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

PART II. PLANT FLOWERING AND DECORATIVE VALUE

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S u m m a r y

The purpose of the studies was to determine the effects of media containing composts from sewage sludge and potato pulp on the flowering and decorative value of 'Butterfly Yellow with Blotch' parviflorous pansy. 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×dm^{-3} and 2 – sphagnum peat with Azofoska at the dose 2.5 g×dm^{-3}. There was no top-dressing during cultivation. The pansies for whose cultivation a slow-release fertiliser was used turned out to have most flowers, but the plants cultivated in compost with peat at the ratio 1:1 had equally abundant flowering. At the generative stage, the pansies in control media were the most decorative and those growing in 25% of compost I, 75% of compost II and 50% of compost III and IV. On the basis of plant valuation scale, quality assessment and the abundance of flowering it was found that the media containing 50% of composts were optimal for pansy cultivation.

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

INTRODUCTION

The garden pansy (*Viola* × *wittrockian*a Gams.) called 'the flower of all seasons' is cultivated on the largest scale in USA, as a bedded and pot plant (S t a r t e k , 2003). According to flower size, pansies are divided into large-flowered – 9-11.5 cm in diameter, medium-flowered – 6-9 cm in diameter; parviflorous – 4-6 cm in diameter and miniature of 2-3 cm in diameter, developed from *Viola cornuta* (K r a u s e et al. 2004).

The plants available on the market are multiple hybrids of *Viola* × *wittrockiana* which have been bred for over 150 years. At present, many cultivar groups may be cultivated in a year cycle – sown either in winter or spring, since they do not need low temperature at the seedling stage for the transition into the generative stage. They are heterositic cultivars F_1 and F_2, tolerant to light and stand, of a shorter production cycle than the cultivars with permanent traits. Apart from the appropriate choice of cultivar for the planned flowering time, the choice of media is an important factor of success in pansy cultivation (S t a r t e k , 2003). For many years pansies have been cultivated in peat substrate supplemented with traditional and slow-release fertilisers. The studies showed that the latter ones give better results, since they ensure an even supply of nutrients and continuous flowering. S t a r t e k et al. (2006a) found that coconut media have a favourable effect on both the pansy emergence and further growth.

Due to limited peat resources and great costs of media import, it is advisable to search for alternate media, rich in nutrients with good physical properties. The mixtures of peat and composts made from municipal sewage sludge with different structure-forming materials may be such media (G a r c i a - G o m e z et al. 2002; K r z y w y et al. 2007).

In the first part of the study, the effects of compost media on the pansy growth and conformation were

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presented, whereas in the second part the effects of these media on the plant flowering and decorative value were evaluated.

MATERIALS AND METHODS

Seeds of parviflorous cultivar of garden pansy 'Butterfly Yellow with Blotch' were the study material. They were sown on 1 September 2005 into sphagnum peat of pH 6.2, supplemented with Osmocote Exact Lo-Start at the dose 2.5 g×dm^{-3}.

The seedlings at the stage of 3-4 leaves were planted into 14 media including 12 compost media from 4 kinds of composts prepared in the autumn of 2004 whose composition adjusted to the dry weight basis, 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 were fermented for 7 months. The origin of compost components, their chemical composition, composting process and chemical characteristics of compost are presented in the work of Krzywy et al. (2007). The media components were described in Part I. Two variants of control media were applied: control I – peat neutralised with chalk and dolomite to pH 6.0 + Osmocote Exact Lo-Start 5-6M (15+8+10), at the dose 5 g×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×dm^{-3}. The media chemical composition and the detailed course of experiments were given in Part I.

Morphological measurements were taken in the spring of 2006 at full blooming (12.04.2006). The length and width of the first flower and the length of its flower stalk were measured, the flowers were counted at 9 dates and removed each time after counting. Valuation scale 1-9 had been developed. It was assumed that 1 indicates very poor quality (plants without flowers, of irregular conformation, poorly leaved) and 9 – the best quality (plants with flower, of regular conformation and dark green leaves). The obtained results were verified by means of analysis of variance for one-factor experiments at $\alpha = 0,05$.

RESULTS

It was found that the pansies cultivated in the medium containing 75% of compost IV produced the largest flowers of the greatest width, the longest with the longest flower stalk (Tab. 1). However, as the analysis of variance showed their traits did not significantly differ from the plants growing in the other media, except the medium with Azofoska which produced the smallest flowers.

There were differences in the dynamics of flowering depending on the medium (Fig. 1). In the control media, more even flowering was observed in the medium with Osmocote Exact than in that with Azofoska. Although the pansies cultivated in the medium containing a slow-release fertiliser formed the most flowers, statistical differences in the number of flowers were not confirmed. In the media containing compost I made from sewage sludge (70%) and straw (30%), at an initial stage the fastest and most abundant flowering was observed in the pansies from the cultivation with 25% of compost, but at the end of flowering the plants from the medium 4 with 50% of compost I had more flowers. As far as the abundance of flowering is concerned, these pansies did not differ from the control plants and among themselves. Among the pansies cultivated in the media with compost II (70% sewage sludge and 30% sawdust), those from the medium 6 were inferior to other plants in terms of flowering, especially at the end of the generative stage. Finally, in relation to the plants cultivated with Osmocote Exact and in the medium with 50% of compost II, they obtained statistically fewer flowers on the average by 38.4 and 33.9%, respectively.

The comparison of pansy flowering from all the media proved that it was the poorest in medium 9, containing 25% of compost III (sewage sludge 35%, potato pulp 35%, straw 30%). The pansies growing in this medium had fewer flowers in a whole season than those from the media with 50 and 75% of compost III, but there were no statistically significant differences in the number of flowers. In comparison with the control plants (medium 1 and 2), the pansies from medium 9 had by 43.5% and 33.9% fewer flowers on the average. The evaluation of flowering in the pansies from the media containing compost IV (sewage sludge 35%, potato pulp 35%, sawdust 30%) revealed even, in a whole season, and abundant flowering in the pansies from 50% of compost IV but compared to control and other variants with compost IV, the differences in the number of flowers were statistically insignificant. In general, the most intensive flowering occurred after the application of compost with peat at the ratio 1:1.

From the beginning of cultivation to flowering, the best decorative value was observed in the pansies cultivated in peat with Osmocote Exact (Fig. 2). In compost media flowering varied, the most beautiful pansies were obtained from the media with 25% of compost I and 75% of compost II. The application of compost III and IV with peat at the ratio 1:1 was more justified and had a more favourable effect on the decorative value of pansies.

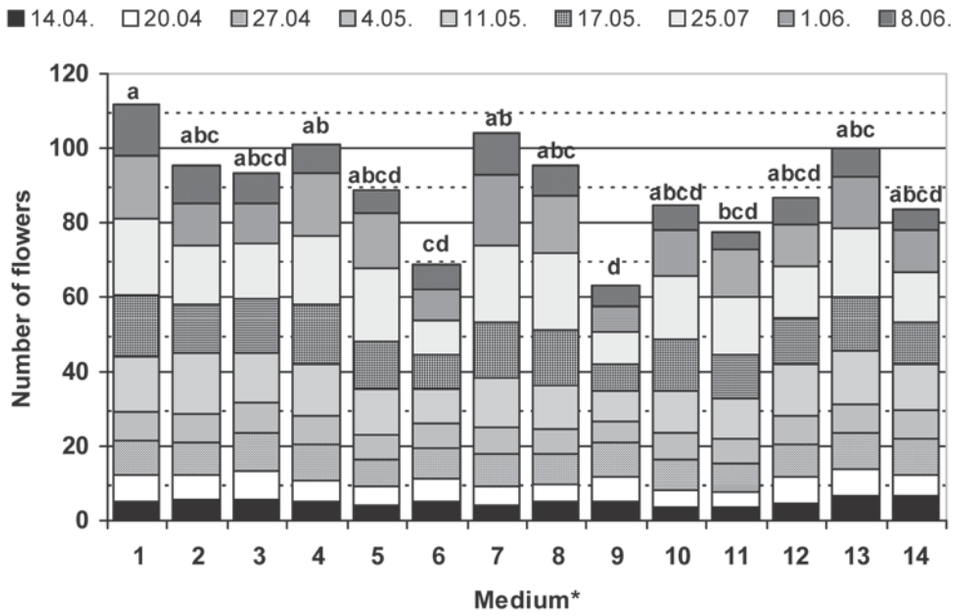
DISCUSSION

The studies conducted by Startek (2002) show that during intensive growth and flowering pansies

Table 1
Effects of compost media on quality of garden pansy flowering.

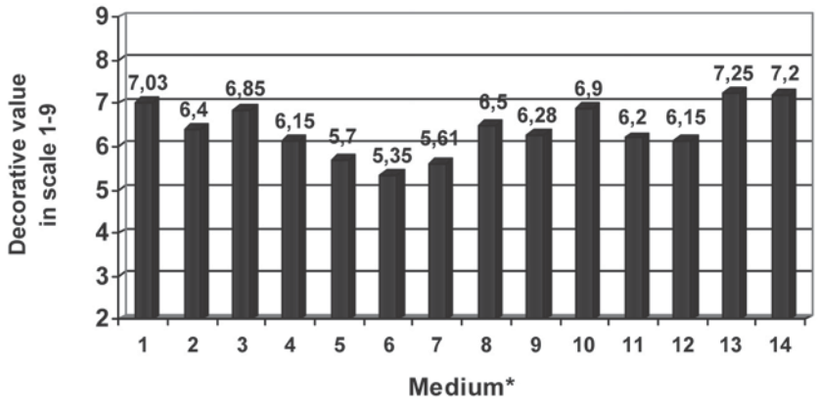
Medium	Length of flower [cm]	Width of flower [cm]	Length of flower stalk [cm]
1 – Peat + Osmocote – control 1	2.42 ab	2.21 ab	3.92 ab
2 –- Peat + Azofoska – control 2	2.16 b	1.95 b	3.56 ab
3 – 25% compost I* + 75% peat	2.69 ab	2.39 ab	4.37 ab
4 – 50% compost I + 50% peat	2.44 ab	2.29 ab	3.40 b
5 – 75% compost I + 25% peat	2.62 ab	2.36 ab	4.17 ab
6 – 25% compost II + 75% peat	2.43 ab	2.22 ab	3.68 ab
7 – 50% compost II+ 50% peat	2.48 ab	2.27 ab	4.04 ab
8 – 75% compost II + 25% peat	2.77 ab	2.56 ab	4.37 ab
9 – 25% compost III + 75% peat	2.71 ab	2.53 ab	4.49 ab
10 – 50% compost III+ 50% peat	2.83 ab	2.62 ab	4.58 ab
11 – 75% compost III + 25% peat	2.40 ab	2.20 ab	3.86 ab
12 – 25% compost IV + 75% peat	2.64 ab	2.49 ab	4.23 ab
13 – 50% compost IV + 50% peat	2.98ab	2.65 ab	4.81 ab
14 – 75% compost IV + 25% peat	3.23 a	2.98 a	5.14 a
Mean	2.63	2.41	4.187
$LSD_{0,05}$	0.847	0.779	1.581

* Media components adjusted to dry matter:
Compost I – municipal sewage sludge 70%, rye straw 30%;
Compost II – municipal sewage sludge 70%, saw dust 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%, saw dust from coniferous trees 30%.



* Media marked as in Table 1
** a, b, c – means marked by the same letter do not differ significantly at α=0,05

Fig. 1. Flowering dynamics of 'Butterfly Yellow with Blotch' (beginning of flowering – 1st decade of June) cultivated in compost media.



* Media marked as in Table 1

Fig. 2. Valuation scale of garden pansy at flowering stage.

have great nutrient requirements and are tolerant to a high nutrient content in the medium. Nutrient deficiency or their uneven supply lowers pansy decorative value by deteriorating plant conformation, reducing the number of flowers and shortening the flowering period. In our studies the media with composts based on municipal sewage sludge rich in nutrients, but containing also heavy metals (Krzywy et al. 2007), had a considerable effect on the course, abundance of flowering and decorative value of the cultivar 'Butterfly Yellow with Blotch'.

According to literature, the media for bedded plants cultivation may be supplemented with 20-50% of municipal sewage sludge, mixed with peat, since it is not rich in nutrients and neutralises the unfavourable effect of salinised sewage sludge with heavy metals. The studies on pelargonium conducted by Andre et al. (2002) demonstrated that even 50-100% of sewage sludge in the medium had a favourable influence on the plant growth, flower number and diameter, but slightly delayed flowering.

In our studies, there were no significant disproportions in the size of flowers, except the medium with Azofoska where the flowers were smaller as a result of nutrient exhaustion. The pansies from the medium containing 75% of compost from sewage sludge, potato pulp and sawdust had the largest flowers on long flower stalks. The most abundant flowering was observed in the plants grown in peat with Osmocote Exact, but no significant differences in comparison with the plants from Azofoska and the majority of compost media were found. The poorest flowering was noted in the case of pansies cultivated with 25% of compost II and III (medium 6 and 9), probably due to the chemical composition of the media (Krzywy et al. 2007), which in April and May – after 8 months of cultivation (autumn sowing) – contained an insufficient amount of nitrogen and potassium. The pansies cultivated in medium 6 turned out to be the worst according to valuation scale, whereas those from the media containing 50 and 75% of compost IV (sewage sludge, potato pulp and sawdust) were rated very high, higher than those grown with Osmocote Exact. They had shapely conformation due to wide leaf rosettes, a great number of intensively green leaves and large flowers.

In the study of Zawadzińska and Klessa (2007) on pelargonium, 50% compost supplement from sewage sludge, potato pulp and straw or sawdust did not affect the flower and inflorescence size, but weakened flowering without any effect on the plant decorative value throughout the experiment. Also, New Guinea Impatiens in the experiments conducted by Startek et al. (2006b) proved to be decorative during the whole season, but its flowering was less abundant than in the medium containing a slow-release fertiliser.

Certain plant species may respond to the presence of sewage sludge in the media with poorer growth and flowering, e.g. *Lysimachia congestiflora* or *Gloxinia sylvatica* (Wilson et al. 2002). Plant response depends, first of all, on their tolerance to medium salinity and pH, and the presence of heavy metals. The origin of municipal sewage sludge and the degree of maturity of applied composts is of great importance.

CONCLUSIONS

1. Pansy flowers cultivated in the compost media do not significantly differ in their size from those cultivated with the addition of Osmocote Exact, whereas those from peat with Azofoska are the smallest.

2. The most abundant flowering is obtained in the pansies for whose cultivation a slow-release fertiliser is applied, but the plants cultivated in the compost with peat at the ratio 1:1 produce equally abundant flowering.

3. At the generative stage, the pansies from the control media and those with the supplement of 25% of compost I, 75% of compost II and 50% of compost III and IV are the most decorative.

4. On the basis of plant valuation scale, quality analysis and abundance of flowering, the media containing 50% compost supplement are found to be the best for pansy cultivation.

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

Cz. 2. Kwitnienie i wartość dekoracyjna roślin

Streszczenie

Celem badań było sprawdzenie wpływu podłoży zawierających komposty z osadów komunalnych i wycierki ziemniaczanej na kwitnienie i wartość dekoracyjną bratków odmiany 'Butterfly Yellow with Blotch' z grupy drobnokwiatowych. 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 nawozem Azofoska w dawce 2,5 g×dm^{-3}. Nie stosowano nawożenia pogłównego w trakcie uprawy.

Stwierdzono, że najwięcej kwiatów miały bratki, do uprawy których zastosowano nawóz o spowolnionym działaniu, ale równie obficie kwitły rośliny uprawiane w kompostach z torfem, w proporcji 1:1. W stadium generatywnym najbardziej dekoracyjne były bratki w podłożach kontrolnych oraz bratki, do uprawy których zastosowano 25% kompostu I, 75% kompostu II i 50% kompostu III i IV. Na podstawie oceny bonitacyjnej roślin, analizie jakości i obfitości kwitnienia stwierdzono, że optymalne do uprawy bratka były podłoża zawierające 50% kompostów.

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