THE INFLUENCE OF GIBBERELLIC ACID ON GROWTH AND DEVELOPMENT OF CALLAS CULTIVATED IN THE GREENHOUSE

INFLUENȚA ACIDULUI GIBERELIC ASUPRA CREȘTERII ȘI DEZVOLTĂRII CALELOR CULTIVATE ÎN SERĂ

ARHIP (ÎNSURĂȚELU) Ioana Cristina[1], DRAGHIA Lucia[1]
e-mail: ioana.arhip@yahoo.com

Abstract. *Popular plant known and used as a cut flower or as a pot plant, Calla is less pretentious to the environmental conditions and easy to grow. In this paper it is analyzed the influence of gibberellic acid (GA_3) treatment on Zantedeschia (cv. 'Black Eyed - Beauty') plants grown in the greenhouse soil. Treatment with GA_3 has been achieved by soaking the tubers for 30 minutes in 250 ppm solution. The start of the vegetation period and the appearance of the floral stems were favored by GA_3 treatment, causing early flowering with 2-10 days. Also, the number of leaves and inflorescences increased, but the height of the plant and the floral stems was reduced.*
Key words: *Zantedeschia, cv. 'Black – Eyed - Beauty', gibberellic acid*

Rezumat. *Plantă populară, cunoscută şi folosită ca floare tăiată sau ca plantă la ghivece, cala este puțin pretențioasă față de condițiile de mediu şi uşor de cultivat. În această lucrare este analizată influența tratamentelor cu acid giberelic (GA_3) asupra plantelor de Zantedeschia (cv. 'Black Eyed - Beauty'), cultivate în solul serei. Tratamentul cu GA_3 s-a aplicat la nivelul tuberculilor, prin îmbăierea acestora timp de 30 minute în soluţie 250 ppm. Pornirea în vegetație, şi apariției tijelor florale au fost favorizate de tratamentul cu GA_3, determinând timpurietatea înfloririi cu 2-10 zile. De asemenea, a crescut numărul de inflorescenţe şi frunze formate, în schimb, s-a redus înălțimea plantelor şi a tijelor florale.*
Cuvinte cheie: *Zantedeschia, cv. 'Black – Eyed - Beauty', acid giberelic*

INTRODUCTION

Zantedeschia (calla) is a popular ornamental plant in the international flower market. It is cultivated as a cut flower, potted plant or as an ornamental plant in gardens around the world and contributes to horticultural financial income in several countries including America, Netherlands, New Zealand (Funnell, 1993 citat de Chen, 2011; Singh, 1996).

Zantedeschia was placed in the Top 20 cut flowers sold on Dutch auction, with over 70 million stems sold every year (Flower Council of Holland, 2005). Callas popularity on the international flower market is due to its stylized and distinct inflorescence and various color palettes (Singh, 1996). The inflorescence consists of a colored spathe deployed around the spadix, which contains the real

[1] University of Agricultural Sciences and Veterinary Medicine of Iaşi, Romania

male and female flowers. Following numerous studies conducted to date concerning spathe color of callas, resulted a wide range of colors going from white, yellow, red, orange, pink, cream to dark purple shades.

The genus *Zantedeschia*, originally from South Africa, belongs to the family Araceae and comprises eight species distributed in two sections, *Zantedeschia* and *Aestivae*. Section *Zantedeschia* consists of *Z. aethiopica* and *Z. odorata*, and Section *Aestivae,* also known as the "colored callas" consisting of *Z. albomaculata, Z. elliotiana, Z. jucunda, Z. pentlandii, Z. rehmannii and Z valida. Z. albomaculata* includes two subspecies: *albomaculata* and *macrocarpa* (Singh et al., 1996).

In the specialized literature there are many studies regarding the increasing production of colored callas flowers and the treatment effects with plant growth regulators applied on *Zantedeschia*. (Funnell and Tjia, 1988; Corr and Widmer, 1991; Funnell et al., 1992; Dennis et al., 1994; Janowska and Krause, 2001; Janowska and Schroeter, 2002; Janowska and Zakrzewski, 2006; Mortazavi et al., 2011). It was nevertheless concluded that increasing the yield depends on the variety, about 120 varieties being currently recognized. The studies conducted so far has not been shown which is the most efficient concentration of gibberellic acid for calla treatments, used to increase productivity (Ali and Elkiey, 1995; Brooking and Cohen, 2002; Corr and Widmer, 1991; Dennis et al., 1994; Funnell et al., 1992; Funnell and Tjia, 1988; Janowska and Krause, 2001; Janowska and Schroeter, 2002; Janowska and Zakrzewski, 2006; Reiser and Langhans, 1992; Tjia, 1987). Recommendations concerning the concentration of GA_3 solution used to treat the underground organs of calla by soaking them are between 50 and 500 ppm (Corr and Widmer, 1991; Dennis et al., 1994; Funnell and Tjia, 1988).

MATERIAL AND METHOD

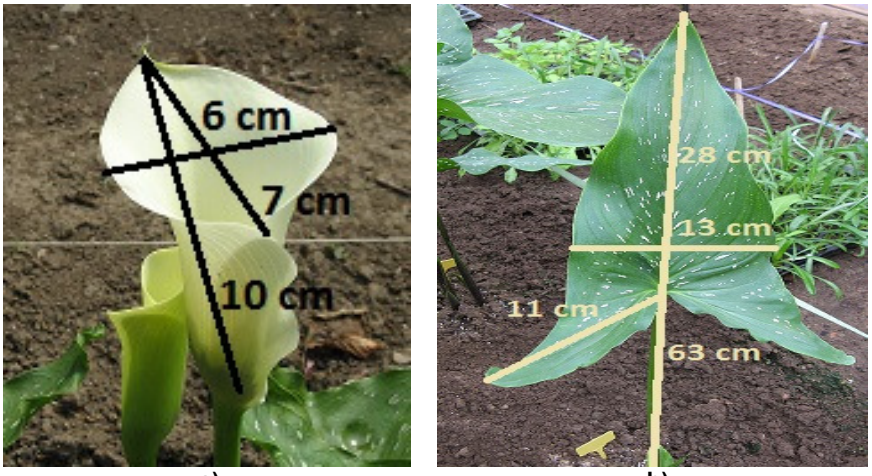
Studies were conducted during 2012 - 2014 to a calla culture, cultivar 'Black - Eyed - Beauty', established in the greenhouse soil, within the Floriculture discipline of University of Agricultural Sciences and Veterinary Medicine Iasi, Romania.

The leaves of this cultivar have upright growth, sagittal form, and many white macules and they are almost as handsome as its flowers.

The flowers that appear in late spring and maintain all summer, consist of a fine bracts (spathe), yellowish-white, wrapped around a same color spadix. A big, black, central "eye" can be seen on the inside of the spathe at the spadix based (http://www.learn2grow.com/plants/zantedeschia-black-eyed-beauty/).

Figure 1 presents some biometric data characterizing cv. 'Black - Eyed - Beauty'. The spathe has the average length of approx. 10 cm and its diameter at the upper side in fully open stage, is between 6 and 7 cm (fig. 1a). The leaves are long petiolated (stem length is 63 cm) and have a sagittal limb, with the ratio between length and width of 2.15 (28/13 cm) (fig. 1b).

As biological material for the establishment of the experimental cultures were used commercially available tubers. There were set up two experimental variants with three repetitions, the V_1 variant (control) using untreated tubers and V2 variant using tubers which were treated before planting by soaking for 30 min in a solution of gibberellic acid (GA_3) 250 ppm.



a) b)

Fig. 1 - Biometric characters of plants - cv. 'Black – Eyed – Beauty': a) spathe dimensions; b) leaf dimensions

The first measurements and observations were made from crop establishment, on tubers (mass), then continued throughout the culture by recording data on the main phenophases (the vegetation period, the emergence floriferous stems, flowering period) and the biometric measurements (plant height and length of the floral stems, number of leaves / plant, number of floral stems/plant). The results obtained at the treated variant were compared with the control, untreated. For statistical calculation has been used analysis of variance (Saulescu and Saulescu, 1967), and the data obtained was performed by using Microsoft Excel.

RESULTS AND DISCUSSIONS

Regarding the weight of underground organs in cv. 'Black Eyed - Beauty', the first year of cultivation was started with tubers that had mass between 20 and 50 g, most of them being in the category of 30-40 g. In the second year of cultivation, tuber weight varied much more, becoming uneven, so that the smallest started from 30 g and the largest reached up to 120 g, the majority being between 60 and 90 g. In the third year of cultivation, tuber weight was similar to that in the first year, ranging between 25 and 70 grams, most of from having 40 to 55 g. It is noted that the mass of underground organs grew steadily until the end of the experiment.

From the point of view of time duration from the start of the plant growth and by the appearance of flower stems during the three years of experimentation it has been a gradual extension of both the control variant and the variant treated with gibberellic acid (from 26 to 52 days in the control variant and from 24 to 42 days at V_2). Comparing variants, the differences are in order to reduce the period comparing the treated variant with the control, with two days in the first year and 10 days in the third year.

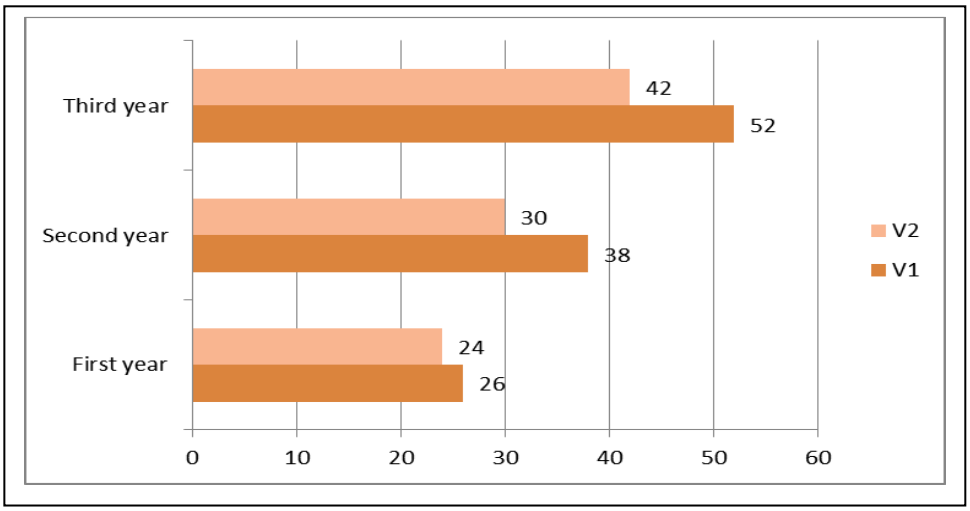


Fig. 2 - The length of time between the star of the vegetation period and the appearance of the floral stems (days)

Basically, tubers treated with gibberellic acid determined an earlier emergence of the floriferous stems. Similar studies were conducted in *Zantedeschia* cultivars and different behaviors are resulted regarding the time needed until the flowering period. Thus, the results reported by Janowski and Schroeter (2002) indicate that the use of gibberellic acid caused a delay of 3-4 weeks of callas flowering period.

Analyzing the overall height of the plant and the length of floriferous stems, it is found that gibberellic acid has effect on growth reduction in different proportions. In the case of total plant height (tab. 1), although the trend is decreasing from one year to another within each variant (which excludes the influence of treatment with GA_3), there are differences between versions. It is noted, however, that the first two years the differences are relatively small (2.5 - 2.8 cm inside the variant and between the variants), and only in the third year there are obvious differences from the previous year, both at the same variant (8.3 cm to 14.1 cm V_1 and V_2) and also between variants (8 cm). Differences from control recorded in the third are significant distinct negative (tab. 1).

Table 1

Results regarding the height of the plants (cm)

Var	First year		Second Year			Third year			±D total (1st-2nd year
	Abs.	±D compared with control	Abs	±D compared with 1st year	±D compared with control	Abs	±D compared with 2nd year	±D compared with control	
V_1	68.7	control	66.3	-2.4	control	58.0	-8.3	control	-10.7
V_2	66.0	-2.7	63.5	-2.5	-2.8 ^{0}	49.4	-14.1	-8.6 ^{00}	-17.2
LSD 5%		4.8			1.2			1.2	
LSD 1%		11.1			2.9			2.9	
LSD 0,1%		35.3			9.2			9.1	

Length of floral stems fall into the same downward trend, except that the differences between the versions are much higher and stands out in the first year of cultivation (11.7 cm in the first year, 14.7 cm in the second year and 15.3 cm in the third year). Differences from control during second and third year are very significant negative (tab. 2).

Table 2

Results regarding the length of the floral stems (cm)

Var.	First year		Second year			Third year			±D total (1st-2nd year)
	Abs.	±D Compared with control	Abs.	±D Compared with 1st year	±D Compared with control	Abs.	±D Compared with 2nd year	±D Compared with control	
V_1	53.2	control	52.6	-0.6	control	49.3	-3.3	control	-3.9
V_2	41.5	11.7 ^{0}	37.9	-3.6	-14.7 ^{000}	34.0	-3.9	-15.3 ^{000}	-7.5
LSD 5%		6.1			0.3			1.4	
LSD 1%		14.1			0.6			3.2	
LSD 0,1%		44.9			0.9			10.2	

Table 3

Evolution of the number of leaves and flower production during the three experimental years

Var.	First year		Second year		Third year		Average		
	Abs.	±d	abs	±d	Abs.	±d	Abs.	± d	Signif.
Number of leaves/plant									
V_1	3.2	-	2.7	-	2.0	-	2.6	-	control
V_2	4.6	+1.4	4.0	+1.3	3.5	+1.5	4.0	+1.4	X
									$LSD_{5\%}$=1.1 $LSD_{1\%}$=2.5 $LSD_{0,1\%}$=8.0
Number of flowers/plant									
V_1	1.1	-	1.0	-	1.0	-	1.0	-	control
V_2	1.2	+0.1	1.3	+0.3	1.2	+0.2	1.2	+0.2	-
									$LSD_{5\%}$ =0.2 $LSD_{1\%}$ =0.6 $LSD_{0,1\%}$ =1.8

Table 3 shows of the synthesis results regarding the average number of leaves and inflorescence / plant of the two variants. Compared to the control, the treated with GA_3 variant recorded higher values both in the number of leaves and number of flowers / plant, but the differences are statistically assured (significant) only regarding the number of leaves.

The literature confirms that the response of the plant to gibberellic acid treatment may vary depending on the variety, the way of the treatment was applied and the concentration used.

CONCLUSIONS

1. The response of *Zantedeschia* plant cv. 'Black Eyed - Beauty' to treatment with gibberellic acid (250 ppm) was marked by changes both in the duration of phenophases and some morphological characters of the plants.

2. Treatment of tubers determined the earlier emergence of the floriferous stems up to 10 days.

3. Plant height, including floriferous stems was reduced under the influence of GA_3. The most obvious was the reduction of the floriferous stems length (with approx. 15 cm from the control).

4. GA_3 favored the formation of leaves and inflorescences, but the differences were statistically assured only in the number of leaves / plant.

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