (tab. 2). Irrespective of the duration of rhizome soaking, the application of a BA + GA_3 mixture in the concentration variants tested caused the formation of shorter peduncles.

The growth regulators in the concentration variants tested and the duration of rhizome soaking had no effect on the length of spathes in the calla lily cultivars studied (tab. 2).

The weight of flowers, it was found that only in 'Black Magic' cultivar this feature depended on the concentration of the growth regulators (tab. 2). Irrespective of the duration of rhizome soaking, after the application of BA + GA_3 at the concentrations tested, this cultivar developed flowers with a smaller weight.

The yield of leaves, it was found only in 'Albomaculata' cultivar to depend on the concentration of the growth regulators (tab. 3). After the application of a BA + GA_3 mixture at the tested concentrations, irrespective of the duration of rhizome soaking, it developed fewer leaves.

The index of leaf greenness, it was found that it depended significantly only on the BA + GA_3 concentration variants applied (tab. 3). Irrespective of the duration of rhizome soaking, the mixture caused the development of leaves with a higher greenness index.

Table 2. Yield and quality of flowers of *Zantedeschia* depending on concentration of growth regulators and time of rhizomes soaking

	Cultivar	Concentration of BA + GA_3	Time of rhizomes soaking (minutes)		Mean for concentration of BA + GA_3
			30	60	
Yield of flowers	‘Black Magic’	0	1.0 a	1.0 a	1.0 a
		100 + 150	3.0 b	4.0 c	3.5 b
		350 + 150	3.0 b	3.0 b	3.0 b
		600 + 150	3.0 b	3.0 b	3.0 b
		mean for time of rhizomes soaking	2.5 a	2.7 a	
	‘Albomaculata’	0	2.0 a	2.0 a	2.0 a
		100 +150	3.5 b	3.4 b	3.4 b
		350 +150	4.8 c	5.2 c	5.0 c
		600 +150	8.2 d	8.2 d	8.2 d
		mean for time of rhizomes soaking	4.6 a	4.7 a	
Length of flowers peduncle (cm)	‘Black Magic’	0	45.0 c	45.0 c	45.0 b
		100 +150	40.9 b	39.1 b	40.0 a
		350 +150	40.4 b	42.6 b	41.5 a
		600 +150	40.8 b	37.1 a	38.9 a
		mean for time of rhizomes soaking	41.8 a	40.9 a	
	‘Albomaculata’	0	34.7 c	34.7 c	34.7 b
		100 +150	30.1 b	30.8 b	30.4 a
		350 +150	33.3 c	26.2 a	29.7 a
		600 +150	28.0 b	29.0 b	28.5 a
		mean for time of rhizomes soaking	31.5 a	30.2 a	
Length of spathe (cm)	‘Black Magic’	0	9.0 a	9.0 a	9.0 a
		100 +150	9.5 a	9.1 a	9.3 a
		350 +150	9.4 a	9.4 a	9.4 a
		600 +150	9.5 a	9.5 a	9.5 a
		mean for time of rhizomes soaking	9.3 a	9.2 a	
	‘Albomaculata’	0	9.4 a	9.4 a	9.4 a
		100 +150	9.5 a	9.5 a	9.5 a
		350 +150	9.6 a	9.6 a	9.6 a
		600 +150	9.6 a	9.8 a	9.7 a
		mean for time of rhizomes soaking	9.5 a	9.6 a	
Weigth of flowers (g)	‘Black Magic’	0	26.0 b	26.0 b	26.0 b
		100 +150	23.1 a	22.3 a	22.7 a
		350 +150	22.7 a	20.8 a	21.7 a
		600 +150	21.2 a	20.9 a	21.0 a
		mean for time of rhizomes soaking	23.2 a	22.57 a	
	‘Albomaculata’	0	7.2 a	7.2 a	7.2 a
		100 +150	8.7 a	8.4 a	8.6 a
		350 +150	8.2 a	7.7 a	7.9 a
		600 +150	7.1 a	7.5 a	7.3 a
		mean for time of rhizomes soaking	7.7 a	7.7 a	

Means followed by the same letter do not differ significantly at $\alpha = 0.05$

Table 3. Yield and quality of leaves of *Zantedeschia* depending on concentration of growth regulators and time of rhizomes soaking

	Cutlivar	Concentration of BA + GA_3 ($mg \cdot dm^{-3}$))	Time of rhizomes soaking (minutes)		Mean for concentration of BA + GA_3
			30	60	
Yield of leaves	‘Black Magic’	0	9.7 a	9.7 a	9.7 a
		100 + 150	9.9 a	9.8 a	8.8 a
		350 + 150	8.4 a	8.3 a	8.3 a
		600 + 150	8.1 a	8.2 a	8.1 a
		mean for time of rhizomes soaking	9.0 a	9.0 a	
	‘Albomaculata’	0	27.5 c	27.5 c	27.5 b
		100 + 150	20.2 b	20.8 b	20.5 a
		350 + 150	23.7 b	15.2 a	19.5 a
		600 + 150	16.5 a	20.4 b	18.4 a
		mean for time of rhizomes soaking	22.0 a	21.0 a	
Index of leaves greenness	‘Black Magic’	0	46.8 a	46.8 a	46.8 a
		100 + 150	53.6 b	53.6 b	53.6 b
		350 + 150	53.7 b	58.6 c	56.1 c
		600 + 150	55.3 bc	58.7 c	57.0 c
		mean for time of rhizomes soaking	52.3 a	54.4 a	
	‘Albomaculata’	0	45.3 a	45.3 a	45.3 a
		100 + 150	58.0 d	52.2 c	55.1 c
		350 + 150	54.1 bc	49.9 b	52.0 b
		600 + 150	51.9 c	56.7 c	54.3 c
		mean for time of rhizomes soaking	52.3 a	51.0 a	
Protein content ($mg \cdot g^{-1}$ FW)	‘Black Magic’	0	17.1 a	17.1 a	17.1 a
		100 + 150	21.4 b	23.2 b	22.3 b
		350 + 150	28.2 c	27.4 c	27.8 c
		600 + 150	39.1 d	38.0 d	38.5 d
		mean for time of rhizomes soaking	26.4 a	26.4 a	
	Albomaculata’	0	14.2 a	14.2 a	14.2 a
		100 + 150	18.4 b	21.0 b	19.7 b
		350 + 150	27.0 c	28.8 c	27.9 c
		600 + 150	42.7 d	39.0 d	40.8 d
		mean for time of rhizomes soaking	25.6 a	25.7 a	
Sugar content ($mg \cdot g^{-1}$ FW)	Black Magic’	0	12.2 a	12.2 a	12.2 a
		100 + 150	19.7 b	17.2 b	18.4 b
		350 + 150	21.0 b	18.1 b	19.5 b
		600 + 150	20.0 b	18.7 b	19.3 b
		mean for time of rhizomes soaking	18.2 a	16.5 a	
	‘Albomaculata’	0	10.9 a	10.9 a	10.9 a
		100 + 150	19.9 b	20.9 b	20.4 b
		350 + 150	19.1 b	22.1 b	20.6 b
		600 + 150	20.8 b	20.5 b	20.6 b
		mean for time of rhizomes soaking	17.7 a	18.6 a	

Means followed by the same letter do not differ significantly at $\alpha = 0.05$

It was shown that protein content in the leaves of the two cultivars depended significantly only on the BA + GA_3 mixture concentration (tab. 3). Irrespective of the duration of rhizome soaking, after the application of the mixture, protein content in the leaves was higher.

The sugar content in the calla lily leaves, it was found to depend only on the concentration of the growth regulator mixture (tab. 3). Irrespective of the duration of rhizome soaking, the application of the mixture had a favourable effect on sugar content in the leaves of both cultivars. In comparison with the leaves of control plants, in those treated with the growth regulators sugar content almost doubled.

DISCUSSION

Rhizome soaking in mixtures of gibberellic acid and benzyladenine increased the yield of flowers in the 'Black Magic' and 'Albomaculata' cultivars. This corroborated the findings of Funnell et al. [1992], who obtained an increase in the yield of cut flowers of the calla lily 'Galaxy' by as much as 469% after the application of Promalin in comparison with control plants. In this cultivar gibberellic acid also caused an increase in the yield, but only half as much. Similarly in *Z. aethiopica* 'Green Goddess' the yield of cut flowers increased after the application of a BA + GA_3 mixture [Ngamau 2001].

In the present research, the combined application of the two growth regulators in the concentration variants tested delayed the flowering of the calla lily cultivars. When comparing the results of various studies, one can observe differences in the responses of species and cultivars to gibberellic acid and benzyladenine. Pogroszewska [2002] reports that the flowering of *Spathiphyllum* was delayed after the combined application of benzyladenine and gibberellic acid only in cultivar 'Castor', while cultivar 'Giant' bloomed earlier. Accelerated flowering after the application of Promalin was observed, e.g., in tulips [Suh 1997], the columbine [Gianfagna and Merritt 1998] and the strawberry [Braun and Kender 1985].

When comparing the quality of yield in the cultivars under study, it was found that the application of a BA + GA_3 mixture brought about the development of flowers with shorter peduncles; additionally, in 'Black Magic' cultivar the flowers had a smaller weight. By contrast, Ngamau [2001] obtained slightly longer peduncles in the calla lily 'Green Goddess' after the application of BA + GA_3, but the differences were statistically insignificant. Pogroszewska [2002] reports that a BA + GA_3 mixture affects the quality of *Spathiphyllum* inflorescences. After the combined application of the two growth regulators, the plants developed shorter peduncles and less magnificent spathes. Similarly in tulips Suh [1997] noted shorter shoots after the application of Promalin, it can be explained by the effect of benzyladenine this preparation contains.

In the present research, the growth regulators had no effect on the yield of leaves except in cultivar 'Albomaculata', in which fewer leaves developed from rhizomes. The leaves of both cultivars had a higher greenness index and a higher protein and sugar content. Presumably, enhanced photosynthesis brought about an elevated protein and sugar content in them. The available literature offers no answer to the question of how a BA + GA_3 mixture can influence the yield of leaves and their quality. Jerzy and Ja-

nowska [2003] report that in the calla lily the application of gibberellic acid does not affect the yield of leaves. This agrees with the findings of Janowska and Zakrzewski [2006], who also showed gibberellic acid to have no effect on the yield of leaves in the calla lily, but in cultivar 'Treasure' the leaves had a higher greenness index after the application of this growth regulator. The response is different in the freesia, in which gibberellic acid at a concentration not exceeding 400 $mg \cdot dm^{-3}$ increases the yield of leaves [Mynett et al. 2001]. In turn, Emongor et al. [2004] report that Promalin increases the size and number of leaves in the ornamental cabbage and raises their fresh weight by 20% in comparison with control plants. There is only scant information in the available literature about changes in the content of saccharides in ornamental plants after the application of growth regulators. Kozłowska et al. [2007] report changes in sugar content in the leaves of *Zantedeschia elliottiana* after the application of gibberellic acid for rhizome soaking depending on the development stage. In their study, at the initial stage of vegetative growth, the content of hydrocarbons, especially fructose and glucose, in the leaf blades of plants treated with gibberellic acid was higher than in the control. The content of hydrocarbons rose as the leaves developed, to decline when the plants entered the generative stage, while the total hydrocarbon content in the leaves of control plants was then twice as high.

CONCLUSIONS

1. BA and GA_3 mixture had an effect on earliness of flowering, yield quality and quantity of flowers and leaves, the reaction on growth regulators depends on their concentration, duration of rhizome soaking and cultivar.

2. Rhizome soaking in a BA and GA_3 mixture increased the yield of flowers in the 'Black Magic' and 'Albomaculata' cultivars, but delayed their flowering, and the flowers developing from rhizomes had shorter peduncles. Besides, in cultivar 'Black Magic' the weight of flowers decreased.

3. The application of a BA and GA_3 mixture reduced the yield of leaves in 'Albomaculata' cultivar. However, they had a higher greenness index and a higher protein and sugar content.

REFERENCES

Björnesjö K.B., 1955. Analysis of protein-bound serum polysaccharides with anthrone reagent. Scand. J. Clinical Lab. Invest. 6, 147–152.

Bradford M.M., 1976. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. Anal Biochem. 72**,** 248–254.

Braun J.W., Kender W.J., 1985. Correlative bud inhibition and growth habit of the strawberry as influenced by application of gibberellic acid, cytokinin, and chilling during short day length. J. Amer. Soc. Hort. Sci. 110 (1), 28–34.

Corr B.E., Widmer R.E. 1991. Paclobutrazol, gibberellic acid and rhizome size affect growth and flowering of *Zantedeschia.* HortScience 26 (2), 133–135.

Emongor V., Pule-Meulenberg F., Phole O., 2004. Effect of Promalin on growth and development of kale (*Brassica oleracea* L. var. *acephala* DC). J. Agron. 3 (3), 208–214.

Erhardt W., Götz E., Bödeker N., Seybold S., 2000. Zander Dictionnaire des noms de plants. Verlag Eugen Ulmer, Stuttgart, 767.

Funnell K.A., MacKay B.R., Lawoko C.R.O., 1992. Comparative effects of Promalin and GA_3 on flowering and development of *Zantedeschia* 'Galaxy'. Acta Hortic. 292, 173–179.

Gianfagna T., Merritt R., 1998. GA_{4+7} promotes stem growth and flowering in a genetic line of *Aquilegia* × *hybrida* Sims. Plant Growth Regulation 24**,** 1–5.

Gregorczyk A., Raczyńska A., Pacewicz K., 1998. Analiza krzywych wzorcowych zawartości chlorofilu dla podstawowych gatunków zbóż. Biul. Magnezol. 3 (1), 19–24.

Gregorczyk A., Raczyńska A., 1997. Badania korelacji między metodą Arnona a pomiarami zawartości chlorofilu za pomocą chlorofilometru. Folia Univ. Agric. Stetin. 181. Agricult. 5, 119–123.

Janowska B., Zakrzewski P., 2006.Wpływ kwasu giberelinowego i sposobu przygotowania kłączy na kwitnienie cantedeskii (*Zantedeschia* Spreng.). Zesz. Probl. Post. Nauk Roln. 1, 510, 223–233.

Jerzy M., Janowska B., 2003. Wzrost i kwitnienie cantedeskii Elliota (*Zantedeschia elliottiana* /W. Wats./ Engl.) uprawianej z sadzonek traktowanych kwasem giberelinowym *in vitro*. Zesz. Probl. Post. Nauk Roln. 491, 125–130.

Kotański E., Witomska M., Łukaszewska A., 2005. Intensification of *Hosta* sp. production. Zesz. Probl. Post. Nauk Roln. 504, 645–654.

Kozłowska M., Rybus-Zając M., Stachowiak J., Janowska B., 2007. Changes in carbohydrate contents of *Zantedeschia* leaves under gibberellin-stimulated flowering. Acta Physiol. Plant. 29, 27–32.

Mynett K., Startek L., Żurawik P., Płoszaj B., 2001. Wpływ Giberescolu i Flordimexu na wschody i wzrost frezji ogrodowej. Rocz. AR Pozn. 332, Ogrodnictwo 33, 103–110.

Ngamau K., 2001. Promoting side shoot develepmnent in *Zantedeschia aethiopica* 'Green Goddess'. Gartenbauwissenschaft 66 (2), 85–92.

Palmer J.W., 2001. New Zealand horticulture. Chron. Horticult. 41 (4), 17–19.

Pogroszewska E., 2002. Studia nad wzrostem i kwitnieniem skrzydłokwiatu (*Spathiphyllum* Schott). Rozp. Nauk. AR w Lublinie 263, 116 ss.

Ranwala A.P., Miller W.B., 1998. Gibberellin$_{4+7}$, benzyladenine and supplemental light improwe postharvest leaf and flower quality of cold-stored 'Star Gazer' hybrid lilies. J. Amer. Soc. Hort. Sci. 3 (4), 563–568.

Rodriguez-Pérez J.A, de Leon-Hernández A.M., Vera-Batista M.C., Rodriguez-Hernández J., Alberto-Rodriguez P., 2009. Effect of pretreatment with gibberellic acid (GA_3) and Promalin (GA_{4+7} + BA) on germination of *Protea aristata and P. repens*. Acta Hortic. 813, 441–444.

Suh J.K., 1997. Stem elongation and flowering response of *Tulipa* cultivars as influenced by bulb cooling. Growth regulators and ligt quality. Acta Hortic. 430, 101–106.

WPŁYW MOCZENIA KŁĄCZY W MIESZANINIE Ba I Ga_3 NA WCZESNOŚĆ KWITNIENIA ORAZ WIELKOŚĆ I JAKOŚĆ PLONU KWIATÓW I LIŚCI CANTEDESKII (*Zantedeschia* Spreng.)

Streszczenie. W badaniach oceniano wpływ BA i GA_3 na plon i jakość kwiatów i liści cantedeskii. Celem podjętych badań była ocena wpływu mieszaniny benzyloadeniny

i kwasu giberelinowego zastosowanej w roztworze do moczenia kłączy i różnego czasu trwania tego zabiegu na wzrost i kwitnienie odmian ‘Albomaculata’ i ‘Black Magic’. W doświadczeniu zastosowano wodny roztwór zawierający benzyloadeninę o stężeniu 100, 350 i 600 $mg \cdot dm^{-3}$ w połączeniu z kwasem giberelinowym o stężeniu 150 $mg \cdot dm^{-3}$. Kłącza o obwodzie 15–18 cm u odmian ‘Black Magic’ oraz o obwodzie powyżej 20 cm u odmiany ‘Albomaculata’ z pąkami liściowymi o długości 0,5–2 cm moczono przez 30 i 60 minut. Moczenie kłączy w mieszaninie BA i GA_3 zwiększyło plon kwiatów u odmian ‘Black Magic’ i ‘Albomaculata’, opóźniło jednak ich kwitnienie, a wyrastające z kłączy kwiaty miały krótsze szypuły kwiatostanowe. Ponadto u odmiany ‘Black Magic’ zmniejszeniu uległa masa kwiatów. Zastosowanie mieszaniny BA i GA_3 zmniejszyło plon liści odmiany ‘Albomaculata’. Miały one jednak wyższy indeks zazielenienia oraz wyższą zawartość białka i cukrów.

Słowa kluczowe: cantedeskia, regulatory wzrostu, plon, cukry, białko, indeks zazielenienia liści

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