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GROWTH OF SELECTED BEDDING PLANTS AS AFFECTED BY DIFFERENT COMPOST PERCENTAGES

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Abstract. **Growth of Dahlberg daisy 'Golden Fleece' (*Dyssodia tenuiloba* B.L. Rob.), impatiens 'Super Elfin Blue Pearl' (*Impatiens walleriana* Hook. f.), marigold 'Little Hero Orange' (*Tagetes patula* L.), and petunia 'Ultra Rose' (*Petunia hybrida* Hook.) was compared in commercial substrates and substrates containing different compost percentages, as follows: 1) Fafard Growing Mix #2; 2) Metro-Mix 350; 3) 60% *Sphagnum* peat, 25% vermiculite, 15% perlite (0% compost); 4) 30% compost, 30% *Sphagnum* peat, 25% vermiculite, 15% perlite; 5) 60% compost, 25% vermiculite, 15% perlite; 6) 100% compost. There were no significant differences in root dry weight for all bedding plants among the six growing substrates. Although no particular trend was observed among treatments, all plants showed some increase in shoot dry weight when using substrates containing one or more levels of compost. Plant quality also varied among the substrates and species evaluated, with no particular effect related to the compost percentage in the substrate. All plants in Fafard #2 showed lowest rates for quality, indicating poor salability. Physical and chemical properties varied for the substrates examined, but were mostly within the suggested standards for growth of bedding plants and did not appear to affect directly shoot dry weight and quality ratings. Results indicate that compost can be of value for growers as a component to substrates for growing ornamental bedding plants.**

The development and utilization of composted waste products has provided the nursery industry with alternatives to fulfill the continuous need for organic materials in the growing substrate. Numerous scientific papers established the positive effects of compost use with horticultural crops (Stoffela and Kahn, 2001). Furthermore, the proliferation of commercial-scale composting facilities and the development of industry standards have enabled compost products to be used more extensively in crop production (Fitzpatrick et al., 2005).

The use of composted urban waste has been evaluated for growth of bedding plants, woody ornamentals, perennial plants, and foliage plants (Beeson, 1996; Fitzpatrick and Verkade, 1991; Fitzpatrick et al., 1998; Klock, 1997a, b; Klock and Fitzpatrick, 1997; Klock-Moore, 1999, 2000). However, compost variability due to differences in feedstocks that make up the compost may result in different plant responses. Furthermore, there are few reported studies on the differences in root growth as well as shoot growth in response to different percentages of compost added to the growing substrate. The objectives of this work were to compare plant quality and root and shoot growth of selected bedding plants grown in commercial substrates as well as substrates amended with 0, 30, 60, and 100% biosolids and yard trimming compost.

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Material and Methods

Plugs of petunia 'Ultra Rose' (*Petunia hybrida*), Dahlberg daisy 'Golden Fleece' (*Dyssodia tenuiloba*), marigold 'Little Hero Orange' (*Tagetes patula*), and impatiens 'Super Elfin Blue Pearl' (*Impatiens walleriana*) were transplanted into 400 mL (4-inch) plastic containers filled with six different growing substrates. These included two commercial growing susbtrates: Fafard Growing Mix #2 (Fafard, Inc., Apopka, Fla.) and Metro-Mix 350 (Sun Gro Horticulture Canada Ltd., Bellevue, Wash.). A third substrate was comprised of 60% Sphagnum peat, 25% vermiculite, 15% perlite, with no compost product added (namely 0% SYT).

The remaining three substrates contained different percentages of compost. The compost product (SYT) was a 1:1 by weight mixture of biosolids and yard trimmings obtained at the Solid Waste Authority of Palm Beach County, Fla. Biosolids used were a combination of polymer-dewatered wastewater residuals (≈14% dry solids) generated by two local utilities. The yard trimmings were mainly woody waste, ground and screened to a 13 to 32 mm (0.5 to 1.3 inches) mulch that was collected through residential collection programs. The compost was made using a rectangular agitated bed system. Materials were mixed and composted for about 21 d, cured for three months, and screened to pass a 13-mm screen. It was stockpiled for six months prior to use in these experiments. The compost product did not contain any significant amounts of inert materials, such as metal, plastic, or glass that would require protective measures when being handled by bedding plants growers or consumers. Three substrates containing different percentages of compost were used: 1) 30% SYT; 30% Sphagnum peat, 25% vermiculite, 15% perlite; 2) 60% SYT; 25% vermiculite, 15% perlite; and 3)100% SYT.

At planting, all containers were top-dressed with 3 g (0.18 oz) per pot of 14N-6.2P-11.6K controlled-release fertilizer (Osmocote Classic, The Scotts Company, Marysville, Ohio). Plants were irrigated once daily for 30 min with an overhead misting irrigation system at an average rate of 1.8 CM (0.7 inch) of water per irrigation. Plants were grown and maintained in a greenhouse with heating and cooling controlled by a fan-pad system, under partial shade with light varying from 150 to 280 $\mu mol \cdot m^{-2} \cdot s^{-1}$ and average day/night temperatureS of 28/20°C (82/68°F). Climatic conditions, fertilization and irrigation were replicated from the conditions used in a commercial production setting. All planting was performed on 10 Dec. 2004.

Evaluations were performed on 1 Feb. 2005, 53 d after planting. Plant quality was rated on a scale of 1 to 5 with 5 = excellent, 4 = above average, 3 = average (basic salability), 2 = below average (poor), and 1 = dead. In addition, shoots were cut at the substrate surface level and oven dried as were the roots after washing away the growing substrate.

Media pH, soluble salts, water-holding capacity, and total pore space were determined prior to planting. The saturated media extraction method was used for pH and EC determinations (Warncke, 1986). The volume displacement method was used for the determination of pore space and air-filled porosity (Niedziela and Nelson, 1992). Water holding capacity was calculated after wetting each mix in a container of known volume and calculating the difference between percent pore space and percent air space.

Containers were arranged in a completely randomized design with 10 single-container replications per treatment. Analysis of variance was performed to analyze the data (SAS Institute, Cary, N.C.). Means and standard errors were calculated and Duncan's multiple range test was used for means separation.

Results and Discussion

There were no significant differences in root dry weight for all bedding plants among the six growing substrates (Fig. 1). In general, shoot dry weight increased with the addition of some compost to the substrate, although responses were variable for different species (Fig. 1). Plant quality also varied among the substrates and species evaluated (Table 1), with no particular effect related to the compost percentage in the substrate.

Lowest shoot dry weights were observed for petunia, daisy, and impatiens growing in Fafard #2 (Fig. 1). Although the lowest dry weight for marigolds was also observed in Fafard #2, it did not show any significant difference from plants grown in Metro Mix 350 and 0% SYT. With respect to plant quality rating, all plants in Fafard #2 showed lowest rates, with below average quality, indicating poor salability (Table 1).

Petunia's greatest shoot dry weight was observed in 60% and 100% SYT (Fig. 1a). However, plants grown in 100% SYT did not differ significantly from plants grown in Metro Mix, 0%, and 30% SYT. It has been demonstrated that shoot dry mass in petunia increases as percentage of compost in the growing substrate increases from 0 to 30%, then decreases at

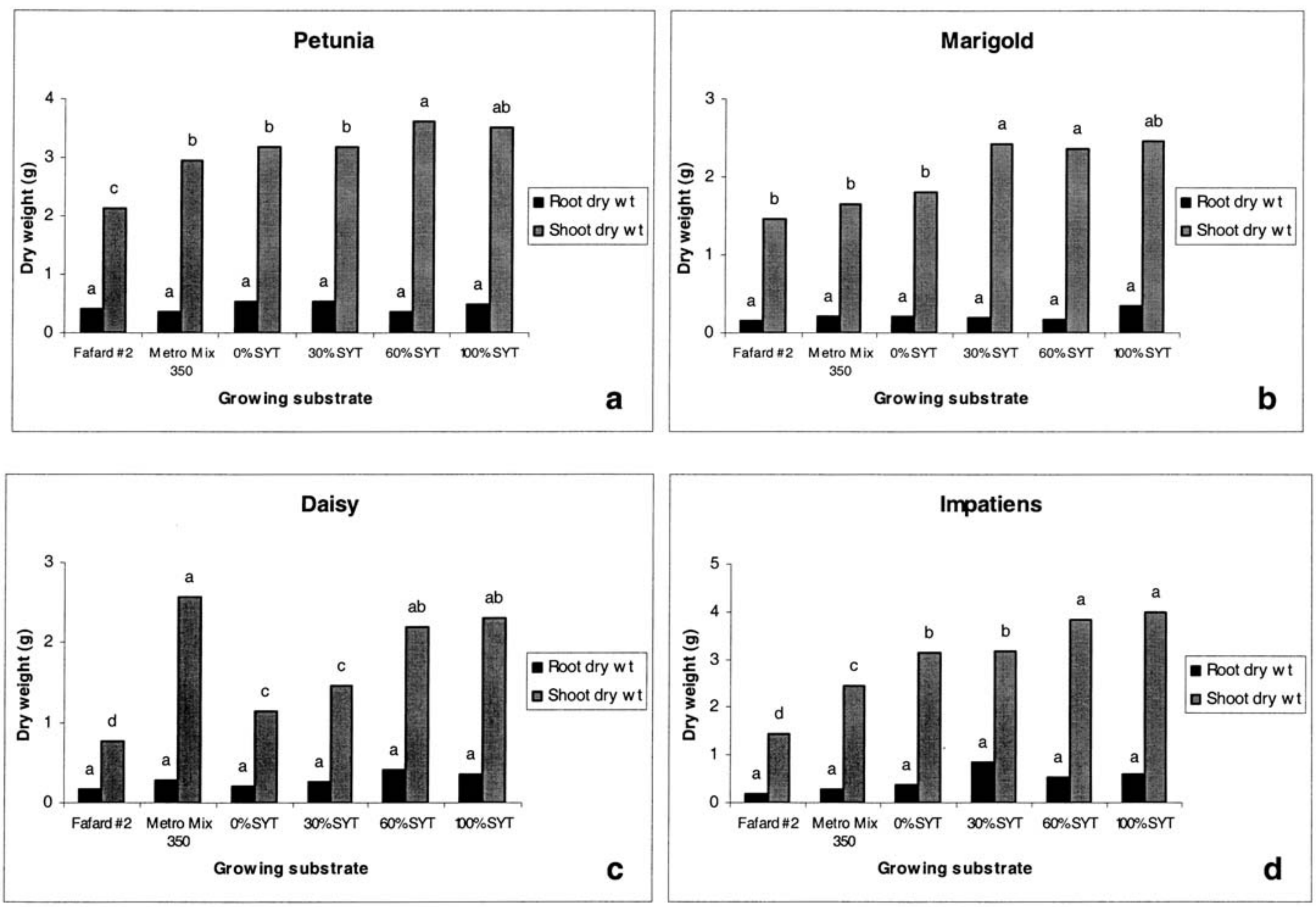

Fig. 1. Root and shoot dry weights (g) for petunia, marigold, daisy, and impatiens grown in six growing substrates (Fafard #2, Metro Mix 350, 0% SYT, 30% SYT, 60% SYT, 100% SYT). Values are means of ten replicates. Shoot bars or root bars for a given plant marked by the same letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$.

Table 1. Mean values for plant quality ratings of daisy, impatiens, marigold, and petunia as affected by commercial growing substrates (Fafard #2 and Metro Mix 50) and substrates amended with different compost percentages (0, 30, 60, and 100% SYT).

	Plant quality rating[z]			
	Daisy	Impatiens	Marigold	Petunia
Fafard #2	1.4 ± 0.16 c	1.2 ± 0.13 b	1.9 ± 0.10 c	2.4 ± 0.22 c
Metro-Mix 350	4.0 ± 0.20 a	2.8 ± 0.13 a	3.0 ± 0.26 a	2.8 ± 0.36 bc
SYT 0%	2.7 ± 0.30 b	3.4 ± 0.16 a	2.3 ± 0.26 bc	3.6 ± 0.16 a
SYT 30%	2.5 ± 0.22 b	3.4 ± 0.22 a	2.9 ± 0.22 ab	3.4 ± 0.22 ab
SYT 60%	2.5 ± 0.22 b	3.3 ± 0.26 a	2.5 ± 0.22 abc	3.3 ± 0.26 ab
SYT 100%	2.2 ± 0.33 b	3.0 ± 0.26 a	2.4 ± 0.33 abc	3.0 ± 0.26 bc

[z]Means in each column followed by the same letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$. Values are means of ten replicates.

60% and 100%, probably due to high salt concentrations (Moore, 2004). However, in this experiment soluble salt levels were low for all substrates (Table 2) and did not affect shoot dry weight as the percentage of compost increased (Fig. 1a). Highest quality ratings for petunias were observed in 0%, 30%, and 60% SYT (Table 1). However, rates for 30% and 60% SYT were similar to Metro Mix 350 and 100% SYT.

Marigold's greatest shoot dry weight was observed in 30%, 60% and 100% SYT (Fig. 1b), although plants in 100% SYT did not differ significantly from plants in all other substrates. Highest quality ratings were comparable in Metro Mix, 30%, 60%, and 100% SYT (Table 1). These results were similar to those obtained by Wootton et al. (1981) and Bugbee and Frink (1989), who demonstrated successful growth of marigold 'Golden Jubilee' and 'Lemondrop', respectively, in composted sewage sludge.

For daisy, greatest shoot dry weight was observed in Metro Mix 350 and was comparable to 60% and 100% SYT (Fig. 1c). Plants in 0% and 30% SYT had significant lower shoot dry weight, with the lowest value observed in Fafard #2, as previously indicated. Highest quality rating was observed for plants in Metro Mix 350.

Greatest shoot dry weight for impatiens was observed in 60% and 100% SYT (Fig. 1d). Impatiens has been reported to be very sensitive to high soluble salt concentrations in the substrate, as driven by higher compost percentages (Klock, 1997b). However, Klock (1997b) reported successful growth of impatiens in 100% compost with soluble salt concentration between 0.5 and 1.0 $dS.m^{-1}$. Although in our experiment soluble salt concentration increased with the addition of compost to the substrate at 30%, 60% and 100% (Table 2), they were not high enough to cause reduction in shoot dry weight (Fig. 1d). Quality ratings were similar for plants grown in Metro Mix 350, 0%, 30%, 60%, and 100% SYT.

Physical and chemical properties varied for the substrates examined, but were mostly within the suggested standards for growth of containerized bedding plants (Table 2) and did not appear to affect directly shoot dry weight and quality ratings. In substrates containing compost, the range of soluble salts was low enough to prevent toxicity or reduced plant growth. Likewise, pH was within the suggested range for all compost products and no symptoms of nutrient deficiency or toxicity were observed. Air-filled porosity and water holding capacity were also within the suggested range for compost substrates. However, pore space was reduced for all compost substrates and was comparable to values for Fafard #2.

Although no particular trend was observed among treatments, all plants showed some increase in shoot dry weight when using substrates containing one or more levels of compost. The only exception was for daisy, whose growth under compost substrates was comparable to a commercial substrate. In contrast, plant quality showed a broader and more variable response when comparing all substrates. Quality ratings were similar among plants grown in different compost substrates and plants were rated near average (basic salability) or higher.

Our results demonstrate that substrates amended with SYT compost can be successfully used to grow impatiens 'Super Elfin Blue Pearl', marigold 'Little Hero Orange', and petunia 'Ultra Rose'. However, Dahlberg daisy 'Golden Fleece'

Table 2. Physical and chemical properties of growing substrates including commercial substrates (Fafard #2 and Metro-Mix 350) and substrates amended with different compost percentages (0, 30, 60, and 100% SYT).

	Physical and chemical properties[z]				
	pH	Soluble salts ($dS.m^{-1}$)	Air-filled porosity (%)	Pore space (%)	Water holding capacity (%)
Fafard #2	5.92 ± 0.13 a	0.64 ± 0.09 b	18.5 ± 1.30 a	61.0 ± 2.33 ab	42.5 ± 2.31 b
Metro-Mix 350	6.34 ± 0.21 a	0.83 ± 0.19 ab	12.9 ± 0.45 b	70.7 ± 2.65 a	57.8 ± 2.38 ab
SYT 0%	4.82 ± 0.05 b	0.06 ± 0.01 c	15.1 ± 2.23 ab	80.4 ± 1.82 a	65.3 ± 1.32 a
SYT 30%	5.50 ± 0.31 a	1.26 ± 0.14 a	13.6 ± 0.34 b	65.8 ± 2.20 ab	52.2 ± 2.14 ab
SYT 60%	6.24 ± 0.06 a	1.33 ± 0.12 a	12.9 ± 0.32 b	56.1 ± 1.87 b	43.2 ± 2.23 b
SYT 100%	6.26 ± 0.12 a	1.51 ± 0.08 a	13.9 ± 0.24 b	57.8 ± 1.74 b	43.9 ± 2.35 b
Suggested range[x]	5.8-6.2	0.75-3.49	5-30	75-85	20-60

[z]Means in each column followed by the same letter are not significantly different according to Duncan's multiple range test at $P \leq 0.05$. Values are means of five replicates.
[x]Suggested standards for physical parameters recommended by Fonteno (1996).

will grow better in Metro Mix 350. Future experiments should be conducted to provide a more thorough evaluation of parameters for the use of compost in substrates for growing bedding plants. The present report indicates that SYT compost can be of value for growers as a component to substrates for growing ornamental bedding plants.

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