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USE OF MEDIA SUPPLEMENTED WITH COMPOST CONTAINING POTATO PULP IN CULTIVATION OF EGYPTIAN STAR CLUSTER (*Pentas lanceolata* (Forssk.) Deflers)

ZASTOSOWANIE PODŁOŻY WZBOGACONYCH W KOMPOST ZAWIERAJĄCY WYCIERKĘ ZIEMNIACZANĄ W UPRAWIE PIĄTAKA LANCETOWATEGO (*Pentas lanceolata* (Forssk.) Deflers)

Abstract: Two experiments were carried out in the years 2005–2006 to examine if media supplemented with 20, 40 or 60 % compost containing 70 % potato pulp and 30 % rye straw can be used in cultivation of three cultivars of *Pentas lanceolata*. In the first experiment compost after 7 months of composting process was used and in the second experiment compost after 19 months of composting process was used.

It was found that mixtures of 20 % compost and 80 % sphagnum peat can be recommended for Egyptian star cluster cultivation. Plants cultivated in such media were healthy, well-formed and blossomed abundantly. Media containing 40 and 60 % compost were characterized by too high macroelements content and by too salinity. Plants cultivated in such media were small and blossomed poorly.

Keywords: *Pentas lanceolata*, compost, potato pulp, cultivation

Resources of sphagnum peat are getting smaller and new media or media components are sought-after to replace sphagnum peat in horticultural production. Waste material from food industry: cocoa hulls, rice chaff and potato pulp; wood industry: pine bark and sawdust; and municipal waste: sewage sludge are used first of all [1–6].

Potato pulp contains macroelements (nitrogen, phosphorus, potassium) and that is why it can be used as an organic fertilizer or a component of composts supplemented with sewage sludge [7, 8]. Potato pulp is often composted with some structure-forming material such sawdust or straw to improve its physical properties [7–9].

Egyptian star cluster is a half-shrub, cultivated as a pot plant, which belongs to the family *Rubiaceae*. Dark-green leaves and star-shaped flowers are decorative

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elements of that species. Its cultivars are characterized by white, purple-red or pink flowers [10].

The aim of conducted experiments was to examine the possibilities of the use of compost containing potato pulp and straw in *Pentas lanceolata* cultivation.

Material and methods

Two pot experiments were carried out in the years 2005–2006. The experimental factors were: medium and cultivar.

Production of compost used in the experiments started in September 2004. Compost contained 70 % potato pulp and 30 % rye straw cut into pieces of 5–6 cm length. Compost components were well mixed and put into a plastic container in a storage room.

The following assessments of potato pulp, rye straw and compost after 7 months of composting process were made: dry matter content, pH (in H_2O), total content of N, P, K, Ca and Mg as well as organic C content with methods usual used in agricultural chemistry [11]. Dry matter content was estimated by the method of drying to the stable weight (105 ^oC), pH (in H_2O) by the potentiometric method, total N by Kjeldahl method, total P by the colorimetric method, total K and Ca by the flame photometry method, Mg by the atomic spectrometry absorption method and organic C by Tiurin method.

In the first experiment compost after 7 months of composting process was used and in the second experiment compost after 19 months of composting process was used as a component of media for *Pentas lanceolata* grow. The following assessments of media used in the experiments were made: pH (in H_2O), salinity, NO_3-N, available forms of P, K, Ca and Mg. Content of NO_3-N was assessed by the ionometric method, P – by the colorimetric method, K and Ca – by the flame photometry method, Mg – by the method of atomic spectrometry absorption. In both years of studies chemical analyses of media were carried out in the first decade of July, before seedlings planting.

In both years of experiments three cultivars of *Pentas lanceolata*: 'Graffiti Pink F_1', 'Graffiti Violet F_1' and 'Graffiti White F_1' were the test plants. Seeds of *Pentas lanceolata* were sown in the first decade of May. Two months later seedlings were planted to 12-cm pots (V = 1.0 dm^3). Four medium variants were used: 1 – sphagnum peat adjusted to pH 6.9 (in the first year of studies) and to pH 6.6 (in the second year of studies), supplemented with 5 g · dm^{-3} of slow-release fertilizer Osmocote Exact 3-4 Standard (16 + 11 + 11 + microelements); 2–4 – mixtures of compost and sphagnum peat: 2–20 % compost + 80 % sphagnum peat, 3–40 % compost + 60 % sphagnum peat, 4–60 % compost + 40 % sphagnum peat. Compost and sphagnum peat were mixed in a volumetric relation. No fertilizer was added to the mixtures of compost and peat before seedlings planting.

Plants were cultivated in a greenhouse. In the second decade of July and in the second decade of August all experimental plants were fertilized with a water solution of Peters Professional (15 + 11 + 29) in concentration of 0.2 % and in a dose of 100 cm^3 per plant. In the second half of September (in full flowering) the measurements of plants

height, diameter and number of inflorescences were conducted. Greenness index of leaves was also measured by the means of Chlorophyll Meter SPAD-502.

The method of complete randomization in five repetitions was used. Twelve plants were in each experimental object. The results of the experiments were worked out using the analysis of variance for two-factorial experiments. The differences between means were verified by Tukey's test at the significance level of $\alpha = 0.05$.

Results and discussion

Selected properties of compost components and of prepared compost after 7 months of composting process are given in Table 1.

Table 1

Selected properties of components used for compost production and of prepared compost after 7 months of composting process

Component	Dry matter [%]	pH in H_2O	Total content					Organic C
			N	P	K	Ca	Mg	
			[g · kg^{-1} d.m.]					
Potato pulp	13.51	4.5	6.60	2.96	11.50	6.32	1.04	102
Straw	86.05	—	4.65	3.85	7.41	0.90	0.21	254
Compost	21.80	5.6	6.56	2.50	11.40	1.96	0.89	250

It was found that potato pulp contained more N, K, Ca and Mg than straw. However, straw was characterized by higher total content of P and organic C and over 6.5 times higher content of dry matter than potato pulp. After 7 months of composting process compost containing 70 % potato pulp and 30 % rye straw contained 21.80 % dry matter and was characterized by pH 5.6. Compost contained 6.56 g total N, 2.50 g total P and 11.40 g total K per 1 kg^{-1} d.m. (Table 1).

Selected properties of all media used in both years of studies are given in Table 2.

Evaluated mixtures of compost and sphagnum peat were characterized by higher pH in the first year of the experiments than in the second (Table 2). In both years an increase of compost content in media caused a decrease of media pH value and an increase of its salinity. Salt concentration of media supplemented with compost was higher in the first year of studies than in the second. Macroelements content (nitrate nitrogen, phosphorus, potassium) was higher in the first year of experiments than in the second.

In both years of experiments significant influence of medium on total height and diameter of plants was shown (Table 3).

In the first year control plants were the highest (18.8 cm), even too high for horticultural production and of the greatest diameter (24.3 cm) (Table 3). Plants cultivated in mixtures containing 20 and 40 % compost were more compact and

Table 2

Selected properties of media used in the experiments before seedlings planting

Medium	pH in H_2O	Salinity [g NaCl · dm^{-3}]	NO_3-N	P	K	Ca	Mg
			[mg · dm^{-3}]				
2005							
1	6.9	0.39	52	22	49	2353	318
2	6.3	3.61	237	189	255	2312	320
3	5.9	5.26	566	305	355	2299	326
4	5.1	5.28	678	325	607	2237	351
2006							
1	6.6	1.31	25	53	60	2683	338
2	5.4	2.95	158	150	210	2361	401
3	5.3	3.68	233	210	256	2410	332
4	4.5	4.12	432	199	353	2119	315

Explanations: 1 – sphagnum peat; 2 – 20 % compost + 80 % sphagnum peat; 3 – 40 % compost + 60 % sphagnum peat; 4 – 60 % compost + 40 % sphagnum peat.

Table 3

Effects of media containing compost on height and diameter of three cultivars of *Pentas lanceolata*

Medium (A)	2005				2006			
	Cultivar (B)			Mean (A)	Cultivar (B)			Mean (A)
	Graffiti Pink	Graffiti Violet	Graffiti White		Graffiti Pink	Graffiti Violet	Graffiti White	
Height [cm]								
1	18.0	18.9	19.5	18.8	21.4	20.8	20.4	20.9
2	14.0	16.0	17.4	15.8	20.9	20.7	20.5	20.7
3	15.2	16.0	17.2	16.1	20.0	20.0	19.8	19.9
4	12.1	14.0	13.0	13.0	19.4	17.9	19.2	18.8
Mean (B)	14.8	16.2	16.8		20.4	19.9	20.0	
$LSD_{0.05}$	A – 0.93; B – 0.73; A(B) – 1.60; B(A) – 1.46				A – 1.37; B – n.s.; A · B – n.s.			
Plant diameter [cm]								
1	24.6	25.6	22.8	24.3	24.4	25.2	23.4	24.3
2	18.7	15.1	16.0	16.6	23.6	23.4	23.0	23.3
3	18.0	15.0	15.7	16.2	23.0	22.8	21.2	22.3
4	15.6	11.6	14.0	13.7	19.2	19.0	16.6	18.3
Mean (B)	19.2	16.8	17.1		22.6	22.6	21.1	
$LSD_{0.05}$	A – 1.66; B – 1.30; A(B) – 2.87; B(A) – 2.61				A – 1.44; B – 1.13; A · B – n.s.			

Explanations: 1 – sphagnum peat supplemented with 5 g · dm^{-3} Osmocote Exact 3-4 Standard; 2 – 20 % compost + 80 % sphagnum peat; 3 – 40 % compost + 60 % sphagnum peat; 4 – 60 % compost + 40 % sphagnum peat; n.s. – not significant difference.

proportional than control plants. They were on the average by 18 % lower and were characterized by 48 % smaller diameter than control plants. Whereas, plants cultivated in medium containing 60 % compost were the smallest. They were only of 13.0 cm height and of 13.7 cm diameter.

In the second year of experiments, similarly to the first year, control plants were too high (20.9 cm) and of the greatest diameter (24.3 cm) however, plants cultivated in medium supplemented with 60 % compost were too small. It was probably caused by high salt concentration in media supplemented with compost. Plants growth inhibition caused by media salinity was also often observed on many species [12]. Jaleel et al [13] observed it on *Catharanthus roseus* and Turhan et al [14] on *Helianthus annuus*. Lee and van Iersel [15] are of the opinion that salinity has a potential to act as a growth regulator in chrysanthemum cultivation because of its ability to reduce plant height with only a small reduction in shoot dry weight.

Results of these experiments are conformable with results of Placek et al [16] that garden pansies cultivated in media supplemented with composts (also containing potato pulp and straw) are characterized by smaller diameter, but their growth and conformation are proper. In both years of these experiments plants cultivated in mixtures of 20 % compost and 80 % sphagnum peat were lower and of smaller diameter than control plants, but they were characterized by higher decorative value. They were compact, well-formed and of proportional conformation. No overcolouring or deformation of leaves were found.

In the first year of studies among three examined cultivars of *Pentas lanceolata* 'Graffiti Violet F_1' and 'Graffiti White F_1' were by 12 % higher and by 13 % less branchy than 'Graffiti Pink F_1'. In the second year of experiments evaluated cultivars did not differ in total height of plants. Plants 'Graffiti Pink F_1' and 'Graffiti Violet F_1' were characterized by 7 % greater diameter than plants 'Graffiti White F_1'.

In the first year of studies significant influence of medium on the greenness index of leaves was shown (Table 4). Leaves of plants cultivated in media containing compost, especially in quantity of 20 %, were darker than leaves of control plants. They were characterized by the highest greenness index of leaves (51.5). Greenness index of leaves of control plants was the lowest and amounted to 49.0. No significant influence of medium on greenness index of leaves in the second year of studies was found.

Among examined cultivars of *Pentas lanceolata* 'Graffiti Pink F_1' was characterized by the highest greenness index of leaves in both years of experiments (53.8 and 52.2, respectively).

According to Martin et al [17], who examined some species of ornamental shrubs, greenness index of leaves indicates nitrogen content in leaves. In these experiments media supplemented with compost were characterized by high content of nitrogen and probably that was why plants cultivated in these media were characterized by high greenness index of leaves.

In both years of studies number of inflorescences depended significantly on medium (Table 4). In the first year of experiments control plants were characterized by the greatest number of inflorescences (8.8). Plants cultivated in medium containing 20 % compost had by 26 % less inflorescences than control plants. Plants cultivated in media

supplemented with 40 or 60 % compost had over twice less inflorescences than plants in the control object. In the second year of studies control plants and those cultivated in medium containing 20 % compost flowered the most abundantly (had 9.5 and 8.7 inflorescences, respectively). Plants cultivated in mixture of 60 % compost and 40 % sphagnum peat flowered poorly and had on average only 4.2 inflorescences. Results of these experiments are unconformable with results of experiments conducted by Placek et al [18] where garden pansies cultivated in media containing composts supplemented with potato pulp and straw blossomed more abundantly than control plants, cultivated in sphagnum peat. Flowers of pansies cultivated in mixtures of composts and sphagnum peat were often characterized by greater diameter than control plants.

Table 4

Effects of media containing compost on greenness index of leaves and number of inflorescences of three cultivars of *Pentas lanceolata*

Medium (A)	2005				2006			
	Cultivar (B)			Mean (A)	Cultivar (B)			Mean (A)
	Graffiti Pink	Graffiti Violet	Graffiti White		Graffiti Pink	Graffiti Violet	Graffiti White	
Greenness index of leaves (SPAD)								
1	50.4	49.1	47.4	49.0	51.7	49.9	48.0	49.9
2	56.0	52.3	54.5	54.3	52.5	51.2	50.7	51.5
3	54.7	46.3	53.4	51.5	52.4	50.0	50.5	51.0
4	54.0	44.4	51.2	49.9	52.1	49.5	49.8	50.5
Mean (B)	53.8	48.0	51.6		52.2	50.2	49.8	
$LSD_{0.05}$	A – 2.08; B – 1.64; A(B) – 3.61; B (A) – 3.28				A – n.s.; B – 1.31; A · B – n.s.			
Number of inflorescences								
1	9.0	9.2	8.2	8.8	9.8	10.2	8.6	9.5
2	6.8	8.0	6.2	7.0	9.2	9.8	7.2	8.7
3	3.2	5.0	4.6	4.3	7.4	5.0	7.2	6.5
4	5.0	2.0	3.0	3.3	4.2	4.0	4.4	4.2
Mean (B)	6.0	6.1	5.5		7.7	7.3	6.9	
$LSD_{0.05}$	A – 1.44; B – n.s.; A(B) – 2.49; B (A) – 2.26				A –1.13; B – n.s.; A(B) – 1.96; B(A) – 1.78			

Explanations: see Table 3.

According to Krzywy-Gawronska [19] potato pulp can be used as a component of composts with structure-forming materials, for example with rye straw. On the basis of the obtained results and chemical analyses of media used in these experiments (Tables 2–4) it was found that medium supplemented with 20 % compost was the most favorable for *Pentas lanceolata*. Media containing 40 % and 60 % compost were characterized by too high macroelements content, especially nitrogen, for Egyptian star cluster. These media were also characterized by concentration of salt which Strojny [20] finds too high or even harmful for plants.

Conclusions

1. Media containing 20 % compost and 80 % sphagnum peat are the most favorable for Egyptian star cluster. Plants cultivated in such media are well-formed, compact, blossom abundantly and are characterized by high greenness index of leaves.

2. Media with addition of 40 or 60 % compost are characterized by too high macroelements content and by too high salinity for *Pentas lanceolata* grow. Plants cultivated in such media are small and blossom poorly, even though are characterized by high greenness index of leaves.

References

[1] Czekalski M.: Ogólna uprawa roślin ozdobnych. Wyd. AR Wrocław, Wrocław 2005, 268 p.
[2] Mupondi L.T., Mnkeni P.N.S. and Brutsch M.O.: Compost Sci. Util. 2006, **14**(4), 238–243.
[3] Startek L., Placek M. and Klessa M.: Zesz. Probl. Post. Nauk Roln. 2006, **510**, 609–617.
[4] Wraga K. and Zawadzińska A.: Ochr. Środow. Zasob. Natur. 2007, **31**, 249–254.
[5] Zawadzińska A. and Klessa M.: Zesz. Probl. Post. Nauk Roln. 2007, **518**, 209–217.
[6] Dobrowolska A. and Janicka D.: Zesz. Probl. Post. Nauk Roln. 2008, **525**, 89–96.
[7] Krzywy-Gawrońska E.: Zesz. Probl. Post. Nauk Roln. 2006, **512**, 363–368.
[8] Krzywy E., Zawadzińska A. and Klessa M.: Zesz. Probl. Post. Nauk Roln. 2007, **518**, 101–110.
[9] Krzywy E. and Krzywy J.: Zesz. Probl. Post. Nauk Roln. 2003, **494**, 233–239.
[10] Schripsema J., Caprini G.P., van der Heijden der R., Bino R., de Vos R. and Dagnino D.: J. Nat. Prod. 2007, **70**, 1495–1498.
[11] Ostrowska A., Gawliński S. and Szczubiałka Z.: Metody analizy i oceny właściwości gleb i roślin – Katalog. Wyd. IOŚ, Warszawa 1991, 334 p.
[12] Leone A.P., Menetti M. and Sorrentino G.: Italian J. Agron. 2001, **4**(2), 75–85.
[13] Jaleel C.A., Sankar B., Sridharan R. and Panneerselvam R.: Turk. J. Biol. 2008, **32**, 79–93.
[14] Turhan H., Genc L., Smith S.E., Bostanci Y.B. and Turkmen O.S.: Afr. J. Biotechnol. 2008, **7**(6), 750–756.
[15] Lee M.K. and van Iersel M.W.: HortScience 2008, **43**(6), 1888–1891.
[16] Placek M., Janicka D. and Piechocki R.: Folia Univ. Agric. Stetin., Agric., Aliment., Pisc., Zootech. 2008, **262**, 93–100.
[17] Martin I., Alonso N., Lopez M., Prieto M., Cadahia C. and Eymar E.: Commun. Soil Sci. Plan. 2007, **38**(13–14), 1785–1803.
[18] Placek M., Janicka D. and Piechocki R.: Folia Univ. Agric. Stetin., Agric., Aliment., Pisc., Zootech. 2008, **262**, 101–108.
[19] Krzywy-Gawrońska E.: Zesz. Probl. Post. Nauk Roln. 2006, **512**, 369–379.
[20] Strojny Z.: Nawożenie roślin ozdobnych pod osłonami. Centrum Ogrodnicze, Skierniewice 1993, 112 p.

ZASTOSOWANIE PODŁOŻY WZBOGACONYCH W KOMPOST ZAWIERAJĄCY WYCIERKĘ ZIEMNIACZANĄ W UPRAWIE PIĄTAKA LANCETOWATEGO (*Pentas lanceolata* (Forssk.) Deflers)

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Abstrakt: W latach 2005–2006 przeprowadzono dwa doświadczenia, których celem było zbadanie, czy podłoża z dodatkiem 20, 40 lub 60 % kompostu zawierającego 70 % wycierki ziemniaczanej i 30 % słomy żytniej mogą być stosowane w uprawie trzech odmian piątaka lancetowatego. W doświadczeniu I zastosowano kompost po 7 miesiącach kompostowania, a w doświadczeniu II kompost po 19 miesiącach kompostowania.

Stwierdzono, że mieszanki 20 % kompostu i 80 % torfu wysokiego mogą być polecane do uprawy piątaka lancetowatego. Rośliny uprawiane w takich podłożach były zdrowe, prawidłowo uformowane i kwitły obficie. Podłoża zawierające 40 i 60 % kompostu charakteryzowały się zbyt dużą zawartością makroelementów i zbyt dużym zasoleniem. Rośliny uprawiane w tych podłożach były niewielkie i kwitły słabo.

Słowa kluczowe: *Pentas lanceolata*, kompost, wycierka ziemniaczana, uprawa