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## CONTROLLING THE GROWTH AND FLOWERING OF SEED – PROPAGATED GERANIUM (*PELARGONIUM* × *HORTORUM* L.H. BAILEY) CULTIVATED IN TWO ORGANIC MEDIA

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### ABSTRACT

Experiments were carried out in the years 2004–2006 on seven heterosis cultivars of *Pelargonium* × *hortorum*. The aim of the research was to examine the influence of organic media, i.e. coconut fibre and peat substrate, on seed germination and growth of seedlings and also to examine the influence of flurprimidol on growth, conformation and flowering of plants. The seedlings at the stage of 2–3 leaves were transplanted to 10 cm pots in the same media – coconut substrate and peat substrate. Additional fertilization was carried out during plants cultivation. At the stage of 5–6 leaves plants were sprayed with flurprimidol at a concentration of 15 mg·dm<sup>-3</sup> (Topflor 015 SL), twice, at a two-week interval.

Seeds of *Pelargonium* × *hortorum* F1 germinated slightly earlier and the percentage of germinated seeds was greater in coconut substrate than in peat substrate. The seedlings were also larger and greener in coconut substrate compared with peat substrate. Plants cultivated in coconut substrate flowered earlier than plants grown in peat substrate. The use of flurprimidol induced earlier flowering of the plants. Cultivar Multibloom Lavender was characterized by the shortest period from seeds sowing to plant flowering.

**Key words:** organic media, germination, *Pelargonium* × *hortorum*, F1 cultivars, flurprimidol, flowering

### INTRODUCTION

Pelargoniums have been for several years in the first place at Dutch Flower Exchange in the group of pot plants. 20 million pots of pelargonium valued at over 17 million euro were sold in the year 2012 [1]. Pelargoniums propagated from seeds are seldom used in Europe in the green areas, although heterosis cultivars grow and flower better in the open ground than cultivars obtained by vegetative reproduction. They are also characterized by greater vigour and growth strength, and flower abundantly [36]. Cultivation of bedding plants is connected with the use of huge quantity of peat substrate as a basic medium in horticulture [10, 14, 16]. Coconut fibre is an alternative medium in cultivation of many species, but as regards salinity it can be used in cultivation of plants which are not too salt sensitive. Numerous authors are of the opinion that pelargonium is one of those plants [4, 15, 20].

Treatment regulating growth and conformation of plants is essential for success with cultivation of heterosis cultivars of pelargonium, and chemical preparations are the most effective [17]. Growth retarding treatment is important at the beginning of cultivation, especially because pelargoniums from seeds ramify poorly at the vegetative stage. The interest in the use of growth regulators is still considerable, although with tendencies to limit the use of chemical preparations. Topflor 015 SL containing 1.5% flurprimidol is an effective preparation in cultivation of many species. This growth regulator used even in very small doses limits growth and affects quality and time of flowering [13, 23, 24, 33, 37]. Its activity is dependent on species and cultivar but also on cultivation conditions and season [32].

The aim of the research was to examine the influence of the medium on seed germination and quality of the seedlings and also to examine the influence of flurprimidol on growth, number of days to flowering and quality of flowering of seven cultivars of *Pelargonium* × *hortorum* from four groups.

## MATERIALS AND METHODS

The experiments were carried out in the years 2004–2006 in the Agricultural University in Szczecin. Seeds of seven cultivars of *Pelargonium × hortorum* F1 from Goldsmith company: one from Multibloom group – ‘Lavender’, two from Elite group – ‘Pink’ and ‘Salmon’, three from Orbit group – ‘Coral’, ‘Appleblossom’, ‘Light Salmon’ and one from Maverick group – ‘Pink’ were the plant material. In each cultivation period (2004/2005 and 2005/2006) seeds were sown in the second decade of December to multi-cell trays in two media: coconut substrate prepared in Bloemexim company and peat substrate from Kronen company. Chemical composition of media was as follows: coconut substrate – pH 5.5; (mg·dm<sup>-3</sup>) N-NO<sub>3</sub> – 198, P – 127, K – 633, Ca – 774, Mg – 116, Cl – 311; salt concentration NaCl – 1.85 g·dm<sup>-3</sup>; peat substrate – pH 5.7; (mg·dm<sup>-3</sup>) N-NO<sub>3</sub> – 211, P – 104, K – 486, Ca – 2264, Mg – 117, Cl – 27; salt concentration NaCl – 1.60 g·dm<sup>-3</sup>.

Seeds were covered with a layer of medium of 0.5 cm thickness and irrigated with a solution of Previcur 607 SL in concentration of 0.3%. Multi-cell trays with seeds were put in a propagation greenhouse with air temperature 22–23°C. Germination was observed every day and after 10 days the percentage of germinated seeds was counted. From the third week of cultivation seedlings were additionally lightened with a light of 120 µmol·m<sup>-2</sup>·s<sup>-1</sup> capacity of quantum irradiation of and seedlings at the stage of 2–3 proper leaves were transplanted to 10cm pots in the same media, respectively.

After six weeks plants were fertilized three times with a solution of Peters Professional Foliar Feed (27+15+12) in concentration of 0.2%, and then six times with a solution of Peters Professional Plant Special (15+11+29) in concentration of 0.2%. Each plant was irrigated every week with fertilizer solution at a dose of 50 ml. Plants were cultivated in the greenhouse with air temperature 18–20°C during the first two weeks and 16–18°C during the next period of cultivation. At the stage of 5–6 leaves seedlings were measured and plant height, plant diameter, number of leaves and greenness index of leaves (Chlorophyll Meter SPAD-502, Minolta, Japan) were evaluated. At that stage a half of the plants grown in coconut substrate and in peat substrate were sprayed with flurprimidol (in the form of Topflor 015 SL) in concentration of 15 mg·dm<sup>-3</sup>. Spraying was carried out in the morning, using about 8–9 ml of the solution per plant. Spraying was repeated after two weeks.

Experiments with pelargoniums grown in coconut substrate and in peat substrate were carried out in total randomization (cultivar x growth regulator), in three replicates, each containing 5 plants.

Total development of the first flower in the inflorescence was approved as a beginning of flowering [2]. Time of flowering was noted consecutively and the length of cultivation (from the day of seed sowing to the day of plant flowering) was counted. Height and diameter of plants, number of leaves and their greenness index were measured. After total development of inflorescences the length of peduncle, number of flowers in inflorescence, diameter of flowers and inflorescences were also measured.

Results regarding seed germination are shown in the figures. Data regarding morphological traits were verified by means of the analysis of variance for two-factorial experiments using the ANALWAR 4.3. software and Tukey’s test at significance level  $\alpha=0.05$ . A synthesis of the results was made with regard to morphological traits.

## RESULTS AND DISCUSSION

Seed germination started 2 days after sowing (Fig. 1). The percentage of germinated seeds of all evaluated cultivars was by 3–10% greater in coconut substrate than in peat substrate. Finally, after 10 days the percentage of germinated seeds of six cultivars in coconut substrate came to 100%. The percentage in peat substrate came to 86–100%.

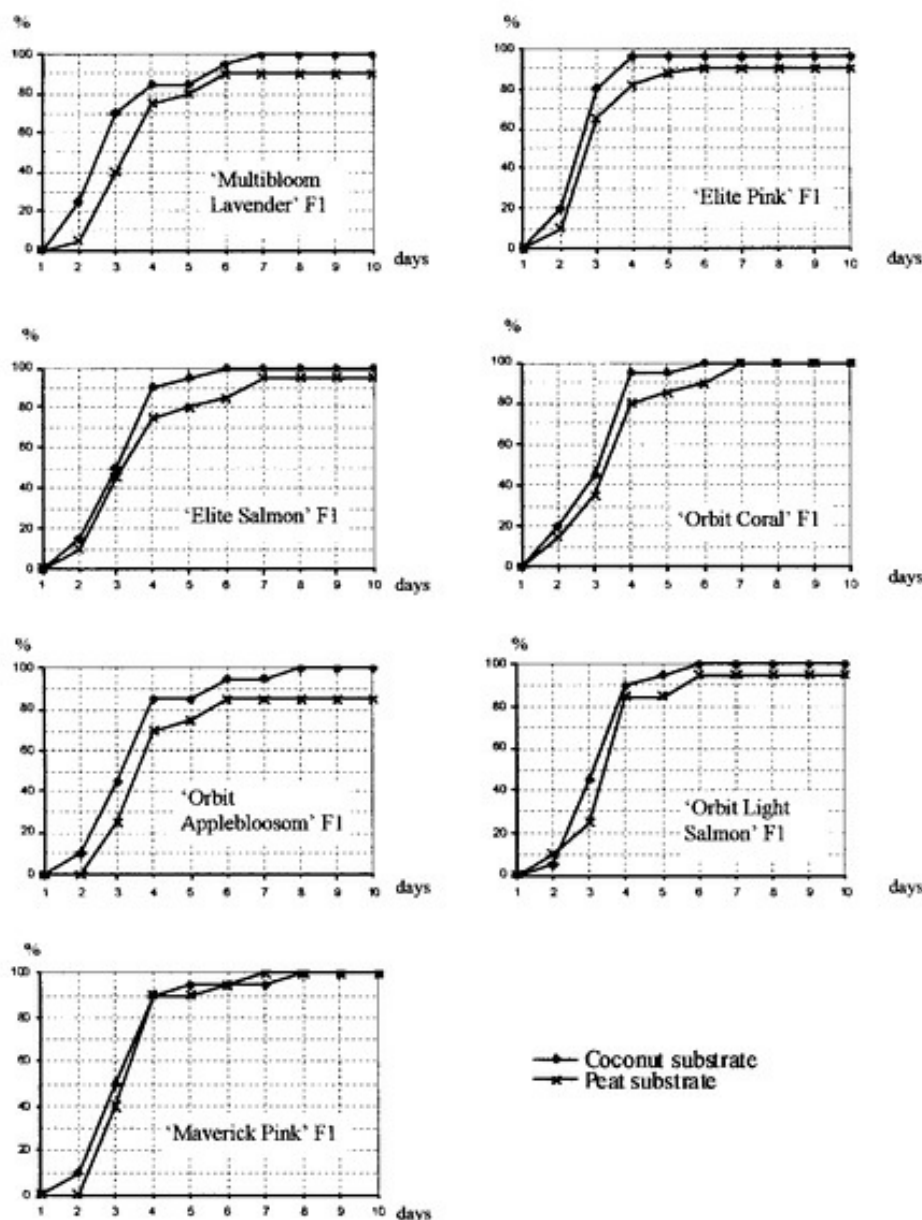


Fig. 1. Dynamics of seeds germination of *Pelargonium* × *hortorum* F1 cultivars grown in two organic media. Means of the years 2005–2006

Results of the experiments conducted with ornamental plants show that coconut fibre is useful in ornamental plants cultivation as a separate medium or as a component of the mixture [3, 21, 28, 30]. In own experiments with pelargonium propagated from seeds slightly earlier germination and growth of the seedlings were observed. Plants were higher, of greater diameter and were characterized by greater number of leaves of higher greenness index than in peat substrate (Tab. 1). According to the literature, coconut fibre favourably affects growth of plants and their roots. Janicka [11] obtained positive results with garden pansy. Its seeds were sown in coconut substrate and seedlings were characterized by stronger roots. Plants were stocky, compact and their leaves were larger. Coconut fibre was also useful in rooting pelargonium seedlings [35]. Evans and Stamps [9] are of the opinion that marigold and petunia grown in coconut fibre are characterized by greater fresh mass of roots than in peat substrate. Favourable influence of coconut fibre can be explained by the occurrence of lignin. During lignin degradation process phenolic acids are released and they are important reactants in humus compounds formation. Humus compounds affect easy assimilation of insoluble chemical compounds by the plants and their faster growth [29]. Coconut fibre can be recommended for cultivation of seedlings of many species of ornamental plants, i.e. ageratum (*Ageratum houstonianum*), marigold (*Tagetes* sp.) [18], garden pansy (*Viola* × *wittrockiana* Gams.) [27], impatiens (*Impatiens walleriana*) and fuchsia (*Fuchsia hybrida*) [25].

Table 1. Effect of organic media on selected morphological traits and greenness index of leaves of *Pelargonium* × *hortorum* F1 before spraying with flurprimidol (stage of 5–6 leaves). Means of the years 2005–2006

Trait	Cultivar (A)	Medium (B)		Mean
		Coconut substrate	Peat substrate	
Height	'Multibloom Lavender'	7.70	6.80	7.25
	'Elite Pink'	6.40	6.50	6.45
	'Elite Salmon'	5.50	5.80	5.65
	'Orbit Coral'	6.00	5.40	5.70

of plant [cm]	‘Orbit Appleblossom’	6.80	6.20	6.50
	‘Orbit Light Salmon’	7.20	6.10	6.65
	‘Maverick Pink’	6.60	6.50	6.55
	Mean	6.60	6.18	6.39
	LSD0.05	A – 0.804 B – 0.301	A(B) – 1.06	B(A) – 0.56
Diameter of plant [cm]	‘Multibloom Lavender’	14.6	13.1	13.8
	‘Elite Pink’	12.3	12.7	12.5
	‘Elite Salmon’	10.2	10.4	10.3
	‘Orbit Coral’	11.1	10.7	10.9
	‘Orbit Appleblossom’	11.9	11.1	11.6
	‘Orbit Light Salmon’	12.7	11.2	12.0
	‘Maverick Pink’	12.8	12.2	12.5
	Mean	12.2	11.6	11.9
	LSD0.05	A – 1.55 B – 0.45	A×B – n.s.	
Number of leaves	‘Multibloom Lavender’	6.15	5.25	5.70
	‘Elite Pink’	5.75	5.45	5.60
	‘Elite Salmon’	5.65	5.75	5.70
	‘Orbit Coral’	6.45	5.75	6.10
	‘Orbit Appleblossom’	6.15	5.65	5.90
	‘Orbit Light Salmon’	6.35	5.85	6.10
	‘Maverick Pink’	5.65	5.65	5.65
	Mean	6.02	5.62	5.82
	LSD0.05	A – 0.45 B – 0.18	A(B) – 0.64	B(A) – 0.44
Greenness index of leaves [SPAD]	‘Multibloom Lavender’	30.3	29.4	29.9
	‘Elite Pink’	34.2	33.7	34.0
	‘Elite Salmon’	34.7	31.1	32.9
	‘Orbit Coral’	41.7	39.8	40.8
	‘Orbit Appleblossom’	35.9	35.3	35.6
	‘Orbit Light Salmon’	33.0	31.9	32.5
	‘Maverick Pink’	36.5	35.9	36.2
	Mean	35.2	33.9	34.6
	LSD0.05	A – 2.32 B – 0.84	A×B – n.s.	
n.s. – differences not significant				

Seedlings of pelargonium differed in height (Tab. 1) which was affected by medium. Pelargoniums 'Multibloom Lavender' grown in both evaluated media were the highest and the widest. Those plants and cultivars from Orbit group were higher and had more leaves in coconut substrate in comparison with peat substrate. Greenness index of leaves of evaluated cultivars was slightly higher when they were cultivated in coconut substrate. Cultivar 'Orbit Coral' was characterized by the highest greenness index of leaves. Cultivar 'Multibloom Lavender' had light green leaves of the lowest greenness index in comparison with other cultivars.

At the generative stage (Tab. 2) when plants were grown in coconut substrate cultivar 'Elite Pink' was characterized by the most impressive conformation. Pelargoniums 'Elite Pink' were the lowest and of small diameter. Conformation of plants cultivated in peat substrate was more regular. Cultivar 'Elite Pink' grown in both media was characterized by greatest number of leaves and highest greenness index of leaves. Cultivar 'Multibloom Lavender' was characterized by smallest number of leaves and low greenness index.

**Table 2.** Effect of spraying with flurprimidol on selected morphological traits and greenness index of leaves of *Pelargonium × hortorum* cultivated in organic media (flowering stage). Means of the years 2005–2006

Trait	Cultivar(A)	Coconut substrate			Peat substrate		
		Retardant (B)		Mean	Retardant (B)		Mean
		Control	Flurprimidol		Control	Flurprimidol	
Height of plant [cm]	'Multibloom Lavender'	40.0	28.0	34.0	35.9	28.4	32.2
	'Elite Pink'	32.0	23.2	27.6	31.0	22.8	26.9
	'Elite Salmon'	43.6	33.6	38.6	41.1	26.9	34.0
	'Orbit Coral'	48.3	35.7	42.0	45.1	36.9	41.0
	'Orbit Appleblossom'	47.7	36.8	43.3	43.8	34.3	39.1
	'Orbit Light Salmon'	46.0	32.6	39.3	46.2	38.1	42.2
	'Maverick Pink'	50.4	41.6	46.0	47.7	33.7	40.7
	Mean	44.0	33.1	38.7	41.5	31.6	36.6
	LSD0,05	A – 5.78 B – 1.96			A – 7.20 B – 2.45		

		A×B – n.s.			A×B – n.s.		
Diameter of plant [cm]	‘Multibloom Lavender’	26.7	20.6	23.7	26.3	22.1	22.7
	‘Elite Pink’	22.3	18.7	20.5	22.7	19.6	21.1
	‘Elite Salmon’	27.3	21.4	24.4	24.7	19.2	21.9
	‘Orbit Coral’	24.7	18.2	21.5	22.1	19.2	20.6
	‘Orbit Appleblossom’	26.9	23.3	25.1	23.9	20.9	22.4
	‘Orbit Light Salmon’	26.4	19.8	23.1	21.7	18.1	19.9
	‘Maverick Pink’	30.0	29.1	29.6	29.6	21.5	25.4
	Mean	26.3	21.6	24.0	24.4	20.1	22.3
	LSD0,05	A – 4.88 B – 1.72 A×B – n.s.			A – n.s. B – 2.12 A×B – n.s.		
Number of leaves	‘Multibloom Lavender’	42.7	40.2	41.5	49.0	43.3	46.2
	‘Elite Pink’	73.0	78.0	75.5	60.2	64.6	62.4
	‘Elite Salmon’	69.7	65.2	67.5	43.3	52.3	47.8
	‘Orbit Coral’	41.3	38.5	39.9	35.3	37.3	36.3
	‘Orbit Appleblossom’	54.7	55.3	55.0	42.3	52.3	47.3
	‘Orbit Light Salmon’	62.0	59.3	60.7	58.9	49.5	54.2
	‘Maverick Pink’	46.3	44.3	45.3	40.3	38.0	39.2
	Mean	55.7	54.4	55.1	47.0	48.2	47.6
	LSD0,05	A – 12.38 B – n.s. A×B – n.s.			A – 12.06 B – n.s. A×B – n.s.		
Greenness index of leaves [SPAD]	‘Multibloom Lavender’	40.6	45.5	43.1	34.9	43.2	39.1
	‘Elite Pink’	52.4	61.0	56.7	49.8	53.4	51.6
	‘Elite Salmon’	48.1	52.4	50.3	42.2	48.2	45.2
	‘Orbit Coral’	48.3	49.4	48.9	47.5	48.6	48.1
	‘Orbit Appleblossom’	46.0	50.6	48.3	42.9	42.2	42.6
	‘Orbit Light Salmon’	47.1	51.0	49.1	44.2	49.2	46.7
	‘Maverick Pink’	48.8	50.5	49.7	40.2	48.2	44.2
	Mean	47.3	51.5	49.4	43.1	47.6	45.4
	LSD0,05	A – 4.74 B – 1.52 A×B – n.s.			A – 3.96 B – 1.42 A(B) – 5.44 B(A) – 3.67		
n.s. – differences not significant							

Plants cultivated in coconut substrate (Fig. 2) flowered earlier than in peat substrate (Fig. 3). Flurprimidol significantly affected plants flowering. The number of days from seeds sowing to flowering of pelargoniums ‘Multibloom Lavender’ was smallest – on the average 129 days when plants were cultivated in coconut substrate (Fig. 2) and were sprayed with flurprimidol. Pelargoniums ‘Multibloom Lavender’ grown in peat substrate and sprayed with flurprimidol also flowered at the earliest date (Fig. 3) among the cultivars, but on the average by 5 days later than in coconut substrate. Cultivar ‘Orbit Coral’ flowered at the latest date in both media. The use of growth regulator affected reduction of the time from seeds sowing to plant flowering of the ‘Orbit Coral’ cultivar grown in coconut substrate. Earlier flowering could have been affected by application of the growth retardant at early developmental stage, i.e. at the stage of 5–6 leaves. Flurprimidol sometimes causes retardation of flowering and that effect was observed in experiments with garden pansy (*Viola × wittrockiana*) [23, 22], impatiens (*Impatiens walleriana*) [34], begonia (*Begonia semperflorens*) [23], or does not affect the time of flowering as it was found in the experiment with marguerite daisy [7] and osteospermum (*Osteospermum ecklonis*) [19].

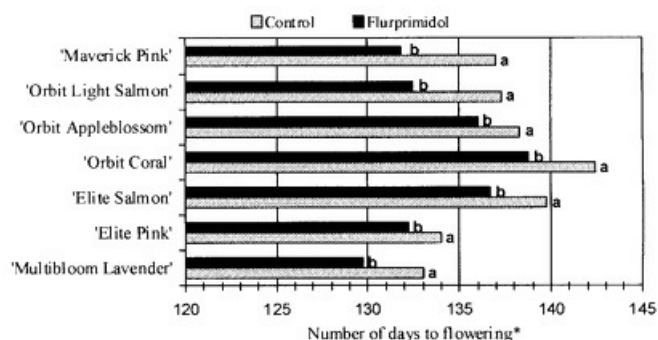


Fig. 2. Effect of flurprimidol on number of days to flowering of *Pelargonium × hortorum* F<sub>1</sub> cultivars grown in coconut substrate

\*a,b– means marked with the same letter do not differ significantly;

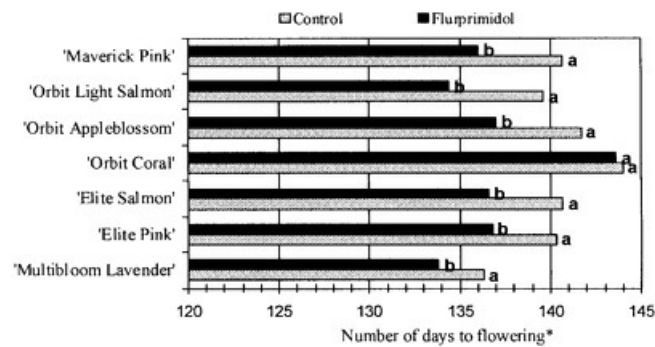


Fig. 3. Effect of flurprimidol on number of days to flowering of *Pelargonium* × *hortorum* F<sub>1</sub> cultivars grown in peat substrate

\*a,b – means marked with the same letter do not differ significantly;

*Pelargoniums* grown in coconut substrate and treated with flurprimidol were characterized by greater number of developed inflorescences than plants cultivated without growth retardant (Tab. 3). However, their inflorescences were characterized by smaller diameters and shorter peduncles. A similar effect, i.e. a decrease of flower size caused by flurprimidol was observed in the experiments with *impatiens* from Riviera group [8], New Guinea *Impatiens* 'Pure Beauty Fuchsia' [34] *begonia* (*Begonia semperflorens*) and *petunia* (*Petunia* × *atkinsiana*) [23]. In cultivation of *pelargonium* in peat substrate flurprimidol caused an increase in the number of inflorescences but did not affect their diameters and diameters of flowers, but it affected the reduction of the length of peduncles (Tab. 3).

Table 3. Flowering of *Pelargonium* × *hortorum* F<sub>1</sub> cultivars sprayed with flurprimidol, cultivated in two organic media. Means of the years 2005–2006

Trait	Cultivar (A)	Coconut substrate			Peat substrate		
		Retardant (B)		Mean	Retardant (B)		Mean
		Control	Flurprimidol		Control	Flurprimidol	
Number of inflorescences per plant	'Multibloom Lavender'	6.8	9.0	7.9	4.4	7.8	6.1
	'Elite Pink'	3.1	6.1	4.6	1.8	2.2	2.0
	'Elite Salmon'	5.1	4.2	4.7	2.8	4.4	3.6
	'Orbit Coral'	4.2	4.1	4.2	3.1	4.1	3.6
	'Orbit Appleblossom'	4.4	5.1	4.8	4.0	4.5	4.3
	'Orbit Light Salmon'	4.3	5.4	4.9	4.1	4.2	4.2
	'Maverick Pink'	4.4	5.8	5.1	2.8	4.4	3.6
	Mean	4.6	5.7	5.2	3.3	4.5	3.9
	LSD 0,05	A – 2.01 B – 0.713 A×B – n.s.			A – 1.52 B – 0.48 A×B – n.s.		
Diameter of inflorescence [cm]	'Multibloom Lavender'	13.5	11.9	12.7	12.9	11.7	12.3
	'Elite Pink'	11.4	10.7	11.1	11.4	10.7	11.1
	'Elite Salmon'	12.7	11.6	12.2	11.9	11.4	11.7
	'Orbit Coral'	11.8	11.3	11.6	10.9	11.2	11.1
	'Orbit Appleblossom'	12.1	11.8	12.0	11.7	11.4	11.6
	'Orbit Light Salmon'	11.9	11.3	11.6	10.7	10.6	10.7
	'Maverick Pink'	12.7	12.2	12.5	11.9	12.0	12.0
	Mean	12.3	11.5	11.9	11.6	11.3	11.5
	LSD 0,05	A – 1.10 B – 0.36 A×B – n.s.			A – 1.11 B – n.s. A×B – n.s.		
Length of peduncle [cm]	'Multibloom Lavender'	16.2	11.1	13.7	14.1	9.90	12.0
	'Elite Pink'	13.4	9.50	11.5	8.25	6.00	7.13
	'Elite Salmon'	15.7	12.9	14.3	14.6	11.4	13.0
	'Orbit Coral'	17.8	14.4	16.1	19.8	16.4	18.1
	'Orbit Appleblossom'	22.0	18.6	20.3	18.3	15.1	16.7
	'Orbit Light Salmon'	16.3	13.2	14.8	17.5	15.2	16.4
	'Maverick Pink'	19.8	16.9	18.4	19.8	14.6	17.2
	Mean	17.3	13.8	15.6	16.1	12.7	14.4
	LSD 0,05	A – 4.18 B – 1.34 A×B – n.s.			A – 2.91 B – 1.00 A×B – n.s.		

Diameter of flowers [cm]	‘Multibloom Lavender’	4.5	4.1	4.3	4.5	4.3	4.4
	‘Elite Pink’	4.0	3.8	3.9	4.4	4.4	4.4
	‘Elite Salmon’	4.2	4.4	4.3	4.9	5.2	5.1
	‘Orbit Coral’	4.3	4.1	4.2	4.6	4.3	4.5
	‘Orbit Appleblossom’	4.1	3.9	4.0	4.2	3.9	4.1
	‘Orbit Light Salmon’	4.2	4.1	4.2	4.4	4.1	4.3
	‘Maverick Pink’	4.3	4.3	4.3	4.5	4.6	4.6
	Mean	4.2	4.1	4.2	4.5	4.4	4.5
	LSD 0,05	A – 0.218 B – 0.075 A(B) – 0.309 B(A) – 0.199			A – 0.305 B – n.s. A×B – n.s.		
Number of flowers in inflorescences	‘Multibloom Lavender’	62.0	55.3	58.7	55.0	78.7	66.9
	‘Elite Pink’	103	109	106	83.0	64.7	73.9
	‘Elite Salmon’	83.3	104	93.7	89.7	67.3	78.5
	‘Orbit Coral’	64.0	59.7	61.9	66.7	50.0	58.4
	‘Orbit Appleblossom’	78.0	86.3	82.2	80.3	65.3	72.8
	‘Orbit Light Salmon’	100	97.0	98.5	105.3	86.0	95.7
	‘Maverick Pink’	80.0	71.0	75.5	46.3	63.3	54.8
	Mean	81.5	83.2	82.4	75.2	67.9	71.6
	LSD 0,05	A – 24.1 B – n.s. A×B – n.s.			A – 28.7 B – n.s. A×B – n.s.		
n.s. – differences not significant							

Cultivar 'Multibloom Lavender' was characterized by the most abundant flowering among all evaluated cultivars. In coconut substrate plants of that cultivar had on the average two inflorescences more in comparison with plants cultivated in peat substrate. In both media that cultivar was characterized by the greatest inflorescences. Inflorescences of pelargoniums from Orbit group: 'Light Salmon' and 'Appleblossom' and from Elite group were very well formed and filled abundantly with flowers.

Although shorter than other evaluated cultivars time of cultivation 'Multibloom Lavender' belongs to the less popular group of cultivars than for example cultivars with dark ring on leaves. It is characterized by light green leaves and light violet flowers. Flurprimidol affects the increase of greenness index of leaves to a certain degree [12, 37, 38].

The effect of the use of growth regulator is dependent on its dose and frequency of its application. In order to better control of plants growth the use of smaller doses more often is more reasonable than the use of greater doses once [5]. On the basis of results of earlier research [37] in conducted experiment flurprimidol in a concentration of 15 mg·dm<sup>-3</sup>, twice was used. In conditions of West Pomerania pelargoniums reproduced vegetatively require lower concentrations of growth retardants than those propagated from seeds. Pelargonium 'Omega' sprayed with flurprimidol in concentration of 7.5 mg·dm<sup>-3</sup> was stocky, proportional and flowered abundantly however, when concentration of 15 mg·dm<sup>-3</sup> was used the growth of plants was excessively inhibited [38]. In American experiments [31] pelargoniums (*Pelargonium × hortorum*) 'Noblesse' and 'Samba' were treated with flurprimidol in concentrations of 15, 20 and 30 mg·dm<sup>-3</sup>. Plants 'Noblesse' were proportional and compact when concentrations of 15 and 20 mg·dm<sup>-3</sup> were used and plants 'Samba' were stocky when concentrations of 20 and 30 mg·dm<sup>-3</sup> were used. It is difficult to compare results of those experiments with results of Polish research because the effect of growth regulators is also dependent on season and climate.

In the own experiments plants cultivated in coconut substrate flowered earlier and gave more inflorescences than pelargoniums cultivated in peat substrate. Inflorescences of plants cultivated in coconut substrate were characterized by greater diameter and greater number of flowers than inflorescences of plants grown in peat substrate. Similar results, i.e. earlier flowering during cultivation in coconut fibre were obtained in experiments conducted by Treder and Nowak [30] with pelargonium and by Evans and Stamp [9] with marigold.

## CONCLUSIONS

1. Seeds of heterosis cultivars of *Pelargonium × hortorum* sown in coconut substrate germinated earlier than in peat substrate and the percentage of germinated seeds in coconut substrate was greater than in peat substrate.
2. Seedlings of pelargonium cultivated in coconut substrate developed earlier, were larger and had more leaves of higher greenness index than plants cultivated in peat substrate.
3. Double spraying plants with flurprimidol in concentration of 15 mg·dm<sup>-3</sup> caused earlier flowering of all evaluated cultivars.
4. Pelargoniums cultivated in coconut substrate grew and flowered earlier than plants grown in peat substrate.
5. Flurprimidol induced a decrease in diameter of flowers and inflorescences of plants grown in coconut substrate. Its use caused limitation of peduncle length but also an increase in the number of inflorescences of plants grown in both examined media.

6. Cultivar 'Multibloom Lavender' was characterized by the earliest date of flowering and cultivar 'Orbit Coral' flowered at the latest date, regardless of growth regulator and medium

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