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EFFECT OF SUBSTRATE VOLUME ON THE GROWTH AND FLOWERING OF *CYCLAMEN PERSICUM* MILL. 'CANTO F₁ SCARLET' FROM MIDI GROUP

Summary. The subject of the studies was the effect of substrate volume on the growth and flowering of *Cyclamen persicum* Mill. 'Canto F₁ Scarlet'. Experiment was carried out in 2005 and 2006, in two cycles lasting from May 6 to November 20. In the experiment, pots were used with substrate volumes of 270 cm³, 340 cm³, 500 cm³ and 721 cm³. Seedling were planted on the 19th day into sphagnum peat with pH 6.0 enriched with fertilizer of Hydrocote 3-4 M type in the dose of 3 g/dm³. Substrate volume did not exert any effect on the plant height, plant diameter, tuber diameter and on the earliness of cyclamen flowering. Cyclamens grown in a greater amount of substrate created a bigger mass and they flowered more abundantly.

Key words: substrate volume, *Cyclamen persicum*, plant growth, flowering

Introduction

Substrate volume in which flowering pot plants are grown is a significant factor in horticultural production. Increasing production costs force the producers to look for cultivars with a poorer growth characterised by the ability of growing in a high density on area unit and at the same time giving high quality commercial material. Presently, there is a tendency to decrease the use of increasingly more expensive substrates (NESMITH and DUVAL 1998). Production in smaller containers requires smaller amount of substrate and significantly decreases the costs of production and transportation (VAVRINA 1995). There is not much information in the literature referring to the effect of substrate volume on the growth and flowering of ornamental plants (LATIMER 1991, ROZAS et AL. 1995, ARTEXTE et AL. 1997, BRĘŚ 1998, VERNIERI et AL. 2006), including cyclamens (SZCZEPANIAK et AL. 2008).

The objective of the presented paper was to investigate the effects of a decreased substrate volume on the vegetative growth and flowering of cyclamen 'Canto F₁ Scarlet' cultivar characterized by a medium growth.

Material and methods

Experiment was carried out in the Experimental Station Marcelin, Poznań University of Life Sciences, in two terms: the first term lasted from the 6th of May to the 20th of November 2005 and the second one was conducted from the 6th of May to the 20th of November 2006.

In the experiment, sphagnum peat was used, in which the pH value was brought to the level of 6.0 according to the neutralization curve. Before planting, the substrate was enriched with a slow-release fertilizer of Hydrocote 3-4 M type, in the dose of 3 g/dm³. Plant material used in the experiment consisted of *Cyclamen persicum* Mill. 'Canto F₁ Scarlet' from midi group obtained from Syngenta Seeds Co. (S&G). Plants were planted in the 19th week, in the years 2005 and 2006, into containers with the capacities of 270 cm³, 340 cm³, 500 cm³ and 721 cm³. The pot diameters were: 9, 10, 11 and 12 cm. Two weeks after planting, the plants were additionally fertilized, independent of the substrate volume in which they were grown at dose of 100 cm³ per plant with a fertilizer solution from Kristalon group. In the vegetative phase, two weeks after planting, blue Kristalon (19:6:20) was applied followed by a single application of yellow Kristalon (13:40:13) and then, until the experiment termination, the white Kristalon (15:5:30) was applied. Experiment was terminated when the plants reached the commercial value, i.e. the stage of minimum five developed flowers. Estimation of the vegetative growth was carried out on the basis of the following measurements: total plant height (cm), height of the leaf level (cm), number of leaves, plant diameter (cm), tuber diameter (cm) and fresh matter of overground plant part together with the tuber (g). Flowering was determined on the basis of the total number of flowers and buds found on the plant, number of days from the date of planting to the day of flowering and the number of days from the development of three flowers to the day of five flowers development on the plant. One combination included 20 replications, one constituted one plant grown in the definite pot volume. Results were analysed using the analysis of variance according to Newman Keuls' test at significance level of $\alpha = 0.05$.

Results and discussion

Cyclamens from midi group 'Canto F₁ Scarlet' grown in the conditions of increased substrate volume (500 cm³ and 721 cm³) showed a significantly greater number of leaves and they produced a higher fresh matter amount, in comparison with plants which had a limited root development by being planted in a smaller amount of substrate (Table 1). KEEVER et AL. (1985) came to a similar conclusion. These authors found that the biomasses of the plants *Ilex cornuta* Lindl. & Paxton, *Euonymus japonica* Thunb. and *Rhododendron* × sp. were positively correlated with the substrate volume in which

Table 1. Growth of *Cyclamen persicum* 'Canto F₁ Scarlet' depending on substrate volume
 Tabela 1. Wzrost *Cyclamen persicum* 'Canto F₁ Scarlet' w zależności od objętości podłoża

Parameter	Year	Volume of substrate (cm ³)			
		270	340	500	721
Height of plant (cm)	2005	20.1 a	21.2 a	21.5 a	22.1 a
	2006	21.8 a	22.5 a	21.0 a	21.4 a
	Mean	21.9 a	21.9 a	21.3 a	21.8 a
Height of leaves level (cm)	2005	10.8 a	11.4 ab	11.4 ab	12.2 b
	2006	9.9 a	9.9 a	9.9 a	10.3 a
	Mean	10.4 a	10.4 a	10.6 a	11.3 a
Number of leaves	2005	38.4 a	46.5 a	50.0 a	47.2 a
	2006	62.2 b	66.4 b	70.8 bc	80.2 c
	Mean	50.3 a	56.5 ab	60.4 b	63.7 b
Diameter of plant (cm)	2005	24.1 a	23.9 a	25.1 a	25.6 a
	2006	25.5 a	27.3 a	27.0 a	28.0 a
	Mean	24.8 a	25.6 a	26.1 a	26.8 a
Diameter of tuber (cm)	2005	2.1 ab	2.2 ab	2.0 a	2.1 a
	2006	2.4 bc	2.6 c	2.6 c	2.8 c
	Mean	2.3 a	2.4 a	2.3 a	2.4 a
Fresh plant mass with corm (g)	2005	63.3 a	87.5 b	90.9 b	88.2 b
	2006	129.1 c	141.9 c	168.0 d	188.1 e
	Mean	96.2 a	114.7 b	129.5 c	138.2 c

Means followed by the same letter are not significantly different at $\alpha = 0.05$.

the selected taxons were grown. A similar statement was made by CANTLIFFE (1993) and BIRAN and ELIASSAF (1980), who believed that the increasing substrate volume exerted an influence on the growth of leaf surface area, shoot biomass and root biomass. In turn, IERSEL (1997), on the basis of the estimation of *Salvia splendens* 'Top Burgundy' grown in different substrate volumes, found that sage grown in a greater amount of substrate showed more leaves and lateral shoots – similarly as cyclamen in our experiment. DUBIK et AL. (1989) reported that the limitation of root development impeded the development of lateral buds in *Euonymus kiautschovica* Loes 'Sieboldiana'. In case of cyclamens from the group 'Canto F₁ Scarlet', there the development of lateral buds could have been limited and it was testified by the decreased number of leaves in case of plants grown in a smaller amount of substrate (270 cm³ and 340 cm³). LATIMER (1991) in *Tagetes erecta* L. 'Janie' did not find any significant effect of substrate volume on plant growth. However in the beginning *Tagetes* grew significantly faster in small containers, similarly as in case of cyclamen (unpublished data). The limitation of

root development, as reported by PETERSON et AL. (1991), decreased the concentration of indolilo-acetic acid (IAA) in the leaves of *Lycopersicum esculentum*. IAA is responsible for the reduction of the leaf size. This phenomenon can explain the greater mass of plants grown in bigger pots. The flowering cyclamens 'Canto F₁ Scarlet' was different in each year because, as stressed by HENDRIKS and SCHARPF (1987, 1988), light and temperature exert an essential effect on the growth and flowering of cyclamen. Substrate volume did not exert any influence on the earliness of *Cyclamen persicum* 'Canto F₁ Scarlet' flowering, or on the further development of flowers (from three to five). An increased amount of substrate – 721 cm³, in which this cultivar was grown, contributed to a significant increase of the number of flowers and buds, but only in comparison with cyclamens grown in the substrate volume of 270 cm³ (Table 2). Cyclamens grown in containers of 721 cm³ volume had over 50 flowers and buds (Table 2). SZCZEPANIAK et AL. (2008), which cultivated miniature cyclamen 'Libretto F₁ Scarlet' in pots with different diameters, have proven that cyclamens grown in containers with diameters of 10 and 11 cm flowered abundantly, because, as stressed by the authors, the plants had more than 10 flowers and buds, in comparison with those grown in the smallest pots (of 9 cm diam.) and in the biggest pots (12 cm diam.). In turn, VERNIERI et AL. (2006) obtained more abundantly flowering plants *Callistemon laevis* Anon by the limitation of root growth, in comparison with specimens grown in a bigger amount of substrate. Additionally, as stressed by that author, *Callistemon* grown in containers of 1.5 dm³ volume was characterised by a better appearance in comparison with plants grown in 3 dm³ of substrate volume. In turn, HANKE (2005), in experiment where he applied four different substrate volumes, had proven that the flowering of plants depended on the substrate volume (pot size) in which *Chrysanthemum* × spp. was grown, but at the same time, he remarked that chrysanthemums grown in smaller pots did not deviate qualitatively from those grown in bigger containers and they received identical values. HOLTSMANN

Table 2. Flowering of *Cyclamen persicum* 'Canto F₁ Scarlet' depending on substrate volume
Tabela 2. Kwitnienie *Cyclamen persicum* 'Canto F₁ Scarlet' w zależności od objętości podłoża

Parameter	Year	Volume of substrate (cm ³)			
		270	340	500	721
Number of days to flowering	2005	114.4 a	113.5 a	105.1 a	107.9 a
	2006	124.4 a	127.1 a	116.2 a	116.8 a
	Mean	119.4 a	120.3 a	110.7 a	112.4 a
Number of days from three to five flowers development	2005	8.0 a	10.2 a	9.4 a	8.5 a
	2006	21.6 ab	12.0 a	11.6 a	30.1 a
	Mean	14.8 a	11.1 a	10.5 a	19.3 a
Number of flowers and buds	2005	26.8 a	31.8 a	33.1 a	32.4 a
	2006	51.6 b	55.3 b	59.2 b	71.1 c
	Mean	39.2 a	43.6 ab	46.2 ab	51.7 b

Means followed by the same letter are not significantly different at $\alpha = 0.05$.

(1998) came to a similar conclusion in growing *Primula vulgaris* 'Gessi' in different substrate volumes. The authors found that those plants differed slightly by their diameter and height and the cultivation in smaller containers is more economical and permits to obtain a greater number of high quality primroses. Taking into consideration our study results, we can state that the differences in the growth of cyclamen from the midi group 'Canto F₁ Scarlet' at substrate volume of 340-721 cm³ were negligible.

Conclusions

1. Substrate volume did not exert any effect on the plant height, tuber diameter or on flowering earliness of cyclamen 'Canto F₁ Scarlet'.

2. Cyclamen grown in a substrate of 340 cm³, 500 cm³ or 721 cm³ volume showed a great number of flowers and they flowered abundantly.

3. An increase of the substrate volume, in which cyclamens were grown, exerted an influence on the increase of plant fresh matter and flower number.

Practical conclusion

Cyclamen from 'Canto F₁' group, designed for commercial purpose on a large scale can be grown in pots of 10-11 cm diameter and in substrate volume of 340 cm³ and 500 cm³, decreasing thereby the production and transportation costs.

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WPLYW OBJĘTOŚCI PODŁOŻA NA WZROST I KWITNIENIE *CYCLAMEN PERSICUM* MILL. 'CANTO F₁ SCARLET' Z GRUPY MIDI

Streszczenie. Badano wpływ objętości podłoża na wzrost oraz kwitnienie cyklamenu perskiego (*Cyclamen persicum* Mill.) 'Canto F₁ Scarlet'. Doświadczenie przeprowadzono w 2005 i 2006 roku, w dwóch cyklach trwających od 6 maja do 20 listopada. W doświadczeniu wykorzystano doniczki o objętości podłoża: 270 cm³, 340 cm³, 500 cm³ oraz 721 cm³, a rozsadę sadzono w 19. tygodniu roku do torfu wysokiego o pH 6,0, wzbogaconego nawozem typu Hydrocote 3-4 M w dawce 3 g/dm³. Nie stwierdzono wpływu objętości podłoża na: wysokość roślin, średnicę roślin, średnicę bulw oraz na wczesność kwitnienia cyklamenu; różnice były niewielkie. Cyklameny uprawiane w większej ilości podłoża tworzyły większą masę i kwitły obficie.

Słowa kluczowe: objętość podłoża, *Cyclamen persicum*, wzrost wegetatywny, kwitnienie

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