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EFFECTS OF COMPOST MEDIA ON GROWTH AND FLOWERING OF PARVIFLOROUS GARDEN PANSY (*VIOLA* × *WITTROCKIANA* GAMS.)*

PART I. PLANT GROWTH AND CONFORMATION

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S u m m a r y

The aim of the studies was to determine the effects of media with composts, based on sewage sludge and potato pulp, on the growth and conformation of the cultivar 'Butterfly Yellow with Blotch'. In the experiment 14 potting media, including 12 media made of 4 composts, were tested. The percentage of compost mixed with sphagnum peat was 25%, 50% and 75%. The components of particular composts were as follows: I – municipal sewage sludge 70% and straw 30%; II – municipal sewage sludge 70% and sawdust 30%; III – municipal sewage sludge 35%, potato pulp 35% and straw 30%; IV – municipal sewage sludge 35%, potato pulp 35% and sawdust 30%. Two control potting media were used: 1 – sphagnum peat with Osmocote Exact Lo-Start at the dose 5 $g \times dm^{-3}$, and 2 – sphagnum peat with Azofoska at the dose 2.5 $g \times dm^{-3}$. There was no top-dressing during cultivation. The potting media used for pansy cultivation were rich in essential nutrients and in certain media macroelement content exceeded the limits recommended for the species with great nutrient requirements. The effects of the media on the growth, conformation and foliage of pansies depended on compost composition and its pecentage in a medium. The composts used for the media were found to be suitable for pansy cultivation. Despite smaller leaf rosettes in comparison with control plants, the pansies from compost media grew well and showed no disease symptoms.

Key words: *Viola* × *wittrockiana,* compost, municipal sewage sludge, potato pulp

INTRODUCTION

The garden pansy (*Viola* × *wittrockiana* Gams.) (E r h a r d t et al. 2002), a plant of moderate climate, belongs to the most popular early spring ornamental plants. In 2006 their sale on Dutch auctions was in the third place after pelargonium (*Pelargonium* sp.) and common box (*Buxus* sp.). Pansy cultivation is neither difficult nor expensive, since they are tolerant to growing conditions (K u e h n y and M o r a l e s , 1998). Peat substrates are most frequently used as growing media because of their physical properties However, peat resources are shrinking due to its demand in ornamental horticulture. Therefore, there is a need for finding alternative media, which could replace peat or minimise its consumption for bedded plants cultivation (R u m p e l , 1998). Organic materials, e.g. straw, compost, bark, sawmill waste or coconut fibre, may be an alternative to peat (J a r o s z e k and S ł o w i ń s k a - J u r k i e w i c z , 2003). Studies on this kind of materials as media components are conducted abroad, especially in USA (G o u i n , 1992; A n d r e et al. 2002). In Poland studies showed favourable properties of composts from municipal sewage sludge used in agriculture and green area reclamation (K r z y w y et al. 2002; K a r o ń and P i e r t , 2006). In the year 2003 at Szczecin University of Agriculture, studies were undertaken to evaluate the usefulness of municipal sewage sludge composts for the culivation of several species of ornamental plants (K r z y w y et al. 2007).

The aim of the studies was to determine the effects of media containing peat and composts made from municipal sewage sludge, potato pulp and structure-forming components – straw and sawdust – on the growth and conformation of garden pansy.

MATERIALS AND METHODS

The studies were conducted in the years 2004-2006 in a cold greenhouse of Szczecin University of

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Agriculture. Seeds of a parviflorous cultivar of garden pansy from the Belgium firm Rudy Raes were the study material. On 1 September 2005 the seeds of 'Butterfly Yellow with Blotch' were sown into boxes at the spacing 2 x 1 cm, into sphagnum peat of pH 6.2, supplemented with Osmocote Exact Lo-Start at the dose of 2.5 $g \times dm^{-3}$.

The media for pansy cultivation were prepared from 4 kinds of composts made in the autumn of 2004, whose composition was as follows: compost I – municipal sewage sludge 70% and rye straw 30%; compost II – municipal sewage sludge 70% and coniferous tree sawdust 30%; compost III – municipal sewage sludge 35%, potato pulp 35% and rye straw 30%; compost IV – municipal sewage sludge 35%, potato pulp 35% and coniferous tree sawdust 30%. Composts fermented for 7 months. The origin of the components used for compost preparation, their chemical composition; the course of composting process and chemical characteristics of these composts are given in the paper of K r z y w y et a1. (2007).

In August of 2005 12 media were made from 4 composts and sphagnum peat. Composts constituted 25%, 50% and 75% of the mix. The composition of particular media was as follows: 1 – 25% compost I, 75% peat; 2 – 50% compost I, 50% peat; 3 – 75% compost I, 25% peat; 4 – 25% compost II, 75% peat; 5 – 50% compost II, 50% peat; 6 – 75% compost II, 25% peat; 7 – 25% compost III, 75% peat; 8 – 50% compost III, 50% peat; 9 – 75% compost III, 25% peat; 10 – 25% compost IV, 75% peat; 11 – 50% compost IV, 50% peat; 12 – 75% compost IV, 25% peat. Two variants of control media were used: control 1 – peat neutralised with chalk and dolomite to pH 6.0 + fertiliser Osmocote Exact Lo-Start 5-6M (15+8+10) at the dose 5 $g \times dm^{-3}$; control 2 – peat neutralised with chalk and dolomite to pH 6.0 + Azofoska (13,6+6,4+19,1) at the dose 2.5 $g \times dm^{-3}$. The chemical analyses of sphagnum peat and media are presented in Table 1. On the basis of their results, the media whose pH was too low were neutralised with chalk and dolomite, using a neutralisation curve.

The media with a low content of nitrogen and potassium were supplemented with ammonium nitrate and potassium sulphate to level the amount of these elements as in the second control variant. The seedlings with 3-4 leaves were transplanted into the media in 10-cm pots and placed in a foil tunnel. During the cultivation period from the first decade of October 2005 to the first decade of June 2006, no extra top dressing was applied. In each variant 20 plants were cultivated, 5 plants in 4 replications.

In the year 2006 morphological measurments were taken in a vegetative (2.01.2006) and generative stage (12.04.2006). The plant height and diameter were measured, the number of leaves calculated and greening index determined using Chlorophyll Meter SPAD-502 (Minolta) in SPAD units. The obtained results were verified by means of the analysis of variance (Anova) for one factor experiments at the level $\alpha = 0.05$.

RESULTS

The cultivar 'Butterfly Yellow with Blotch' cultivated in compost media in winter season differed slightly in the plant height and leaf rosette diameter (Tab. 2). The plants growing in the control medium with Osmocote Exact were significantly the highest. The smallest height and diameter were found in pansies from the medium containing 50% of compost made from sewage sludge and sawdust. The pansies cultivated in the medium 11 – with 75% of compost made from sewage sludge, potato pulp and straw, did not differ significantly from them in their conformation. Similarly small rosettes were observed in the pansies from 75% of sewage sludge and straw or sawdust (medium 5 and 8). In the medium 14 – with 75% of compost IV – the plants had the most abundant foliage but did not differ statistically in the number of leaves from the plants from the other media, except medium 5 and 7 whose plants were characterised by the smallest number of leaves. In the vegetative stage, the greening index of pansies from the examined media was similar. Only the plants from the media with 75% of compost III had the smallest greening index.

In the flowering stage, significant differences were observed in the height of pansies from the medium containing Osmocote Exact and those from the medium with 50% of compost made from sewage sludge and straw – they were by 2.0 cm shorter on the average (Tab. 2). In the media containing compost IV (sewage sludge, potato pulp and sawdust), with the increase of compost content the leaf rosette diameter enlargement was noted; the greatest with 75% of compost IV. 25% of compost III resulted in the smallest rosette. The most abundunt foliage was found in the pansies cultivated in the control media and the media with the compost from sewage sludge and straw. The analysis of the effects of particular composts showed that the application of compost from sewage sludge and sawdust decreased the number of leaves. The plants from 75% of compost II and III had by 30% fewer leaves, on the average, than those from the peat with Osmocote Exact.

DISCUSSION

Garden pansies belong to bedded plants of moderate cultivation requirements and are tolerant to growing conditions. However, in order to obtain the marketable material of good quality, they require the constant availability of nutrients, especially during their intensive growth (S t a r t e k , 2003). There is no information

Table 1
Chemical composition of applied media.

Media	Available forms ($mg \times dm^{-3}$)						
	pH (H_2O)	$N\text{-}NO_3$	P	K	Ca	Mg	Salinity ($g\ NaCl \times dm^{-3}$)
Peat	3.6	17	20	6	42	27	0.35
1*	4.4	364	460	289	1132	303	2.98
2	5.2	785	687	379	2265	500	3.66
3	5.5	800	847	385	3478	580	4.37
4	5.1	326	419	139	1430	236	1.65
5	5.9	346	671	224	2690	309	1.69
6	6.4	945	741	256	3080	327	1.66
7	4.6	298	417	454	1080	191	1.26
8	5.6	386	518	644	1596	285	1.44
9	6.4	610	631	840	2238	268	1.64
10	4.7	186	186	75	925	128	0.73
11	5.8	281	348	180	1625	202	0.83
12	6.0	294	668	311	2390	269	2.03

* Media components:

1. compost I 25%, peat 75%;
2. compost I 50%, peat 50%;
3. compost I 75%, peat 25%;
4. compost II 25%, peat 75%;
5. compost II 50%, peat 50%;
6. compost II 75%, peat 25%;
7. compost III 25%, peat 75%;
8. compost III 50%, peat 50%;
9. compost III 75%, peat 25%:
10. compost IV 25%, peat 75%;
11. compost IV 50%, peat 50%;
12. compost IV 75%, peat 25%.

Composition of the compost calculated into dry matter:
Compost I – municipal sewage sludge 70%, rye straw 30%
Compost II – municipal sewage sludge 70%, sawdust from coniferous trees 30%
Compost III – municipal sewage sludge 35%, potato pulp 35%, rye straw 30%
Compost IV – municipal sewage sludge 35%, potato pulp 35%, sawdust from coniferous trees 30%

Table 2
Effects of compost media on morphological traits of 'Butterfly Yellow with Blotch'.

Medium	Height of plants [cm]		Diameter of plants [cm]		Number of leaves		Green index [SPAD]	
	I**	II	I	II	I	II	I	II
1 – Peat + Osmocote – control 1	7.48 a	10.58 a	9.96 a	13.92 abc	17.42 abc	30.74 a	55.28 ab	57.16 a
2 – Peat + Azofoska – control 2	6.48 ab	10.15 ab	9.04 abc	13.64 abc	14.34 abc	28.82 ab	55.70 ab	57.18 a
3 – 25% compost I* + 75% peat	6.42 ab	10.56 ab	9.75 a	13.86 abc	17.82 ab	31.72 a	54.84 ab	54.64 abcd
4 - 50% compost I + 50% peat	6.71 ab	8.57 b	9.07 abc	12.90 abc	15.32 abc	28.16 ab	55.96 ab	56.50 ab
5 – 75% compost I + 25% peat	5.62 ab	9.06 ab	7.96 bcd	11.78 bc	10.67 bc	25.74 abc	52.72 ab	55.12 abcd
6 – 25% compost II + 75% peat	6.22 ab	8.76 ab	8.81 abcd	12.86 abc	11.92 abc	21.72 bc	53.94 ab	53.14 cd
7 – 50% compost II+ 50% peat	5.49 b	9.06 ab	7.39 d	12.98 abc	10.02 c	21.82 bc	53.62 ab	53.36 bcd
8 – 75% compost II + 25% peat	6.04 ab	8.72 ab	7.76 cd	12.64 abc	11.82 abc	20.48 c	53.76 ab	53.12 cd
9 – 25% compost III + 75% peat	6.24 ab	10.26 ab	8.57 abcd	10.84 c	13.66 abc	22.02 bc	54.58 ab	52.68 d
10 – 50% compost III+ 50% peat	6.17 ab	9.73 ab	8.62 abcd	13.50 abc	12.87 abc	24.92 abc	56.82 a	56.06 abc
11 – 75% compost III + 25% peat	5.55 b	8.96 ab	7.96 bcd	12.12 bc	12.06 abc	19.18 c	51.56 b	53.38 bcd
12 – 25% compost IV + 75% peat	6.71 ab	9.92 ab	8.88 abcd	13.42 abc	15.36 abc	21.04 bc	52.94 ab	52.60 d
13 – 50% compost IV + 50% peat	6.54 ab	10.26 ab	9.45 ab	14.22 ab	15.88 abc	25.48 abc	56.94 a	55.54 abcd
14 –-75% compost IV + 25% peat	6.59 ab	10.45 ab	9.55 a	15.30 a	18.78 a	28.06 ab	54.48 ab	54.34 abcd
Mean	6.31	9.70	8.77	13.14	14.14	24.99	54.51	54.63
$LSD_{0,05}$	1.902	2.073	1.571	3.168	7.717	7.212	4.796	3.212

* Composts marked as in Table 1
** Mesurement date:
I – vegetative stage (2.01.2006 r.)
II – generative stage (12.04.2006 r.)

in available literature concerning the optimal content of essential nutrients in a medium. It is known that they thrive in peat media containing slow-release fertilisers e.g. Osmocote Plus, Osmocote Exact and traditional ones provided a top-dressing is applied (Startek, 2003). Positive results were also obtained when coconut fibre was used for cultivation. It had a particularly favourable effect on the emergence of pansies. Up till now the effects of the media containing sewage sludge on the growth and flowering of pansies have not been investigated in Poland. There is not much detailed information on the effects of composts on the quality of other species of bedded plants. Reports of foreign authors show that 20-50% of sewage sludge (Gouin, 1992) or 30% (Bragg et al. 1993) may be added to peat, but it causes a slight weakening of the plant growth. Andre et al. (2002) state that even 50 to 100% of sewage sludge may be used in the case of bedded pelargonium.

Our studies revealed that pansies tolerate 75% of composts containing from 70-35% of sewage sludge in the medium, but their conformation depends on compost composition and the percentage of compost in the medium; the plant height and diameter can either increase or decrease with the compost content increase. It was observed that 50% compost supplement in the media under study had a favourable effect on the degree of greening leaves which were intensively green in the course of the experiment. In the studies of Startek et al. (2006) and Dobrowolska et al. (2007) on New Guinea Impatiens cultivated in sewage sludge composts, similar results were obtained; although these plants were slightly smaller than control plants, the applied composts did not worsen their marketable value. The conducted studies and observations on the growth of garden pansy indicate that the composts from sewage sludge may be used in the cultivation of pansies.

CONCLUSIONS

1. The applied media containing composts are rich in essential nutrients. In some media macroelement content exceeds the limits recommended for the species with great nutrient requirements.

2. The effects of the media on the growth, conformation and foliage depend on the compost composition and its percentage in a given medium.

3. On the basis of the plant growth and development, it is found that the composts used for the media preparation may be applied in pansy cultivation. Despite a smaller size of leaf rosettes in comparison with control groups, the plants grow and develop properly and show no disease symptoms.

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Wpływ podłoży kompostowych na wzrost i kwitnienie bratków ogrodowych z grupy drobnokwiatowych

Cz. 1. Wzrost i pokrój roślin

S t r e s z c z e n i e

Celem badań było określenie wpływu podłoży z udziałem kompostów na bazie osadu ściekowego i wycierki ziemniaczanej na wzrost i pokrój bratka ogrodowego odmiany 'Butterfly Yellow with Blotch'. W doświadczeniu testowano 14 podłoży, w tym 12 podłoży kompostowych, skomponowanych z 4 kompostów, których udział w mieszance z torfem wysokim wynosił 25, 50 i 75%. Skład rzeczowy kompostów był następujący: I – komunalny osad ściekowy 70% i słoma 30%; II – komunalny osad ściekowy 70% i trociny 30%; III – komunalny osad ściekowy 35%, wycierka ziemniaczana 35% i słoma 30%; IV – komunalny osad ściekowy 35%, wycierka ziemniaczana 35% i trociny 30%. Zastosowano 2 podłoża kontrolne na bazie torfu wysokiego: 1 – torf z nawozem Osmocote Exact Lo-Start w dawce 5 g×dm^{-3} oraz 2 – torf z Azofoską w dawce 2,5 g×dm^{-3}. W trakcie uprawy nie stosowano nawożenia pogłównego roślin.

Zastosowane do uprawy bratków podłoża zawierające komposty były zasobne w podstawowe składniki pokarmowe, a w niektórych podłożach zawartość makroskładników przekraczała liczby graniczne zalecane dla gatunków o dużych wymaganiach pokarmowych. Wpływ podłoży na wzrost, pokrój i ulistnienie bratków zależał od składu rzeczowego kompostów i od procentowego udziału kompostu w podłożu. Stwierdzono, że komposty użyte do sporządzenia podłoży nadają się do uprawy bratków. Rośliny te, mimo że miały mniejsze rozmiary rozet liściowych niż rośliny kontrolne, rosły prawidłowo i nie wykazywały oznak chorobowych.