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THE EFFECT OF FERTILIZERS ON GROWTH AND FLOWERING OF HETEROSIS CULTIVARS OF *Cyclamen persicum* Mill. FROM HALIOS GROUP

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Abstract. The aim of the experiment was to assess the effect of applied fertilizers: Hydrocote + Kristalon, Osmocote + Peters and Polyon + Hortimix on the length of the production period and the quality of two heterosis cultivars of *Cyclamen persicum* from Halios group during two years of the study late date cultivation. The experiment was conducted in the following cycles: 04.08.2003–12.01.2004 and 29.07.2004–30.12.2004. Plant growth was evaluated on the basis of the following characters: total height, plant diameter, the number of leaves, the weight of the aboveground part and tuber diameter. The following characters were assessed in the evaluation of flowering: earliness of the cultivar, flower development rate and the number of flowers and buds. The experiment was completed when most plants reached commercial value, i.e. after developing five flowers per plant.
It was found that slow-release fertilizers did not have a significant effect on the growth and flowering of *Cyclamen persicum* from Halios group, only the application of fertilizer Osmocote resulted in an increase of plant diameter and weight. A bigger effect was found for the year of cultivation: bigger insolation during cultivation boosts growth. Earliness of flowering was not affected by the year of cultivation, cultivars formed similar numbers of flowers, whereas the rate of flower development depended on both factors and in the year with bigger insolation it was higher and resulted in the formation of a bigger number of flowers.

Key words: *Cyclamen persicum*, fertilizers, cultivation term, cultivars

INTRODUCTION

The introduction of slow-release fertilizers and completely water-soluble fertilizers creates a possibility of a long-term fertilization or fertilization at each watering. Slow-release fertilizers ensure constant release of macro- and microelements throughout the cultivation period at subsoil temperature of 20/21°C [Arnim 1986]. According to Kill-

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gus [cited after Grantzau 1994] slow-release fertilizers need to be applied cautiously, since under the influence of high temperature excessive release of nutrients may occur. That author recommended top-dressing in order to ensure better plant quality. Also Biermann [1986] and D'Angelo et al. [1995] were of the opinion that regular top-dressing is more advantageous for plant growth and flowering than the application of higher doses of slow-release fertilizers. Cyclamens belong to plants sensitive to high mineral contents and their fluctuations and excess or deficit of minerals in the subsoil result in inhibited growth of plants and lignification of spots sending leaves and flowers from the tubers [Oszkinis and Haber 1992]. Moreover, minerals may also be accumulated in tissues, causing the extension of the cultivation period [Suda and Fukuda 2000].

The aim of this study was to determine the effect of applied fertilizers on the length of production period and on the quality of two heterosis cultivars of *Cyclamen persicum* from the Halios group during two years of the study at late date of cultivation.

MATERIAL AND METHODS

The experiment was conducted in glasshouse at the Marcelin Experimental Station of the Agricultural University of Poznan in the late time cultivation from the 31-st week of the year in 2003 and 2004, in the following cycles: 04.08.2003–12.01.2004 and 29.07.2004–30.12.2004. Cultivars of the Maxi type were selected for the study: 'Halios Pure White Compact F_1' and 'Halios Scarlet with Red F_1'. Plant material consisted of transplants grown in X-trays with 72 plants in each. Young plants were planted in 12 cm diameter pots. The substrate was peat moss from Pasłęk, deacidified with calcium carbonate at 5 $g \cdot dm^{-3}$ until pH of approx. 6.0 was obtained. During pot planting side dressing of 2 g slow-release fertilizer was applied directly under roots. Three fertilizers were compared: Hydrocote 5-6M (13:13:13), Osmocote Plus 5-6M (15:10:12:2) and Polyon 5-6M (15:10:12). Two weeks after planting weekly fertilization was started, with the use of 0.1% solutions of water-soluble fertilizers. Hydrocote fertilizer was applied incombination with Kristalon: blue Kristalon (19:6:20), yellow Kristalon (13:40:13), white Kristalon (15:5:30:3); in combination with Osmocote Peters fertilizers were used: Peters Professional Special (20:10:20), Peters Blossom Booster (10:30:20), Peters Professional Special (15:11:29); and with Polyon Hortimix fertilizers were applied in the following order: Hortimix vegetation (20:20:20), Hortimix budding stimulation (10:30:20), Hortimix budding (15:11:29). In the vegetative phase from the 2nd to the 5th week of cultivation fertilizers with the biggest amount of nitrogen were applied four times. To boost flower induction in the 6th week of cultivation a fertilizer with the highest amount of phosphorus was applied once. Whereas during the generative phase until full flowering fertilizers with the highest amounts of potassium were applied about a dozen times. Liquid fertilizers were applied at the dose of 100 cm^3 per plant. The experiment was completed when most plants reached commercial value, i.e. then five flowers developed on one plant. Plant growth was assessed on the basis of the following parameters: total height of plant from the level of the pot to the highest flower (cm), plant diameter at the level of leaves extending widest (cm), the number of leaves, the weight of the aboveground part (g), and tuber diameter measured in the widest spot at

the cross-section (mm). While evaluating flowering the following features were considered: earliness of the cultivar, defined by the number of days from planting to the beginning of flowering, the rate of development of flowers, defined by the number of days from the development of 3 to 5 flowers per plant and the number of flowers and buds. The combination consisted of the cultivar, fertilizer and a year of cultivation. The number of replications in each combination was 20; one plant constituted a replication. The obtained results were subjected to three-way analysis of variance using the Newman – Keuls test.

RESULTS AND DISCUSSION

In *Cyclamen persicum* from the group Halios the effect of the applied fertilizer on plant growth turned out to be slight (tab. 1). Only the diameter of plants and the weight of the aboveground part were significantly bigger in plants grown with the addition of fertilizer Osmocote to the substrate and after the top-dressing with Peters fertilizer. They were wider in diameter by 1.1 cm than plants grown with the application of Hydrocote + Kristalon and by 1.6 cm bigger from the diameter of plants fertilized using Polyon + Hortimix. In turn, the weight of plants fertilized with Osmocote + Peters was by 18.9 g bigger than plants fertilized with Hydrocote + Kristalon and by 25.2 g than plants with fertilized with Polyon + Hortimix. Also Szczepaniak [2000] showed that the biggest diameter of cyclamens was obtained in cyclamens when Osmocote fertilizer is applied, whereas in studies on the frequency of fertilizer applications that author [Szczepaniak 2002] found that plant growth does not depend on the frequency of fertilization or on the concentration of the fertilizer, but on the year of cultivation. Hendriks and Scharpf [1987, 1988] and Arendts and Escher [1989] emphasized that light and temperature, differing in individual years, have a crucial effect on the growth and development of cyclamens, which was also observed in the investigations conducted by the authors of this study. In 2004 insolation was 37.6 hours longer and it resulted in an increase of plant height by 1.6 cm, plant diameter by 3 cm, the weight of the aboveground part by 27.1 g, and the number of leaves by 5.5. compared to the results from 2003. Also Szczepaniak and Czuchaj [2003] showed in their studies on the date of cultivation that plant diameter, the number of leaves and the weight of the aboveground part of cultivar 'Concerto White Apollo F_1' in the year with the higher insolation were significantly bigger. Also Hendriks [1993] reported that at bigger light availability plants form more leaves. In this study however, when analyzing the effect of fertilization it turned out that the number of leaves did not differ significantly between the years of cultivation. Tuber diameter was also similar in both years. During the study it was observed that at the application of Hydrocote + Kristalon no significant differences were found in plant growth between the years of cultivation, apart from the weight of the aboveground part, which was higher in 2004 by 21.5 g. In contrast, when Osmocote + Peters and Polyon + Hortimix were applied, the differences between the years of cultivation were significant, i.e. in 2004 plant growth was stronger. At the application of fertilizers Osmocote + Peters plant height was by 1.1 cm bigger, the formed diameter was by 3.1 cm bigger, and the other analyzed characters were also bigger, although the

Table 1. Growth of *Cyclamen persicum* depending on the cultivar, fertilizer and year of cultivation
Tabela 1. Wzrost cyklamenu perskiego zależności od odmiany, nawozu i roku uprawy

Fertilizer Nawóz	Year of cultivation Rok uprawy	Cultivar Odmiana	Plant height Wysokość roślin, cm	Plant diameter Średnica roślin, cm	Number of leaves Liczba liści	Fresh weight of leaves and flowers Świeża masa liści i kwiatów, g	Tuber diameter Średnica bulwy, mm
Hydrocote +Kristalon	2003	Pure White Compact	21.4	26.7	42.2	143.2	20.3
		Scarlet with Red	21.1	28.2	48.3	146.2	22.6
		Mean – Średnia	21.3a	27.5b	45.3ab	144.7a	21.5a
	2004	Pure White Compact	21.6b	28.4	41.2	163.6	20.5
		Scarlet with Red	23.8	27.9	60.5	168.8	27.0
		Mean – Średnia	26.7a	28.1b	50.9b	166.2b	23.8a
	Mean – Średnia		22,0a	27.8a	48.1a	155.5a	22.6a
Osmocote +Peters	2003	Pure White Compact	21.2	28.2	40.1	166.6	19.2
		Scarlet with Red	21.6	26.7	39.3	162.8	24.5
		Mean – Średnia	21.4a	27.4b	39.7a	164.7b	21.9a
	2004	Pure White Compact	21.7	30.2	45.7	199.4	21.7
		Scarlet with Red	23.2	30.8	49.4	168.6	23.3
		Mean – Średnia	22.5b	30.5c	47.6ab	184.0b	22.5a
	Mean – Średnia		21,9a	28.9b	43.6a	174.4b	22.2a
Polyon +Hortimix	2003	Pure White Compact	19.5	25.1	44.0	138.6	21.4
		Scarlet with Red	21.4	24.3	43.3	119.4	23.9
		Mean – Średnia	20.4a	24.7a	43.7ab	129.0a	22.7a
	2004	Pure White Compact	22.0	30.1	45.0	185.2	36.9
		Scarlet with Red	23.1	29.8	48.5	153.6	25.8
		Mean – Średnia	22.5b	30.0c	46.8ab	169.4b	31.4a
	Mean – Średnia		21,5a	27.3a	45.2a	149.2a	27.0a
Mean for year of cultivation Średnia dla roku uprawy	2003		21,0a	26.5a	42.9a	146.1a	22.0a
	2004		22,6b	29.5b	48.4b	173.2b	25.9a
Mean for cultivar Średnia dla odmiany		Pure White Compact	21.2a	28.1a	43.0a	166.1b	23.3a
		Scarlet with Red	22.4b	27.9a	48.2b	153.2a	24.5a

differences were not significant in comparison to the year 2003. During cultivation in 2004 with the use of Polyon + Hortimix fertilizer plant height, diameter and the weight of the aboveground parts were significantly bigger in comparison to those in 2003 by 2.1 cm, 5.3 cm and 40.4 g, respectively. In this study it was found that tuber diameter did not depend on any of the analyzed factors. Similarly, Szczepaniak and Czuchaj [2003] showed that the year of cultivation did not have any effect on tuber size, while differences were observed between cultivars, as it has been mentioned earlier. Also in the experiment conducted by Szczepaniak [2002] the biggest tuber weight was found at the application of fertilizer Azofoska in the suspension form, while the lowest when applying a water-soluble fertilizer Kristalon azur, with the difference amounting to 15.6 g.

Table 2. Flowering of *Cyclamen persicum* depending on the cultivar, fertilizer and year of cultivation
Tabela 2. Kwitnienie cyklamenu perskiego zależności od odmiany, nawozu i roku uprawy

Fertilizer Nawóz	Year of cultivation Rok uprawy	Cultivar Odmiana	Number of days to beginning of flowering Liczba dni do początku kwitnienia	Duration of flower development from the 3rd to the 5th (number of days) Długość fazy rozwoju kwiatów od 3. do 5. (liczba dni)	Number of flowers and buds Liczba kwiatów i pąków
Hydrocote +Kristalon	2003	Pure White Compact	125.9	14.5	20,7
		Scarlet with Red	129.7	11.6	17,6
		Mean – Średnia	127.8a	13.0b	19,2a
	2004	Pure White Compact	121.5	6.2	25,5
		Scarlet with Red	128.7	8.8	40,3
		Mean – Średnia	125.1a	7.5a	32,9b
	Mean – Średnia		126,4a	10.3a	26.0a
Osmocote +Peters	2003	Pure White Compact	113.1	12.1	23,7
		Scarlet with Red	130.0	15.7	19,6
		Mean – Średnia	121.5a	13.9b	21,7a
	2004	Pure White Compact	118.2	6.5	27,5
		Scarlet with Red	126.7	8.2	31,8
		Mean – Średnia	122.5a	7.3a	29,7b
	Mean – Średnia		122,0a	10.6a	25.7a
Polyon +Hortimix	2003	Pure White Compact	124.4	11.2	21,8
		Scarlet with Red	127.9	12.5	19,7
		Mean – Średnia	126.1a	11.8b	20,8a
	2004	Pure White Compact	118.7	6.5	32,9
		Scarlet with Red	126.8	8.2	33,2
		Mean – Średnia	122.7a	7.4a	33,1b
	Mean – Średnia		124,4a	9.6a	26.9a
Mean for year of cultivation Średnia dla roku uprawy	2003		125,1a	12.9b	20.5a
	2004		123,4a	7.4a	31.9b
Mean for cultivar Średnia dla odmiany	Pure White Compact		120,3a	9.5a	25.4a
	Scarlet with Red		128,3b	10.8b	27.0a

Large differences were shown between cultivars. Plant height in cultivar 'Halios Scarlet with Red F_1' was bigger in comparison to cultivar 'Halios Pure White Compact F_1' by 1.2 cm, the number of leaves was higher by 5.2, whereas weight turned out to be lower by 12.9 g, which may result from the size or a different structure of the leaf blade. Diameters of plants and tubers did not differ significantly, in contrast to the results reported by Szczepaniak [2002], where large differences were found between diameters of plants formed by analyzed cultivars. In 1999 the difference between the cultivar with the biggest plant diameter 'Estrella F_1' and the cultivar with the smallest diameter 'Maestro F_1' was 3.7 cm, while in 2000 the difference between 'Capelia F_1' and 'Leila F_1' was found to be 2.5 cm. Results of successive studies by the same author [Szczepaniak and Czuchaj 2003] indicated large differences between cyclamen cultivars from group Concerto also in terms of other characters. The difference between the biggest cultivar 'Leila F_1' and the smallest 'Lucia F_1' was 2.2 cm. Plants of cultivar 'Papageno

F_1' had the largest diameter and the biggest weight of the aboveground part, differing from those of the cultivar with the smallest diameter and the lowest weight by 2.6 cm and 57.2 g, respectively. Cultivar 'Leila F_1' formed a smaller number of leaves by 26.4 than 'Lucia F_1'. Tuber diameter of 'Papageno F_1' was by 8 mm bigger from the smallest tuber diameter, formed by plants of 'Lucia F_1'. In this study the weight of plants was bigger in 'Halios Pure White Compact F_1' when fertilizers Osmocote and Polyon were applied, in contrast to Hydrocote, where the dependency was opposite.

During cultivation it was found that the applied fertilizer did not have an effect on flowering (tab. 2), similarly as in previous experiments by Szczepaniak [2000, 2002]. In turn, Brückner [1990] found the effect of fertilizer on the number of flowers, Arnim [1986] showed in his studies that the application of fertilizer Osmocote 5-6M considerably shortened cultivation period and resulted in the formation of the biggest number of flowers in comparison to this fertilizer with a different period of activity. Arendts and Escher [1989] were of the opinion that better plant quality and a shorter cultivation period are the effect of large light availability and similar results were obtained in this study. Although no significant differences were found in the earliness of flowering in 2004, the year with better light conditions, the rate of flower development was by 5.5 days faster and resulted in an increase of the number of flowers and buds by 11.4 in comparison to those in 2003. In 2004 in comparison to 2003 in the variant with the application of fertilizers Hydrocote + Kristalon the number of days from the development of 3 to 5 flowers was smaller by 5.5 days while the number of flowers was by 13.7 bigger. At the application of fertilizers Osmocote + Peters during the cultivation in 2004 the rate of flower development was 6.6 days longer, with 8 more flowers being formed. At the application of fertilizers Polyon + Kristalon in 2004 the commercial product with 5 developed flowers was obtained 4.4 days faster and the number of flowers was by 12.3 higher. Also Szczepaniak and Czuchaj [2003] found that the year of cultivation has an effect on the number of flower buds, but it has no effect on the earliness of a given cultivar, while the duration of cultivation depends on the cultivar.

It was found that cultivar 'Halios Pure White Compact F_1' is earlier than 'Halios Scarlet with Red' F_1' by 8 days, with the rate of flower development faster by 1.3 days, whereas the number of flowers does not differ significantly between them. In turn, Szczepaniak [2002] and Szczepaniak and Czuchaj [2003] found differences between cultivars also in the number of flowers.

CONCLUSIONS

1. There were no influence of fertilizer on the growth and flowering of *Cyclamen persicum* from group Halios that cultivation conditions found in a given year.

2. The application of fertilizers Osmocote + Peters resulted in plants of good quality; plant diameter and plant weight were significantly bigger than when other fertilizers were used.

3. The biggest differences in plant growth were found between years of cultivation when Polyon + Hortimix were applied.

4. Plants of 'Halios Scarlet with Red F1' were higher and created larger number of leaves, the weight of aboveground part of plants was smaller; but date of flowering was later and the development of flowers was slower than with 'Halios Pure White Compact F_1' cultivar.

5. In the year of cultivation with bigger insolation plants formed more flowers, which also developed faster.

REFERENCES

Arendts H.P., Escher F., 1989. Wie stark dürfen Cyclamen schattiert werden? GbGw 32, 1616–1619.

Arnim J., 1986. Neue Dünger und Düngungsverfahren für den Zierpflanzenbau. Zierpflanzenbau 88(6), 242–243.

Bierman W., 1986. Düngung von Pelargonien und Cyclamen in Weißtorf und Einheitserde. Zierpflanzenbau 6, 224–228.

Brückner U., 1990. Einfluß von Düngung und Substrat auf die Blütenzahl bei Cyclamen. GbGw 39, 1914–1916.

D'Angelo G., Pusterla M., Castelnuovo M., 1995. Response of Peat- and Compost-based Substrates to Different Levels of Irrigation and Fertilization in Cyclamen. Acta Hortic. 401, 537–543.

Hendriks L., 1993. Kultursteuerung für Könner. Dtsch. Gartenb. 40, 2548–2553.

Hendriks L., Scharpf H.Ch., 1987. Kultursteuerung von Cyclamen. Dtsch. Gartenb. 52/53, 1378–1381.

Hendriks L., Scharpf H.Ch., 1988. Kultursteuerung von Cyclamen II. Dtsch. Gartenb. 22, 3091–3095.

Killgus Ch., 1994. Traumhaus für Cyclamen. Dtsch. Gartenb. 45, 2702–2703.

Oszkinis K, Haber Z., 1992. Cyklameny. PWRiL, Warszawa.

Suda A., Fukuda M., 2000. Nutrient uptake of cyclamen grown with ebb and flow irrigation system. Research Bulletin of the Aichi-ken Agricultural Research Center 32, 183–188 (abstract).

Szczepaniak S., 2000. Wpływ nawozów wieloskładnikowych na wzrost i kwitnienie odmian heterozyjnych cyklamenu perskiego (*Cyclamen persicum* Mill.). Rocz. AR Pozn. CCCXVIII, Ogrodn. 29, 117–122.

Szczepaniak S., 2002. Wzrost i kwitnienie cyklamenu perskiego (*Cyclamen persicum* Mill.) w zależności od częstotliwości stosowania nawozów z grupy Kristalon. Zesz. Probl. Post. Nauk Roln. 483, 237–243.

Szczepaniak S., Czuchaj P., 2003. Wzrost i kwitnienie heterozyjnych odmian cyklamenu perskiego (*Cyclamen persicum* Mill.) z grupy Concerto w zależności od terminu uprawy. Acta Scientarium Polonorum, Hortorum Cultus 2(2), 131–136.

WPŁYW NAWOZÓW NA WZROST I KWITNIENIE HETEROZYJNYCH ODMIAN CYKLAMENU PERSKIEGO (*Cyclamen persicum* Mill.) Z GRUPY HALIOS

Streszczenie W doświadczeniu badano wpływ zastosowanych nawozów: Hydrocote + Kristalon, Osmocote + Peters, Polyon + Hortimix na długość okresu produkcji i jakość dwóch odmian heterozyjnych cyklamenu perskiego z grupy Halios w dwóch latach badań

podczas uprawy w terminie późnym. Doświadczenie przeprowadzono w cyklach: 4.08.2003–12.01.2004 i 29.07.2004–30.12.2004. Wzrost roślin oceniano na podstawie następujących cech: całkowitej wysokości rośliny, średnicy rośliny, liczby liści, masy części nadziemnej, średnicy bulwy. Do oceny kwitnienia brano pod uwagę: wczesność odmiany, tempo rozwoju kwiatów oraz liczbę kwiatów i pąków. Doświadczenie zakończono, gdy większość roślin osiągnęła wartość handlową, czyli po rozwinięciu pięciu kwiatów na roślinie.

Stwierdzono, iż nawozy o spowolnionym działaniu nie wpływają istotnie na wzrost i na kwitnienie cyklamenu perskiego z grupy Halios, jedynie stosowanie nawozu Osmocote zwiększyło średnice roślin i ich masę. Większy wpływ ma rok uprawy, większe usłonecznienie podczas uprawy pobudza wzrost. Na wczesność kwitnienia nie wpływa rok uprawy, odmiany tworzą podobną liczbę kwiatów, natomiast tempo rozwoju kwiatów zależy od obu czynników i w roku z większym usłonecznieniem jest większe i wpływa na zwiększenie liczby kwiatów.

Słowa kluczowe: *Cyclamen persicum*, nawóz, termin uprawy, odmiana

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