Growth of Dianthus and Petunia in Media Amended with Composted Urban Waste[1]

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Abstract

Bedding plant growers have the opportunity to utilize composted urban waste as a component in bedding plant media. Growth of *Dianthus chinensis* L. (dianthus) and *Petunia* x *hybrida* Hort. (petunia) was evaluated in media with 0, 30, 60, or 100% compost made from biosolids and yard trimmings. Dianthus and petunia shoot dry mass, size, and height increased as the percentage of compost in the medium increased from 0 to 60% but decreased at 100% compost. However, dianthus and petunia growth was greater in 100% than 0% compost. Initial nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and soluble salt concentrations linearly increased as the percentage of compost in the medium increased from 0 to 100%. Soluble salt concentrations in 100% compost were 28× greater than in 0% compost and 2× greater than in 30 and 60% compost. Media containing compost made from biosolids and yard trimmings produced larger dianthus and petunia plants than plants grown in peat, vermiculite, perlite medium. The best dianthus and petunia growth was in the medium containing 60% compost.

Index words: composted urban waste, *Dianthus chinensis*, *Petunia* x *hybrida*.

Significance to the Nursery Industry

A 1993 survey indicated that total production of compost from municipal solid waste, sewage sludge, horticulture/silviculture waste, and agricultural residuals was approximately 100 million cubic yards, but that demand for compost for container and field nursery crops was 4.9 million cubic yards (1). Compost made from biosolids and yard trimmings is a suitable medium for growing dianthus and petunia. Use of this compost in the medium produced larger dianthus and petunia plants than in the peat, vermiculite, perlite medium. The best growth was observed in the medium with 60% composted biosolids and yard trimmings and that initially had an air-filled porosity (APS) of ≈15 to 20%, a water-holding capcity (WHC) of ≈30 to 40%, a moisture content of ≈50 to 60%, a pH of ≈6.5, a soluble salt concentration of ≈0.50 dS/m, a N concentration of ≈135 ppm, a P concentration of ≈60 ppm, a K concentration of ≈250 ppm, a Ca concentration of ≈1170 ppm and a Mg concentration of ≈200 ppm.

Introduction

Bedding plant medium selection is an important aspect of bedding plant growth. The medium serves to anchor plants and provides air, water, and nutrients (4). Bedding plant growers located in urban areas have the potential to utilize composted urban waste products made from biosolids (sewage sludge), yard trimmings (e.g. grass clippings, branches, and leaves), and municipal waste (garbage and trash).

Composts made from various organic waste materials have been successfully used as a growing medium for marigold, zinnia, petunia, snapdragon, and geranium (3, 7, 10). For example, Wootton et al. (10) reported greater petunia growth in their sludge and sludge-vermiculite media than in the sand-peat medium. Because of the extreme heterogeneity among compost products produced from different facilities, it is important to identify media characteristics as well as compost incorporation rates associated with superior bedding plant growth. The objective of this experiment was to compare the growth of dianthus and petunia plants grown in media with 0, 30, 60, or 100% compost made from biosolids and yard trimmings.

Materials and Methods

Plugs of dianthus and petunia were transplanted into 400 ml (13.5 oz) pots filled with by volume: 1) 100% compost; 2) 60% compost:25% vermiculite:15% perlite; 3) 30% compost:30% sphagnum peat moss:25% vermiculite:15% perlite; or 4) 60% sphagnum peat moss:25% vermiculite:15% perlite. The compost product was a 1:1 by weight mixture of biosolids and yard trimmings obtained from the Solid Waste Authority (SWA) of Palm Beach County, FL. Biosolids used by SWA for composting were a combination of polymer dewatered wastewater residuals (≈14% dry solids) generated by two local utilities. The yard trimmings used were mainly woody waste ground and screened to a 1.2–3.0 cm (0.5–1.25 in) mulch that was collected by SWA through residential and commercial collection programs in Palm Beach County. Further deatils on the compost feedstock components are published eleswhere (2). The compost was made using a rectangular agitated beds system. Materials were mixed and composted for 21 days, stockpiled for 3 months, and screened to pass a 2 cm (0.75 in) screen. The compost did not contain significant amounts of man-made inert substances such as plastics, glass, etc.

All pots were top-dressed with 3 g (0.11 oz) of 14N–6.2P–11.6K (14N–$14P_2O_5$–$14K_2O$) Osmocote (The Scotts Company, Marysville, OH) 6 days after transplanting. Plants were watered twice daily at 800 HR and 1300 HR. Plant height and width were recorded 35 days after transplanting and plant size was calculated as the average of final height and width. Shoots were pruned at the surface of the media, dried at 93C (199F) for 48 hr, weighed, and ground with a Wiley Mill (Arthur H. Thomas Co., Philadelphia, PA) to pass through a

[1]Received for publication April 3, 1997; in revised form June 16, 1997. Florida Agricultural Experiment Station journal series no. R-05677. I thank Maria Bravo, Gary Gorecki, and George Fitzpatrick for their technical assistance, the Solid Waste Authority of Palm Beach County for the compost product, and Lovell Farms, Miami, FL, for the plant material. This work was supported in part by a grant from the Center for Biomass Programs, University of Florida.

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40-mesh screen. Elemental shoot N, P, K, Ca, and Mg concentrations were determined by A&L Southern Agriculture Laboratories Inc., Pompano Beach, FL.

Compost product quality was assessed by determining the initial APS, WHC, bulk density, and moisture content as well as by determining initial and final pH and soluble salt, N, P, K, Ca, and Mg concentrations. Percent APS, WHC, bulk density, and moisture content were determined using volume displacement methods (5). Initial and final pH and soluble salt, N, P, K, Ca, and Mg concentrations were determined by A&L Southern Agriculture Laboratories Inc. using a Morgan extract.

This experiment was conducted in November 1996 in a 30% shade house exposed to ambient air temperatures at the University of Florida, Fort Lauderdale Research and Education Center, Fort Lauderdale, FL. Pots were arranged in a completely randomized design with five single pot replicates per medium and bedding plant combination. All data were analyzed using analysis of variance and regression procedures (9).

Results and Discussion

Dianthus and petunia final shoot dry mass, size, and height increased as the percentage of compost in the medium increased from 0 to 60% but decreased at percentages greater than 60% compost (Fig. 1). However, dianthus and petunia growth in 100% compost was greater than in 0% compost (Fig. 1). Wootton et al. (10) also observed an increase in petunia shoot dry mass as the percentage of fine sludge in their sludge-vermiculite media increased up to 50%. In their work, petunia plants in 100% sludge were bigger than control plants grown in the sand-peat medium but were smaller than plants in the 50% sludge:50% vermiculite medium (10). Generally, as the percentage of compost in the medium increases above 50%, plant growth can decrease as a result of high soluble salt concentrations, poor aeration, heavy metal toxicity, and/or phytotoxicity (8).

Initial and final soluble salt, N, P, K, Ca, and Mg concentrations linearly increased as the percentage of compost in the medium increased from 0 to 100%, but initial and final pH were not different among the media (Table 1). Although media pH can affect plant growth by influencing nutrient availability, there were no nutrient deficiencies or toxicities observed on the plants. There was no significant difference in dianthus or petunia shoot N, P, K, Ca, or Mg concentrations for plants grown in the four media (data not shown). The above optimum and/or high initial soluble salt, N, P, K, Ca, and Mg concentrations in 100% compost probably suppressed plant growth while below optimum and/or low initial soluble salt, N, P, K, Ca, and Mg concentrations in 0% compost contributed to poor plant growth in this media (Table 1). Differences between initial and final media pH and soluble salt, N, P, K, Ca, and Mg concentrations may be due to addition of fertilizer, irrigation water, and/or leaching of ions. For example, final soluble salt concentrations in media containing compost were ≈1.5× less than initial concentrations, indicating that ions responsible for the initial soluble salt concentrations were readily leached under normal bedding plant growing conditions (Table 1).

Physical parameters of media also can influence plant growth. Moisture content linearly decreased as the percentage of compost in the medium increased, but APS, WHC, and bulk density were not significantly different among the media (Table 2). Because there are no published standards for physical properties of bedding plant media, the suggested standard ranges for foliage plant media of 5 to 30% APS, 20 to 60% WHC, and 0.3 to 0.75 g/cm³ bulk density were used to evaluate the four media (6). Moisture content was evaluated based on values determined from numerous samples that suggest moisture contents of typical bedding plant media can range from 50% to 80% depending on the

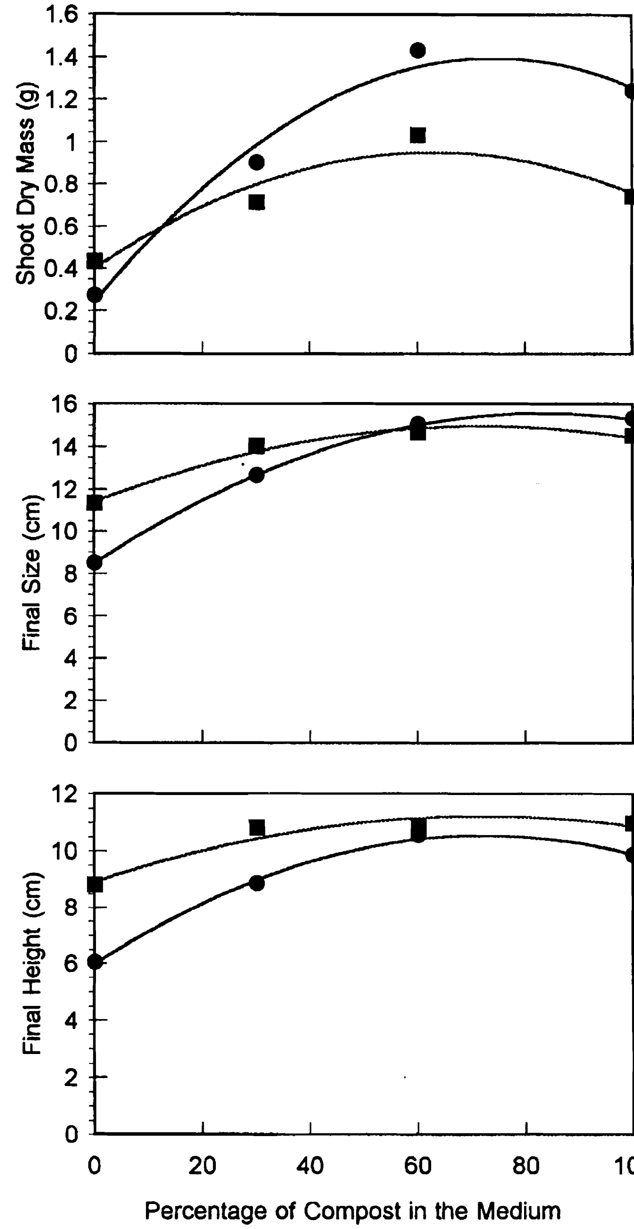

Fig. 1. Shoot dry mass, size and height of dianthus (-■-) and petunia (-●-) plants grown in media containing 0, 30, 60, or 100% compost made from biosolids and yard trimmings. Values are means of five replicates. Equations for shoot dry mass are: $y = -0.0001x^2 + 0.02x + 0.40$, $r^2 = 0.49$ (dianthus) and $y = -0.0002x^2 + 0.03x + 0.24$, $r^2 = 0.63$ (petunia). Equations for size are: $y = -0.0007x^2 + 0.10x + 11.40$, $r^2 = 0.36$ (dianthus) and $y = -0.001x^2 + 0.17x + 8.46$, $r^2 = 0.56$ (petunia). Equations for height are: $y = -0.0004x^2 + 0.06x + 8.90$, $r^2 = 0.35$ (dianthus) and $y = -0.0009x^2 + 0.13x + 5.97$, $r^2 = 0.43$ (petunia).

Table 1. **Initial and final media pH and soluble salt, nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), and magnesium (Mg) concentrations of media containing 0, 30, 60, or 100% compost made from biosolids and yard trimmings.**

Percentage of compost in the medium	pH	Soluble salts (dS/m)	N	P	K	Ca	Mg
					(ug/g)		
			Initial medium analysis				
0	4.7[z]	0.03	15	6	56	115	130
30	4.6	0.34	69	31	160	570	136
60	6.4	0.50	134	63	272	1170	198
100	6.5	0.83	152	80	444	1795	314
Significance[y]	NS	$L^{0.006}$	$L^{0.04}$	$L^{0.02}$	$L^{0.001}$	$L^{0.004}$	$L^{0.04}$
			Final medium analysis[x]				
0	6.6	0.28	19	10	24	678	126
30	7.1	0.19	25	44	36	1034	154
60	7.0	0.33	30	80	50	1268	162
100	6.8	0.58	62	80	69	1666	203
Significance	NS	$L^{0.02}$	$L^{0.0003}$	$L^{0.0001}$	$L^{0.0001}$	$L^{0.0001}$	$L^{0.0001}$
Suggested standard[w]	5.5 to 6.5	0.2 to 1.0	25 to 150	12 to 60	50 to 250	500 to 5000	50 to 500

[z]Values are means of three replicates.

[y]NS or L indicate a non significant response or a linear response, respectively.

[x]Final medium analysis was not different among petunia and dianthus plants; therefore final medium analyses were combined.

[w]Suggested standards are from recommendations from A&L Southern Agriculture Laboratories who used a Morgan extract.

Table 2. **Initial air-filled porosity, water-holding capacity, bulk density, and moisture content of media containing 0, 30, 60, or 100% compost made from biosolids and yard trimmings.**

Percentage of compost in the medium	Air-filled porosity (%)	Water-holding capacity (%)	Bulk density dry (g/cm³)	Moisture content (%)
0	21.7[z]	71.7	0.12	72.6
30	39.1	39.1	0.19	57.4
60	17.4	43.5	0.31	57.2
100	27.2	25.0	0.32	31.9
Significance[y]	NS	NS	NS	$L^{0.045}$

[z]Values are means of three replicates.

[y]NS or L indicate a non significant response or a linear response, respectively.

media components (4). Based on these guidelines, 0% compost had above optimum WHC, high moisture content and below optimum bulk density in addition to low nutrient concentrations, while 100% compost had below optimum moisture content in addition to high nutrient concentrations that also could have contributed to poor plant growth in these media.

Best dianthus and petunia growth was in the medium with 60% composted biosolids and yard trimmings and that had an initial APS of ≈15 to 20%, a WHC of ≈30 to 40%, a moisture content of ≈50 to 60%, a pH of ≈6.5, a soluble salt concentration of ≈0.50 dS/m, a N concentration of ≈135 ppm, a P concentration of ≈60 ppm, a K concentration of ≈250 ppm, a Ca concentration of ≈1170 ppm, and a Mg concentration of ≈200 ppm.

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