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MORPHOLOGICAL TRAITS, FLOWERING AND CORM YIELD OF *Crocosmia* × *crocosmiiflora* (Lemoine) N.E. CULTIVARS ARE DETERMINED BY PLANTING TIME

Piotr Żurawik, Piotr Salachna, Agnieszka Żurawik, Agnieszka Dobrowolska
West Pomeranian University of Technology in Szczecin

Abstract. Crocosmia (*Crocosmia* × *crocosmiiflora*) is an exceptionally attractive and interesting ornamental plant. Numerous varieties of this species have been produced, however, the information concerning their requirements and cultivation conditions is lacking. The study was conducted in the field conditions in the years 2008–2010. The plant material included corms of four crocosmia cultivars: 'Emily McKenzie', 'Lucifer', 'Mars', and 'Meteor'. The corms were planted on 15th April, 5th May and 25th May. The number of days from the beginning of sprouting until the end of flowering was established, and measurements of vegetative and generative traits were performed during cultivation. Corm yield was determined at the end of the cultivation period. It was found that delaying the planting time resulted in accelerated sprouting of the corms. Irrespective of the cultivar, the plants grown from the corms planted on 5th May were the first, and those planted on 25th May – the last to bloom. The corm planting time affected vegetative and generative features of the crocosmia plants. The plants grown from the corms planted on 5th and 25th May were higher, had more shoots and leaves on the main shoots. The plants grown from the corms planted on 5th May were characterized by the longest main inflorescence shoots and flowers of larger diameter than the plants grown from the corms planted on 15th April and 25th May. Cultivar-specific features largely determined the vegetative and generative traits. The plants of 'Emily McKenzie' cultivar were characterized by the longest main inflorescence shoots and the largest flower diameter, but they produced the lowest number of inflorescence shoots and flowers per main inflorescence spike. The study showed that earlier planting time (15th April and 5th May) resulted in higher coefficient of weight and number increase of the new corms, but it did not affect the coefficient of total corm weight increase, as compared to the delayed planting time (25th May).

Key words: ornamental plants, montbretia, method of cultivation, growth, development

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Corresponding author: Piotr Żurawik, Department of Horticulture, Laboratory of Ornamental Plants, West Pomeranian University of Technology in Szczecin, ul. Papieża Pawła VI 3A, 71-459 Szczecin, Poland, e-mail: kro@zut.edu.pl

INTRODUCTION

In the recent years crocosmia (*Crocosmia* × *crocosmiiflora* (Lemoine) N.E.), also known as montbretia, has become a fairly popular corm plant [Goldblatt et. al. 2004]. *Crocosmia* genus belongs to Iridaceae family and it includes seven species occurring naturally in the south Africa [Erhardt et al. 2008]. Crocosmia is cultivated mainly for its attractive flowers and ornamental fruit [Armitage and Laushman 2008], it can be also grown in gardens and pots [Filios and Miller 2010]. Cultivation and cross-breeding yielded over 300 different cultivars, with red, orange or yellow flowers [Goldblatt et al. 2004]. New hybrids of crocosmia can be obtained by the use of micropropagation [Hannweg et al. 2013, Krupa-Małkiewicz et al. 2013]. Crocosmia corms have been for a long time used in natural medicine for treating dysentery and infertility, and they contain many biologically active compounds [Asada and Furuya 1996], including substances of antitumor properties [Nagamoto et al. 1988]. Crocosmia is not fully frost resistant in the Central European climate, which is why its corms should be dug out in the autumn and stored until spring in peat or vermiculite [Goldblatt et al. 2004].

Results of numerous studies [Hetman et al. 2007, Ahmad et al. 2011, Kapczyńska 2012, Zubair et al. 2013] on various species of ornamental geophytes indicate that inflorescence quality and corm or bulb yield depend on the planting time. This factor determines also the blooming course, which is especially important when the plants are bred for cut flowers [Armitage and Laushman 1990]. The subject literature lacks data on the relationships between planting time and growth and development of crocosmia in the climatic conditions of Poland. Therefore, the aim of this study was to determine the effect of three planting times of corms on the length of the cultivation period, flowering course and corm yield of four cultivars of crocosmia.

MATERIALS AND METHODS

The field study was conducted in the years 2008–2010 in Szczecin (14º31' E and 53º26' N) and it involved four cultivars of *Crocosmia* × *crocosmiiflora*: 'Emily McKenzie', 'Lucifer', 'Mars', and 'Meteor'. The plant material included corms 8–10 cm in circumference. The corms were stored at 5–8ºC and relative air humidity of 60–70%, and planted on 15th April, 5th May and 25th May. The plants were dug out before the first autumn frost in the second decade of October, irrespective of their planting time.

Before planting, the soil was fertilized with multicomponent mineral fertilizer Azofoska (N 13.6, P_2O_5 6.4, K_2O 19.1, MgO 4.5, B 0.045, Cu 0.180, Fe 0.17, Mn 0.27, Mo 0.040, Zn 0.045), at a dose of 30 $g \cdot m^{-2}$. During vegetation and before flowering, top dressing with Azofoska at 20 $g \cdot m^{-2}$ was applied. Following the storage, the corms underwent a 30 minute wet treatment in a mixture of 1.5% Kaptan 50 WP suspension, 0.4% Benazol WP, and 0.1% Actelic 500 EC. Then, they were planted at the depth of 10 cm, with 25 cm row spacing and 10 cm corm spacing. Air temperature during the experiment was recorded using Testo 175 H 2 device. Average decade and monthly air temperature for each year and average annual temperatures are presented in Table 1.

Table 1. Average decade and monthly air temperature (ºC) in the years 2008–2010

Year	Decade	Temperature (ºC) – Month						
		April	May	June	July	August	September	October
2008	I	11.6	10.3	19.2	18.1	19.5	15.8	13.9
	II	10.1	15.1	17.5	18.9	18.3	15.1	8.0
	III	14.2	15.4	17.6	16.1	18.3	14.5	8.9
	mean	12.0	13.6	18.1	17.7	18.7	15.1	10.3
2009	I	12.4	12.0	13.6	20.1	21.0	17.0	10.2
	II	12.1	12.5	14.5	19.7	19.4	13.9	5.6
	III	14.6	14.8	17.8	19.4	19.2	12.6	7.7
	mean	13.0	13.1	15.3	19.7	19.9	14.5	7.8
2010	I	7.9	10.3	17.0	22.2	19.8	13.8	10.6
	II	7.4	13.3	15.6	24.0	19.5	13.5	5.0
	III	10.6	12.8	17.4	19.9	17.0	13.0	7.1
	mean	8.6	12.1	16.7	22.0	18.8	13.4	7.6
2008–2010	I	10.6	10.9	16.6	20.1	20.1	15.5	11.6
	II	9.9	13.6	15.9	20.9	19.1	14.1	6.2
	III	13.1	14.3	17.6	18.5	18.2	13.4	7.9
	mean	11.2	12.9	16.7	19.8	19.1	14.3	8.6

The number of days from the beginning of sprouting to the beginning of flowering and from the beginning to the end of flowering were determined during the experiment (the flowering period was counted from an opening of the first flowers in the main inflorescences until a withering of the last flower on a plant). Morphological traits of the vegetative organs were measured at three time points – one month after the sprouting had begun, at full bloom and at the end of the study. Plant height, number of shoots and number of leaves on main shoot and total number of leaves per plant were determined, and chlorophyll meter SPAD-502 was used for assessing the leaf greenness index. Characteristic traits of the generative organs were measured since the opening of the first flower in an inflorescence in subsequently blooming plants. The measurements included total length of main inflorescence shoot (from the substrate surface to the base of the first flower in the main inflorescence), length of main inflorescence shoot (from the first lateral branching to the base of the first flower in the main inflorescence), length of main inflorescence spike (spike length from the base of the first flower in the inflorescence to the base of the terminal bud), number of inflorescence shoots (all shoots growing from a bulb were counted), diameter of the first flower in the main inflorescence (the widest section), and the number of flowers in the main inflorescence spike (open flowers and properly formed buds). The corms were dried and cleaned from dry shoots, leaves and roots, and their yield was assessed by calculating the coefficient of new corm weight (the ratio of daughter corm weight after the vegetation period to the weight of the planted corms) and number increase (the ratio of daughter corm number to the number of planted corms) and coefficient of total corm weight increase (the ratio of daughter and adventitious corm weight to the weight of the planted corms).

The experiment included 12 different variants, each variant comprised 60 corms, divided into three replicates of 20 corms. The results concerning generative traits and yield were analyzed statistically by means of a two-way analysis of variance, with planting time and variety as factors. The data on morphological traits were analyzed using a three-way analysis of variance, with the measurement time as the third factor. Study design was based on randomized blocks for the consecutive years and final results were calculated for the whole 3-year period. Mean results were compared using Tukey's test, at the significance level $\alpha = 0.05$.

RESULTS

Average decade air temperature in the years 2008–2010 was the lowest for the earliest planting time, i.e. 15th April, and it was 9.9°C. The temperature was by 1°C higher for the second planting time, and by 4.4°C for the latest planting time. The plants grown from the corms planted on 15th April experienced the lowest average decade temperature (14–17°C) at the beginning of the vegetative growth and during formation of the generative organs. The temperature rose up to 20°C only at the end of this period. For the corms planted on 5th May, the temperatures at the beginning of plant growth remained at 15–17°C, then increased to 20°C and again decreased slightly to 18°C. The corms planted at the latest, on 25th May, experienced the highest average decade temperature from the beginning of sprouting until flowering, always exceeding 18°C. Average decade air temperature gradually declined during flowering (tab. 1).

The study showed that the planting time affected crocosmia sprouting (fig. 1). In all cultivars, delayed planting was followed by accelerated sprouting. The corms planted on 15th April sprouted 5.7 and 7.7 days later than those planted on 5th and 25th May, respectively. The greatest differences were observed for the corms of 'Mars' cultivar – 11 days, then for 'Lucifer' – 8 days and 'Emily McKenzie' – 7 days, and the smallest for 'Meteor' cultivar – only 4 days. Irrespective of the planting date, the sprouting time was the shortest for 'Mars' and 'Lucifer' cultivars – 26.3 and 27.3 days, respectively, and the longest for 'Emily McKenzie' cultivar – 34.0 days. The corm planting time to a large extent determined the number of days from the beginning of emergence to the first flowers. In all four cultivars, the anthesis began first in the plants grown from the corms planted on 5th May. Regardless of the cultivar, flowering in the plants grown from the corms planted on 5th May occurred on average 5.8 days earlier than in the plants grown from the corms planted on 15th April, and 17.3 days earlier than in the plants grown from the corms planted on 25th May. The greatest difference in the number of days from the beginning of sprouting to the beginning of flowering was found in 'Emily McKenzie' plants – 24.0 days, then in 'Meteor' cultivar – 20 days and 'Mars' cultivar – 16 days, while the smallest difference of only 9 days was observed in 'Lucifer' plants. During cultivation, the most uniform flowering was observed in the plants grown from the corms planted on 5th May, except for 'Emily McKenzie' cultivar (fig. 1). In all crocosmia cultivars, the corms of which were planted on 25th May, and in 'Emily McKenzie' cultivar planted on 5th May, the flowering time was highly irregular.

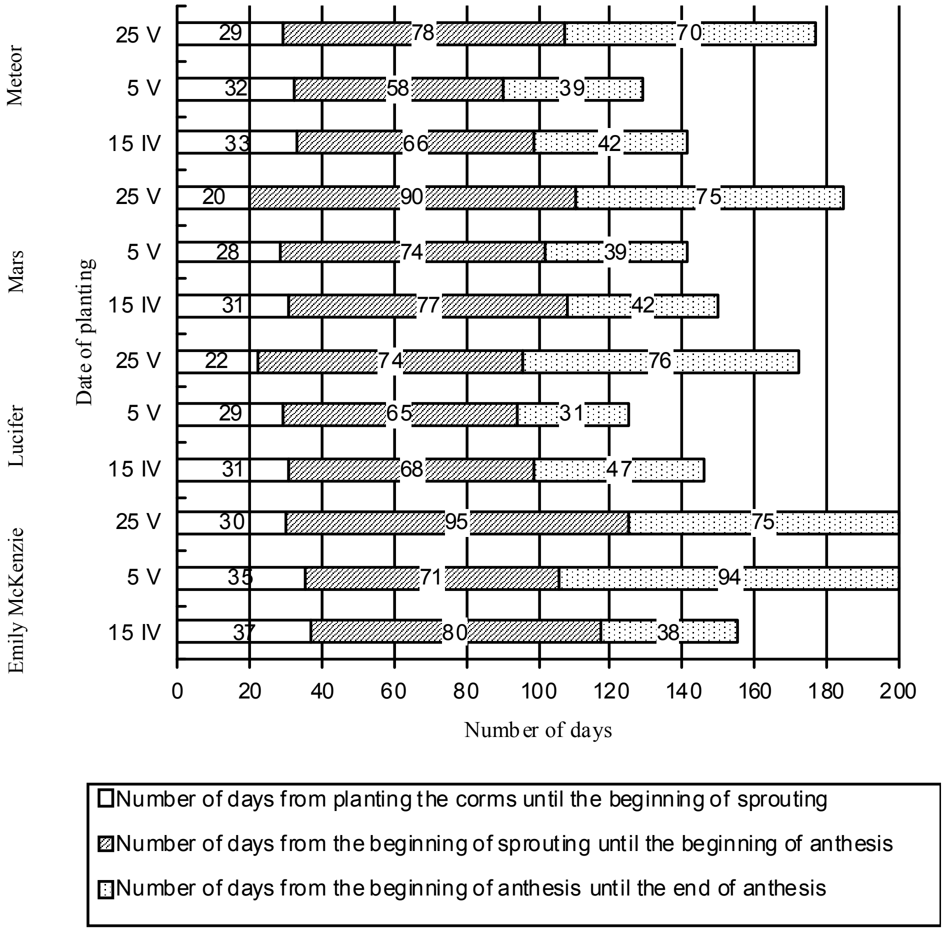

Fig. 1. Number of days from planting the corms until the end of anthesis, depending on the cultivar and planting time (mean of the years 2008–2010)

The traits of the vegetative organs were largely dependent on corm planting time (tab. 2). The plants of all cultivars were higher and had more shoots and leaves on the main shoot, when the corms were planted on 5th and 25th May than on 15th April. The highest total number of leaves per plant was found in the crocosmias grown from the corms planted on 5th May. The lowest number of leaves per plant was observed in the plants grown from the corms planted on 15th April. In our study, a greater leaf greenness index was measured in the crocosmias grown from the corms planted on 25th May, only when compared to the plants grown from the corms planted on 15th April. 'Lucifer' cultivar plants were the highest, and 'Meteor' plants were the shortest. The greatest total number of shoots and leaves per plant was noticed in 'Meteor' cultivar. The lowest number of leaves and shoots per plant were found in 'Mars' and 'Emily McKenzie' cultivars. Different patterns were observed for the number of leaves on the main shoot. 'Lucifer' plants had more leaves than all other investigated crocosmia cultivars. In the cultivation period, the plants were growing in length and developed new shoots and leaves. The greatest height, number of shoots and number of leaves on the main shoot and per plant were observed at the end of the growing season. Different pattern was demonstrated with respect to the leaf greenness index. It was higher when measured one month after the first sprouting and at full bloom than at the end of the vegetation period.

Table 2. Vegetative traits of *Crocosmia* × *crocosmiiflora* depending on cultivar and planting date (mean for the years 2008–2010)

Trait	Date of planting (P)	Date of measurement (M)			Cultivar (C)				Mean
		I*	II	III	Emily McKen-zie	Lucifer	Mars	Meteor	
Plant height (cm)	15.04	26.3	54.7	58.9	46.8	52.5	51.0	36.2	46.6
	5.05	27.7	58.5	61.3	44.7	58.6	54.3	39.0	49.2
	25.05	29.7	57.7	60.8	45.9	58.9	55.7	37.5	49.4
Mean		27.9	57.0	60.4	45.8	56.6	53.7	37.6	48.4
$LSD_{0.05}$		C – 1.75 P – 1.38 M – 1.38 C(P) – 3.03 P(C) – 2.76 C(M) – 3.03 M(C) – 2.76 M × P – n.s.*							
Number of shoots (pcs.)	15.04	2.6	3.1	3.4	2.4	3.0	2.7	4.1	3.0
	5.05	2.9	3.7	4.0	3.3	3.8	2.9	4.1	3.5
	25.05	2.8	3.3	3.9	3.2	3.4	2.7	3.9	3.3
Mean		2.8	3.4	3.7	3.0	3.4	2.8	4.0	3.3
$LSD_{0.05}$		C – 0.26 P – 0.21 M – 0.21 C × P – n.s. C(M) – 0.45 M(C) – 0.41 M × P – n.s.							
Number of leaves set on main shoot (pcs.)	15.04	3.1	6.3	7.2	4.8	6.1	5.6	5.6	5.5
	5.05	3.3	6.4	7.5	5.4	6.2	5.7	5.7	5.8
	25.05	3.5	6.3	7.2	5.6	6.7	5.2	5.2	5.7
Mean		3.3	6.3	7.3	5.3	6.3	5.5	5.5	5.7
$LSD_{0.05}$		C – 0.25 P – 0.19 M – 0.19 C × P – n.s. C(M) – 0.43 M(C) – 0.39 M × P – n.s.							
Total number of leaves per plant (pcs.)	15.04	7.6	15.5	22.0	13.0	15.0	12.9	19.2	15.0
	5.05	7.9	19.8	26.1	13.3	21.6	15.0	21.8	17.9
	25.05	7.9	17.2	24.2	14.2	19.1	13.5	18.9	16.4
Mean		7.8	17.5	24.1	13.5	18.6	13.8	20.0	16.5
$LSD_{0.05}$		C – 1.06 P – 0.84 M – 0.84 C(P) – 1.83 P(C) – 1.67 C(M) – 1.83 M(C) – 1.67 P(M) – 1.45 M(P) – 1.45							
Greenness index of leaves (SPAD)	15.04	43.6	49.1	41.2	48.2	47.0	46.1	37.2	44.6
	5.05	47.7	46.6	42.1	45.1	48.9	47.1	40.8	45.5
	25.05	48.4	48.7	43.5	49.9	50.2	44.8	42.5	46.9
Mean		46.6	48.1	42.3	47.7	48.7	46.0	40.2	45.7
$LSD_{0.05}$		C – 2.09 P – 1.64 M – 1.64 C(P) – 3.61 P(C) – 3.28 C(M) – 3.61 M(C) – 3.28 P(M) – 2.84 M(P) – 2.84							

* Explanations:
I – a month after the beginning of sprouting
II – at full bloom
III – at the end of the cultivation
n.s. – not significant difference

Table 3. Characteristics of flowering of *Crocosmia × crocosmiiflora* depending on cultivar and planting date (mean for the years 2008–2010)

Trait	Cultivar (C)	Date of planting (P)			Mean
		15.04	5.05	25.05	
Total length of main inflorescence shoot (cm)	Emily McKenzie	55.7	56.3	54,0	55.3
	Lucifer	72.8	71.1	77.0	73.6
	Mars	72.3	66.8	68.2	69.1
	Meteor	41.5	46.9	45.3	44.6
Mean		60.6	60.3	61.1	60.7
$LSD_{0.05}$		P – n.s.; r.n* C – 2.57 C(P) – 3.46 P(C) – 1.69			
Length of main inflorescence shoot (cm)	Emily McKenzie	19.5	24.1	19.5	21.0
	Lucifer	15.3	16.2	15.2	15.6
	Mars	12.4	12.8	13.1	12.7
	Meteor	17.0	15.1	14.9	15.7
Mean		16.1	17.1	15.7	16.3
$LSD_{0.05}$		P – 0.61 C – 0.93 C(P) – 1.61 P(C) – 0.61			
Length of main inflorescence spike (cm)	Emily McKenzie	21.7	24.7	20.7	22.4
	Lucifer	18.9	21.8	18.8	19.8
	Mars	11.6	10.8	9.5	10.6
	Meteor	18.9	18.1	18.1	18.4
Mean		17.8	18.9	16.8	17.8
$LSD_{0.05}$		P – 0.61 C – 0.91 C(P) – 1.58 P(C) – 0.61			
Number of inflorescence shoots (pcs.)	Emily McKenzie	1.9	1.4	1.5	1.6
	Lucifer	2.8	3.7	3.0	3.1
	Mars	2.3	1.6	2.2	2.1
	Meteor	3.2	4.5	3.8	3.8
Mean		2.6	2.8	2.6	2.7
$LSD_{0.05}$		P – n.s.; r.n C – 0.44 C(P) – 0.75 P(C) – 0.29			
Number of flowers in main inflorescence spike (pcs.)	Emily McKenzie	11.4	10.8	11.1	11.1
	Lucifer	16.4	18.0	16.7	17.0
	Mars	18.5	19.5	18.3	18.7
	Meteor	15.0	15.5	14.8	15.1
Mean		15.3	16.0	15.2	15.5
$LSD_{0.05}$		P – 0.78 C – 1.21 P × C – n.s.; r.n.			
Diameter of the first flower in the main inflorescence spike (cm)	Emily McKenzie	7.1	7.8	7.5	7.4
	Lucifer	4.7	4.6	4.4	4.6
	Mars	3.1	3.4	2.8	3.1
	Meteor	3.5	3.4	3.5	3.5
Mean		4.6	4.8	4.6	4.7
$LSD_{0.05}$		P – 0.17 C – 0.26 C(P) – 0.45 P(C) – 0.17			

* Explanations:
n.s. – non-significant difference

Table 4. Yield of corms of *Crocosmia* × *crocosmiiflora* depending on cultivar and planting date (mean for the years 2008–2010)

Trait	Cultivar (C)	Date of planting (P)			Mean
		15.04	5.05	25.05	
Coefficient of new corms number increase	Emily McKenzie	1.75	1.90	1.49	1.71
	Lucifer	4.10	3.22	3.00	3.44
	Mars	2.37	1.85	2.71	2.31
	Meteor	2.70	4.40	2.75	3.28
Mean		2.73	2.84	2.48	2.68
$LSD_{0.05}$		C – 0.394	P – 0.309	C(P) – 0.618	P(C) – 0.394
Coefficient of new corms weight increase	Emily McKenzie	2.23	2.34	2.35	2.31
	Lucifer	1.73	1.54	1.60	1.62
	Mars	1.77	1.59	1.37	1.57
	Meteor	2.00	1.97	1.17	1.71
Mean		1.93	1.86	1.62	1.80
$LSD_{0.05}$		C – 0.249	P – 0.195	C(P) – 0.390	P(C) – 0.249
Coefficient of corms weight increase total	Emily McKenzie	3.38	2.47	3.02	2.96
	Lucifer	4.61	5.30	4.36	4.76
	Mars	3.15	3.42	3.21	3.26
	Meteor	5.11	4.05	3.41	4.19
Mean		4.06	3.81	3.50	3.79
$LSD_{0.05}$		C – 0.768	P – n.s.; r.n*	C(P) – 1.204	P(C) – 0.768

* Explanations:
n.s. – non-significant difference

The study showed that the ornamental value of crocosmia plants depended on the corm planting time. This factor significantly affected the length of the main inflorescence shoot, the length of the main inflorescence spike, and the number and diameter of the first flowers in the main inflorescence spike. No substantial effects of the planting date on the total length of the main inflorescence shoot and the number of developed inflorescence shoots were found (tab. 3). Irrespective of the cultivar, longer main inflorescences spike and greater first flower diameter were found in the plants grown from the corms planted on 5th May, as compared to those planted on 15th April and 25th May. The longest inflorescences spikes were formed in the plants grown from the corms planted on 5th May, and the shortest were seen in the plants grown from the corms planted on 25th May. Similar response to the planting dates were received regarding the number of flowers in the main inflorescences spikes. Crocosmias planted on 5th May had more flowers than those planted on 25th May. The cultivars compared in the experiment differed significantly in their generative organs. The total longest main inflorescence shoots were developed in 'Lucifer' plants, and the shortest in 'Meteor' cultivar. 'Emily McKenzie' plants had the longest, and 'Mars' plants the shortest main inflorescence shoots. Crocosmias of 'Emily McKenzie' cultivar were also characterized by the longest inflorescences spikes and the largest flower diameter. The highest number of inflorescence shoots was produced by 'Meteor' cultivar, and the lowest by 'Emily McKenzie' plants. Crocosmias of 'Mars' cultivar developed the largest number of flowers per main inflorescence spike. The lowest number of flowers per plant was noticed in 'Emily McKenzie' plants.

Measurements of total length of the main inflorescence shoot, the length of main inflorescence shoot, the length of inflorescence spike, and the number of inflorescence shoots and the first flower diameter revealed different responses of the investigated crocosmia cultivars to the planting time. No such differences were demonstrated regarding the number of flowers in the main inflorescence spike.

The planting date significantly affected the yield of new corms (tab. 4). Regardless of the cultivar, the plants grown from the corms planted on 5th May produced more new corms than crocosmias developed from the corms planted on 25th May. The coefficient of new corm weight increase was greater in the plants grown from the corms planted on 15th April and 5th May, than on 25th May. However, the total coefficient of corm weight increase was unaffected by the corm planting time.

The cultivars tested differed in the corm weight and number. The highest number increase of the new corms was identified in 'Lucifer' and 'Meteor' cultivars, and the lowest in crocosmias of 'Emily McKenzie' cultivar. Another relationship was demonstrated for the coefficient of new corm weight increase. This coefficient was the highest in the plants of 'Emily McKenzie' cultivar. The total weight of crocosmia corms was higher in 'Lucifer' and 'Meteor' plants, as compared to 'Mars' and 'Emily McKenzie' cultivars.

DISCUSSION

Following the recommended planting times for individual geophyte species and their cultivars grown in specific climatic conditions, is an extremely important and topical issue in their industrial production [Marcinek and Hetman 2005, Ahmad et al. 2011, Laskowska et al. 2012, Pavani et al. 2012, Zubair et al. 2013]. In Europe, the study investigating the effects of planting time of crocosmia corms on anthesis were conducted near Athens in Greece on 'James Coey' cultivar [Armitage and Laushman 1990]. The authors found that when the corms were planted in January, the inflorescence harvesting period lasted for 30 days, and it was by 5 and 7 days shorter when the corms were planted in February and March. A reverse situation occurred in our study, when delayed time of planting the corms of 'Lucifer', 'Mars' and 'Meteor' cultivars prolonged their anthesis period. This can be explained by the fact that crocosmia is a thermophilous plant and higher summer temperatures promote its growth [Goldblatt et al. 2004]. Long flowering period may be advantageous when crocosmias are grown in gardens and green areas, but it is not desirable in the case of cut flowers. Armitage and Laushman [1990] showed that delayed planting time resulted in smaller number and lower quality of inflorescences. The corms planted in January produced 1.3 inflorescences with a length of 25.7 cm per corm, and the mean for crocosmias planted in February and March was 0.8 inflorescence with a length of 20.1 cm. In our study, the number and length of main inflorescence shoots did not depend on the planting date, but significant differences within these traits occurred among the investigated cultivars. The highest number of inflorescence shoots developed from one corm (3.8) was seen in 'Meteor' cultivar, and the longest inflorescence shoots (73.6 cm) were found in 'Lucifer' plants. Due to its long inflorescence shoots this cultivar is recommended as an outdoor crop for cut flowers. The best quality inflorescences were produced by plants grown from the corms planted on 5th May. The plants grown from the corms planted on this date were characterized by the longest main inflorescence shoots and flowers of larger diameter than the plants grown from the corms planted on 15th April and 25th May. It can be assumed that these plants experienced more favorable climatic conditions for their growth and development than those planted on the other two dates. On the first planting date, air temperature at the initial growth period was lower than recommended minimum temperature for crocosmia cultivation, i.e. 16ºC [De Hertogh 1996]. On the other hand, lower quality of inflorescences produced by plants from the latest batch may be due to too high temperatures that may cause deformation and withering of flower primordia [Goldblatt et al. 2004].

Our study showed that in the case of the latest planting date (25th May) the yield of the new corms significantly decreased. The coefficients of new corm number and weight increase were by 9.16 and 16.06% lower, as compared to the earliest planting date (15th April). Lower yield from crocosmia corms planted on 25th May was probably due to a shorter vegetation season. Similar results were obtained in other bulbous ornamental plants from the *Iridaceae* family. Marcinek and Hetman [2005], who described a field crop of *Sparaxis tricolor* Ker-Gawl near Lublin, proved that a total and commercial yield of corms were higher, respectively by 55 and 71%, in the case of the earliest planting date (20th April), when compared to the latest planting date of 20th May. Similar results were obtained by Salachna and Zawadzińska [2007], who investigated three freesia cultivars, grown in field conditions in the Western Pomerania region. The authors showed that the coefficient of number and weight of corms of the freesias planted at the latest date (22nd May) were lower by respectively 50.8–74.0% and 50.2–50.8%, depending on the year of the study, when compared to the plants planted at the earliest date (26th April).

CONCLUSIONS

1. Delaying the planting time of crocosmia corms accelerates their sprouting. The plants grown from the corms planted on 5th May were the first to bloom.

2. The plants grown from the corms planted on 5th and 25th May are higher and have more shoots and leaves on the main shoots than those planted on the earliest date. The highest total number of leaves was found in crocosmias planted on 5th May.

3. Irrespective of cultivar, the corms planted on 5th May produced plants of the highest ornamental value, that is with the longest inflorescences and flowers of the greatest number and diameter.

4. The most decorative plants of Mars and Meteor cultivars were produced when the corms were planted on 15th April, while of Emily McKenzie and Lucifer cultivars on 5th May.

5. Planting the corms on 15th April and 5th May was associated with higher daughter corm weight and number increase ratio but did not affect the total ratio of corm weight increase.

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CECHY MORFOLOGICZNE, KWITNIENIE I PLON BULW *Crocosmia* × *crocosmiiflora* (Lemoine) N.E. W ZALEŻNOŚCI OD ODMIANY I TERMINU SADZENIA

Streszczenie. Krokosmia (*Crocosmia* × *crocosmiiflora*) należy do wyjątkowo atrakcyjnych i interesujących roślin ozdobnych. W obrębie gatunku wyhodowano wiele odmian, niestety brakuje informacji dotyczących ich wymagań oraz zasad uprawy. Badania prowadzono w latach 2008–2010 w gruncie odkrytym. Materiał roślinny stanowiły bulwy następcze czterech odmian krokosmii ogrodowej: ‘Emily McKenzie’, ‘Lucifer’, ‘Mars’, ‘Meteor’. Bulwy sadzono 15 kwietnia, 5 maja i 25 maja. W trakcie uprawy ustalono liczbę dni od początku wschodów do zakończenia kwitnienia oraz wykonano pomiary cech wegetatywnych i generatywnych. Po zakończeniu uprawy oceniono plon bulw. Wykazano, że wraz z opóźnieniem terminu sadzenia bulw następowało przyspieszenie ich kiełkowania. Niezależnie od porównywanej odmiany, najwcześniej początek kwitnienia nastąpił u roślin uprawianych z bulw sadzonych 5 maja, najpóźniej zaś u tych, które uzyskano z bulw sadzonych 25 maja. Termin sadzenia bulw wpływał na cechy wegetatywne i generatywne krokosmii. Wyższe, o większej liczbie pędów i liści osadzonych na pędach głównych były rośliny uprawiane z bulw sadzonych 5 i 25 maja. Rośliny uzyskane z bulw sadzonych 5 maja charakteryzowały się najdłuższymi głównymi pędami kwiatostanowymi oraz wykształciły kwiaty o większej średnicy niż rośliny uprawiane z bulw sadzonych 15 kwietnia i 25 maja. Cechy odmianowe w dużym stopniu decydowały o cechach wegetatywnych i generatywnych roślin. Krokosmia odmiany ‘Emily McKenzie’ charakteryzowała się najdłuższymi głównymi pędami kwiatostanowymi oraz kwiatami o największej średnicy, przy czym wytworzyła najmniej pędów kwiatostanowych i miała najmniej kwiatów w głównym kwiatostanie. W przeprowadzonych badaniach wcześniejsze terminy sadzenia bulw (15 kwietnia i 5 maja) w stosunku do opóźnionego terminu sadzenia (25 maja) powodowały zwiększenie współczynnika przyrostu masy i liczby bulw następczych, nie wpływały natomiast na wielkość współczynnika przyrostu masy bulw ogółem.

Słowa kluczowe: rośliny ozdobne, montbrecja, metoda uprawy, wzrost, rozwój

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