THE INFLUENCE OF SOME FERTILIZERS ON ANATOMICAL STRUCTURE AND THE ASSIMILATING PIGMENTS OF *GAZANIA SPLENDENS* SPECIES – 'BIG KISS'

INFLUENȚA UNOR INGRĂŞĂMINTE ASUPRA STRUCTURII ANATOMO MORFOLOGICE ŞI A CONȚINUTULUI ÎN PIGMENȚI ASIMILATORI LA SPECIA *GAZANIA SPLENDENS* - 'BIG KISS'

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Abstract. *This paper presents results of the research on the influence of the latest fertilizers on the growth and development of 'Big Kiss' which belongs to the Gazania splendens species. The research aimed to establish the influence of fertilizers Osmocote®Pro and Blutenzauber on the content of photosynthetic pigments and histo-anatomical structure of the 'Big Kiss'. The results obtained showed that samples that were fertilized presented an increase of photosynthetic pigments' content compared to the untreated sample. By analyzing the results of all samples, it was noted that the application of Pro Osmocote® fertilizer led to obtaining the greatest total content of assimilating pigments and also the increase of a,b chlorophyll content. Highlighting the structural differences due to the type of fertilizer was made by histo-anatomical sections at the level of the leaf lamina.*
Key words: *Gazania splendens*, photosynthetic pigments, anatomy

Rezumat. *Lucrarea de față prezintă rezultatele cercetărilor privind influența unor îngrăşăminte de ultimă generație asupra creşterii şi dezvoltării hibridului 'Big Kiss' ce apartine speciei Gazania splendens. Cercetările au vizat stabilirea influenței îngrăşămintelor Osmocote®Pro şi Blutenzauber asupra conținutului în pigmenți fotosintetici, şi a structurii histo-anatomice la specia Gazania splendes, hibridul 'Big Kiss'. Rezultatele obținute au arătat că variantele care au fost tratate cu îngrăşăminte au prezentat o creştere a conținutului în pigmenți fotosintetici comparativ cu varianta care nu a fost tratată. Prin analizarea rezultatelor tuturor variantelor s-a remarcat că aplicarea îngrăşământului Osmocote® Pro a determinat obținerea celui mai mare conținut total de pigmenți asimilatori, dar şi creşterea conținutului de clorofilă a, b. Evidențierea diferențelor structurale cauzate de tipul de îngrăşământ s-a efectuat prin secțiuni histo-anatomice la nivelul limbului foliar.*
Cuvinte cheie: *Gazania splendens*, pigmenți fotosintetici, anatomie

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INTRODUCTION

The production of flower seedlings is based on the use of different substrates and the treatment with different professional controlled-release fertilizers (Nelson, 2003). The use of slow-release fertilizers influences both the seedling production in containers and pots, as well as the development of ornamental plants (Belger and Drach, 1989). Expert studies have highlighted the influence of controlled-release fertilizers on the quality of seedlings in different medicinal, aromatic or spice plant species (Beatović *et al.*, 2007 a, b, c) as well as on the quality of flower seedlings (Vujošević *et al.,* 2007). The advantage of using these fertilizers is represented by a long-term use that may satisfy the needs of all plants for mineral nutrients. These fertilizers release, in time, the necessary mineral elements, in very precise concentrations. Due to this fact, the production of high salts concentrations in the substrate can be avoided, this being the main cause of deterioration of plants that are grown in containers and pots (Hanić, 2000). *Gazania splendens* belongs to the group of annual floricultural species and it is very attractive for the local producers due to its ornamental characteristics. Besides other species of flowers, *Gazania splendens* represents one of the ornamental species that are important in landscape architecture (Ferant *et al*., 2006; Vujoševic *et al*., 2007 b). This species is characterized by a long-term flowering period, from May up to late autumn. In order to ensure good conditions for this species, it is necessary to ensure sufficient food for the entire vegetation period.

MATERIAL AND METHOD

In order to achieve the objectives set out, we have studied the influence of some of the latest generation of fertilizers on the growth and development of the "Big Kiss" hybrid, which belongs to the *Gazania splendens* species. The experiment was carried out in the Field of the Floriculture Discipline, which is part of the "V. Adamachi" didactic farm of the University of Agricultural Sciences and Veterinary Medicine of Iaşi.

For the fertilization there were used the Osmocote®Pro and Blutenzauber fertilizers. The experiment was organized in 7 variants as follows: C - nonfertilized, V1- 4g Osmocote /plant; V2- 6g Osmocote /plant, V3- 8g Osmocote /plant, V4- 1g Blutenzauber/L ; V5- 2g Blutenzauber/L, V6- 3g Blutenzauber/L. The extraction and determination of the assimilatory pigments were carried out in accordance with the Current Protocols in Food Analytical Chemistry (Lichtenthaler and Buchmann, 2001). The tissues of the fresh leaves (0.1 g) were ground in the mortar in acetone (pure solvent) and then centrifuged at 10000 x g for 5 minutes. After centrifugation, the reading of the supernatant was done at the absorbance of 661.6 nm for chlorophyll a (Chl. a), at 644.8 nm for chlorophyll b (Chl. b) and at 470 nm for carotenoids (car.), using the T70 UV/VIS Spectrophotometer PG.

RESULTS AND DISCUSSIONS

The study has investigated the influence of the two fertilizers on the assimilatory pigments content. The experimental results (tab. 1) have shown differences regarding the total content of assimilatory pigments obtained within the seven experimental variants. The results obtained have highlighted a tendency of increase in the total content of assimilatory pigments, with the increase in the concentration of Osmocote and the concentration of Blutenzauber (tab. 1).

Within the seven variants, the total content of photosynthetic pigments has varied between 1.98 $mg \cdot g^{-1}$ d.w. in the plants from the control variant and 2.49 $mg \cdot g^{-1}$ d.w. in the plants from variant V_3. By reporting the results obtained from the variants fertilized with Osmocote to the nonfertilized variant (control), an increase in the total content of assimilatory pigments was obtained, by 0.18 $mg \cdot g^{-1}$ d.w. in variant V_2, by 0.40 $mg \cdot g^{-1}$ d.w. in variant V_3 and by 0.51 $mg \cdot g^{-1}$ d.w. in variant V_4. Regarding the results of the variants fertilized with Blutenzauber, the increase in the content of photosynthetic pigments compared to the control variant was by 0.02 $mg \cdot g^{-1}$ d.w. in variant V_5 and by 0.42 $mg \cdot g^{-1}$ d.w. in variant V_6.
Generally, an increase in the content of chlorophyll *a* is observed in the fertilized variants, the values obtained having varied between 0.50 $mg \cdot g^{-1}$ d.w. in the plants cultivated from variant V_3 and 0.42 $mg \cdot g^{-1}$ d.w. in the plants from variants V_4 and V_5. The content of chlorophyll *a* in the control variant was much more reduced compared to the fertilized variants, by comparing results having obtained an increase by 0.19 $mg \cdot g^{-1}$ d.w. in variant V_1, by 0.38 $mg \cdot g^{-1}$ d.w. in variant V_2, by 0.45 $mg \cdot g^{-1}$ d.w. in variant V_3, by 0.02 $mg \cdot g^{-1}$ d.w. in variant V_4, by 0.05 $mg \cdot g^{-1}$ d.w. in variant V_5 and by 0.38 $mg \cdot g^{-1}$ d.w. in variant V_6.

Table 1

Content of assimilatory pigments in Gazania splendens species 'BIG KISS'(mg g^{-1} d.w.)

Variant	Cl. a mg/g D.W	Cl. b mg/g D.W	x+c mg/g D.W	Σ	Chl./Car. ratio	Chl.b/car. ratio
C	1.09±0.08	0.41±0.03	0.48±0.06	1.98	3.13	0.85
V_1	1.28±0.09	0.43±0.04	0.45±0.04	2.16	3.80	0.96
V_2	1.47±0.10	0.45±0.05	0.46±0.05	2.38	4.17	0.98
V_3	1.54±0.12	0.50±0.05	0.45±0.06	2.49	4.53	1.11
V_4	1.11±0.12	0.42±0.12	0.45±0.12	1.98	3.40	0.93
V_5	1.14±0.12	0.42±0.12	0.44±0.12	2.00	3.55	0.95
V_6	1.47±0.12	0.46±0.12	0.47±0.12	2.40	4.11	0.98

± d = standard deviation

The results regarding the content of chlorophyll *b* in the control variant have presented a slight decrease compared to the fertilized variants, by comparing results having obtained an increase by 0.02 $mg \cdot g^{-1}$ d.w. in variant V_2, by 0.04 $mg \cdot g^{-1}$ d.w. in variant V_3, by 0.09 $mg \cdot g^{-1}$ d.w. in variant V_4, by 0.01 $mg \cdot g^{-1}$ d.w. in variants V_4 and V_5 and by 0.05 $mg \cdot g^{-1}$ d.w. in variant V_6. The results of the analyses show that in the fertilized variants the ratio between chlorophyll (a + b) and carotenoid pigments is higher, within the six experimental variants the increase being by 0,68 $mg \cdot g^{-1}$ d.w. in variant V_1, by 1.05 $mg \cdot g^{-1}$ d.w. in variant V_2, by 1.41 $mg \cdot g^{-1}$ d.w. in variant V_3, by 0,28 $mg \cdot g^{-1}$ d.w. in variant V_4, by 0,42 $mg \cdot g^{-1}$ d.w. in variant V_5 and by 0.98 $mg \cdot g^{-1}$ d.w. in variant V_6.

Regarding the ratio between chlorophyll b / carotenoids, the results present a slight decrease of values under the theoretical limit. The decrease of the values obtained was by 0.10 $mg \cdot g^{-1}$ d.w. in variant V_1, by 0.12 $mg \cdot g^{-1}$ d.w. in variant V_2, by 0.26 $mg \cdot g^{-1}$ d.w. in variant V_3, by 0.08 $mg \cdot g^{-1}$ d.w. in variant V_4, by 0.10$mg \cdot g^{-1}$ d.w. in variant V_5 and by 0.12 $mg \cdot g^{-1}$ d.w. in variant V_6. Regarding the content of carotenoid pigments the values have varied from 0.48 $mg \cdot g^{-1}$ d.w. in the plants cultivated from variant V_1 to 0.44 $mg \cdot g^{-1}$ d.w. in the plants from variant V_5.

The study investigated the influence of the two fertilizers on the anatomical structure of the foliar apparatus (figures 1 - 7).

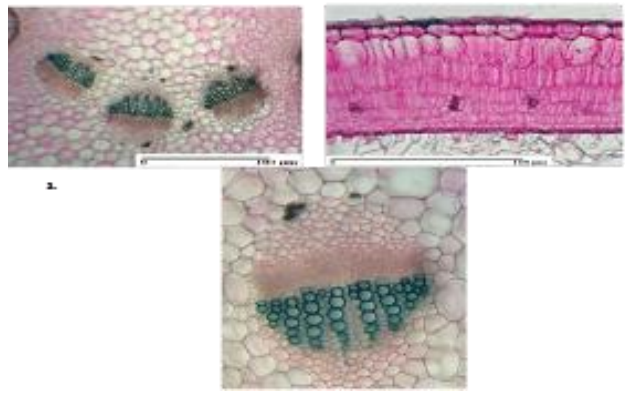

Fig. 1 Cross-section through the foliar fronds in the control variant: a. conducting bundles from the primary vein; b. mesophyll structure; c. detail of conducting bundle from the primary vein

In the cross-section through the foliar fronds, the median vein is strongly prominent in the upper side of the fronds and comprises in its fundamental parenchyma 3 conducting free-ligneous bundles, running in an open arch; the ligneous vessels run in parallel radial rows, separated by cellulosic parenchyma; the mesophyll is clearly differentiated in the palisade tissue in the upper side and lacunar tissue in the underside.

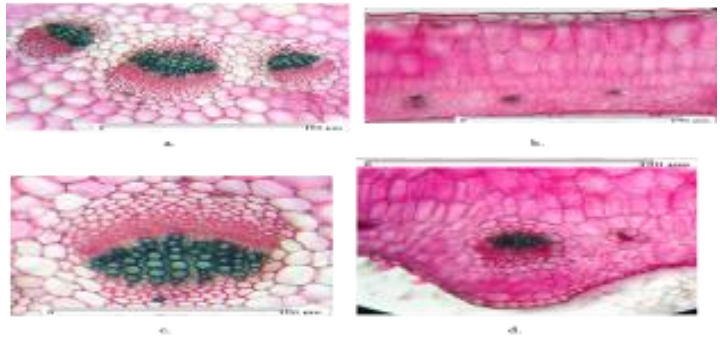

Fig. 2 Cross-section through the foliar fronds in variant V1 : a. conducting bundles from the primary vein; b. mesophyll structure; c. detail of conducting bundle from the primary vein; d. 1st order lateral vein

The median vein comprises 3 free-ligneous bundles; the 1st order lateral veins are visibly prominent in the underside; the perifloemic parenchyma of each bundle forms an arch with cells that have slightly thickened walls.

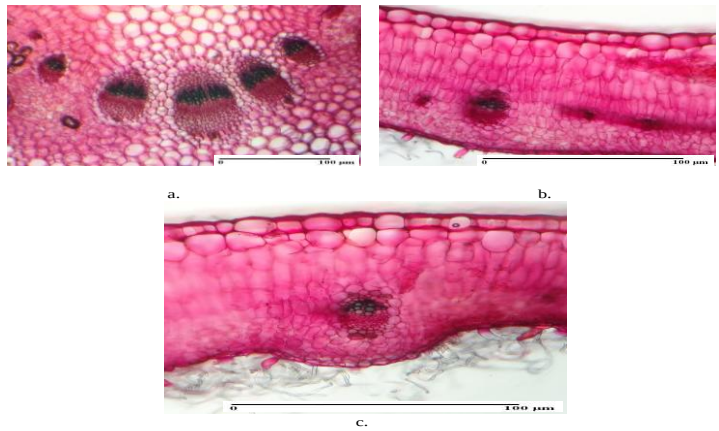

Fig. 3 Cross-section through the foliar fronds in variant V2: a. conducting bundles from the primary vein; b. mesophyll structure; c. 1st order vein structure

The primary vein comprises 5 free-ligneous bundles; the cells of the upper epidermis are very large, compared to the ones on the lower epidermis, at the level of the lateral veins; the 1st order lateral veins are slightly prominent on the underside and each have a conducting bundle of medium size; on the upper side of the fronds, the cells of the hypodermal layer are isodiametric, rounded or pear-shaped, after which there are 3-4 layers of typical palisade cells, the ones that are in the vicinity of the lacunar tissue being visibly shorter.

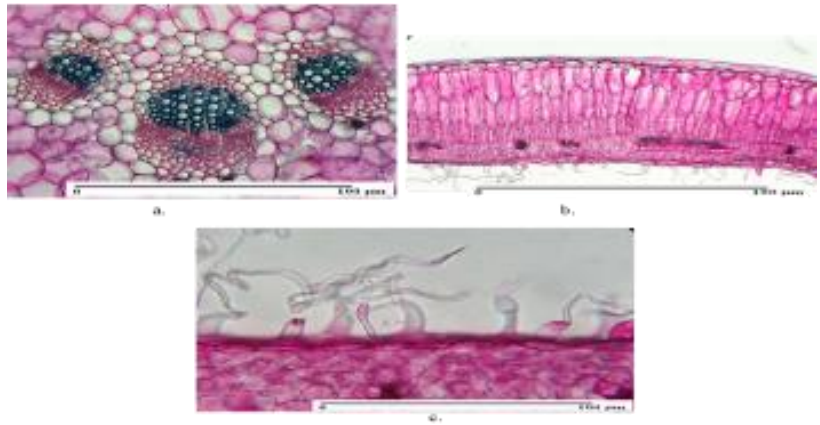

Fig. 4 Cross-section through the foliar fronds in variant V3 : a. conducting bundles from the primary vein; b. mesophyll structure; c. tector hairs

The cross-section through the primary vein highlights 3 free-ligneous conducting bundles; the number of conducting bundles from between the veins is lower; the palisadic tissue is three-layered (70-85%); the cells of the hypodermal layer are larger; the cells of the upper epidermis are visibly larger, with the outer wall much thicker than that on the opposite side of the fronds; the tector hairs are fewer.

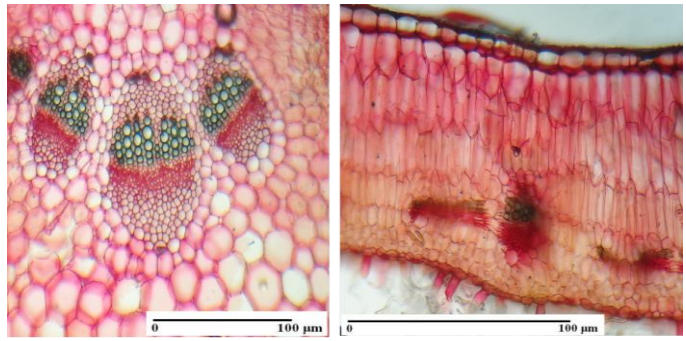

Fig. 5 Cross-section through the foliar fronds in variant V4 : a. conducting bundles from the primary vein; b. mesophyll structure

The median vein has 4 free-ligneous bundles; the palisadic tissue is single-layered, the length of the cells decreasing towards the upper side of the fronds; the lacunar tissue is reduced to 2 layers; the bundles from between the lateral veins are bigger and fewer; the upper epidermis has bigger cells.

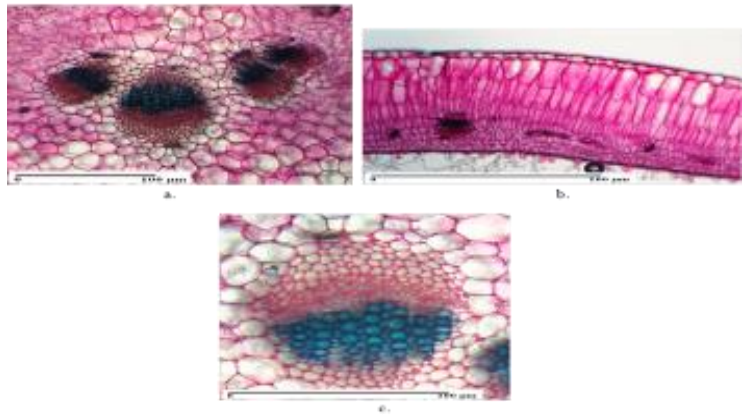

Fig. 6 Cross-section through the foliar fronds in variant V5: a. conducting bundles from the primary vein; b. mesophyll structure; c. conducting bundle from the primary vein

The median vein comprises 4 conducting bundle; the palisadic tissue is four-layered, the cells of the upper layer being much longer and larger, and the layer that is adjacent to the lacunar tissue has more narrow and much shorter cells; the tector hairs are fewer.

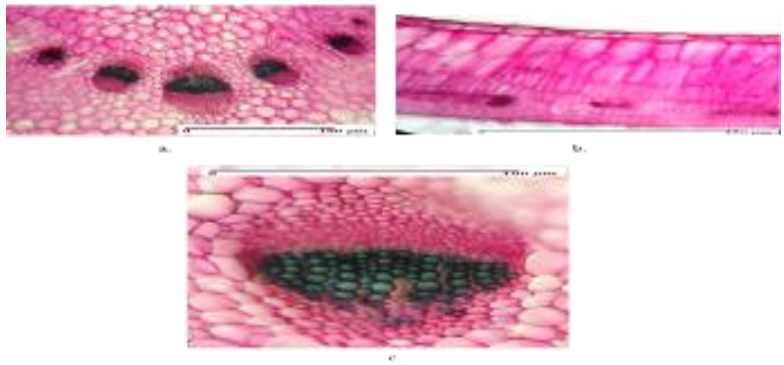

Fig. 7 Cross-section through the foliar fronds in variant V6 : a. conducting bundles from the primary vein; b. mesophyll structure; c. conducting bundle from the primary vein

The median vein comprises 5 conducting bundles and they are less prominent in the underside of the fronds; the ligneous vessels don't run strictly radially.

CONCLUSIONS

1. The variants fertilized with Osmocote® Pro have presented a higher content of photosynthetic pigments than the ones recorded in the variants fertilized with Blutenzauber.

2. The treatment with the Osmocote® Pro fertilizer has determined the highest value of total content of assimilatory pigments, as well as an increase in the content of chlorophyll a, b.

3. The structure of the primary vein, the number of conducting bundles, the cells of the hypodermal layer, the cells of the upper epidermis and the tector hairs are influenced by the type of fertilizer used, the best results being obtained in variants that were fertilized with Osmocote®Pro.

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