Container and Field Evaluation of *Gaillardia pulchella* Production in Compost-based Media©

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Medium composition effects on growth of blanketflower (*Gaillardia pulchella*) Foug. were determined during container (greenhouse) production and subsequent field plantings. At 10 weeks, plant height and shoot dry weight were greater for plants grown in the compost-based medium or compost alone than for plants grown in the peat-based medium. However, incorporation of compost in the medium did not affect growth index, leaf greenness, flowering, root mass, or post performance in the landscape.

INTRODUCTION

The physical properties of peat make it an excellent component of container media for ornamental plant production. Both environmental and economical implications of peat usage have resulted in the development of new substrate substitutes worldwide. Fitzpatrick (2001) has reviewed and cited numerous investigations illustrating the beneficial effect of compost (waste by-product) utilization in greenhouse and nursery crop production systems. The use of compost as a complete or partial replacement for peat in soil mixtures has yielded plants of comparable quality to those produced in traditional peat-based media (Wilson et al., 2001). However, results varied by plant species and lacked subsequent post-performance field assessments. Also, despite the rising interest and applications of native landscaping, previous research primarily has focused on non-native plants. The objectives of this study were to compare peat- and compost-based media for container production and landscape performance of a popular U.S.A. native, *Gaillardia pulchella*.

MATERIALS AND METHODS

Uniform blanketflower plugs (D.R. Bates Nursery, Loxahatchee, Florida) were transplanted into 3.8-liter (1-gal) plastic pots filled with a compost-based medium formulated on site [5 pine bark : 4 compost : 1 coarse sand, (by volume)]. Additional containers were filled with compost alone or a peat-based commercial soilless mix [5 pine bark : 4 Florida peat : 1 coarse sand, (by volume)] (Atlas 3000, Atlas Peat and Soil Inc., Boynton, Florida). Compost was generated by the Palm Beach County Solid Waste Authority (West Palm Beach, Florida) using a 1 biosolids : 1 yard trimmings [screened to 0.64 cm (0.25 in)] (w : w). All plants were topdressed at a manufacture recommended rate of 15 g (0.53 oz) per pot of 15N : 3.9P : 10K Osmocote Plus®.

Percent moisture, air-filled porosity, total porosity, container capacity, bulk density, and particle density were determined on five samples from each medium. Chemical and nutrient composition, EC, pH were determined on three samples from each medium prior to adding slow-release fertilizer. Total C and N concentrations were determined by a CNS analyzer (Carlo-Erba Na-1500; BICO, Burbank, California).

Table 1. Chemical and physical properties of compost and peat-based media[z].

Medium[y]	pH	EC ($mmho\cdot cm^{-1}$)	Air filled porosity	Total porosity (% by vol)	Container capacity	Bulk density ($g\cdot cm^{-3}$)	Particle density ($g\cdot cm^{-3}$)
Peat-based	6.58 a[x]	1.63 c	5.08	48.0 a	43.0 a	0.23 b	0.46 b
Compost-based	5.97 b	5.73 b	4.06	41.6 b	38.0 b	0.33 a	0.57 a
Compost	6.53 a	11.2 a	6.67	50.8 a	44.0 a	0.20 c	0.42 b

[z] Data measured prior to transplanting.

[y] Peat-based commercial mix consists of 4 peat : 5 pine bark : 1 coarse sand (by volume). Compost-based mix consists of 4 compost : 5 pine bark : 1 coarse sand (by volume). Compost consists of 1 yard waste : 1 biosolids (w : w).

[x] Means separation by Duncan's Multiple Range Test, 5% level.

The Environmental Protection Agency method 3050 (USEPA, 1998) was used to determine total P, K, Ca, Mg, Fe, Zn, Cu, Mn, and B. An acid digestion procedure was used to prepare the samples for analysis by Inductively Coupled Argon Plasma Spectroscopy (ICP) (Model 61E, Thermo Jarrell Ash Corp, Franklin, Massachusetts). Samples were air-dried for 2 days and ground to a powder with a ball mill grinder. A portion of the sample (1.0 g) was digested in nitric acid then treated with 30% hydrogen peroxide. The sample was then refluxed with nitric acid, filtered through Whatman filter paper (no. 41), and diluted to 100 mL for analyses.

Plant height and perpendicular widths were measured bi-weekly. After 10 weeks, leaf greenness, dry shoot weight, and dry root weight of five plants from each treatment were measured. SPAD readings were measured on the fifth, sixth, and seventh leaves of the predominant stem using a handheld chlorophyll meter. Stems were separated from the roots at soil level and the roots were washed to remove media prior to oven drying at 74 °C (165 °F) for 7 days. For subsequent field evaluations, the remaining plants were transplanted (13 April 2004) 0.91 m (3 ft) on center on raised beds covered with landscape fabric. Plants were watered by seep irrigations as needed. Field conditions were as follows: 2.5% organic matter, pH 5.3, average monthly rainfall 3.31 cm (1.3 inch), mean minimum and maximum temperatures 14.9 °C (57 °F) and 35 °C (93 °F), respectively, and relative humidity 74.0%. Plants were evaluated based on flowering and visual quality bi-weekly for 12 weeks after planting. Flower ratings were based on a scale of 1–5, where 1 = no flowers or buds present, 2 = flower buds present, 3 = a few open flowers, 4 = many open flowers, and 5 = abundant open flowers. Visual quality (color and form) ratings were based on a scale of 1 to 5 with 1 indicating very poor quality and 5 indicating excellent quality.

In the greenhouse study, a randomized complete block experimental design was used with 5 single plant replications for each medium. The field study utilized a randomized complete block experimental design with 3 replications (three single plant samples per treatment per block). All data were subjected to an analysis of variance (ANOVA) and means separated by Duncan's Multiple Range Test at $P \leq 0.05$.

RESULTS AND DISCUSSION

Physical, Chemical, and Nutrient Characteristics of the Media. Compost-based media had lower pH, total porosity, container capacity, and higher bulk density, and particle density than peat-based media or compost alone (Table 1). Higher bulk density generally corresponds to a lower porosity (Poole, et al., 1981). The EC of the compost-based medium was three times higher than that of the peat-based medium. High EC values have been reported for other biosolids and yardwaste composts (Varrina, 1994), and would adversely affect salt-sensitive species.

Compost or compost-based media had higher N content than the peat-based medium (Table 2). Organic wastes have been reported as a valuable source of N (Sims, 1995). Composts with C : N ratios less than 20 are considered stable and optimum for plant growth (Davidson et al., 1994), while those with ratios greater than 30 may result in plant phytotoxicity and N immobilization (Zucconi et al., 1981). The compost-based medium had substantially more P and K than the peat-based medium (Table 2). Phosphorus and K are often present at higher levels in compost media, which correlates with higher EC (McLachlan et al., 2004). Heavy metal contents did not exceed the Environmental Protection Agency (EPA) levels for biosolids application (USEPA, 1994) for any substrate (data not presented).

Growth and Development. Regardless of the medium, at 10 weeks all plants were considered marketable (Fig. 1). The average height of plants grown in the compost-based medium was consistently greater than the average height of plants grown in the peat-based medium (Fig. 2). This is consistent with results of Wightman et al. (2001), who reported that hardwood

Table 2. Elemental contents of compost and peat-based media[z].

Medium[y]	N	C	C/N	P	K	Ca	Mg	Zn	Cu	Mn	Al	Fe	B
	(%)		ratio	concentration (mg·kg^{-1})									
Peat-based	0.52 c[x]	31.8 a	60.7 a	103 c	267 c	13300 b	3660 a	5.4 c	3.6 c	20.1 c	1326 c	1174 c	11.0 b
Compost-based	0.84 b	24.3 b	28.9 b	3540 b	1937 b	13940 b	1105 c	40.9 b	58.0 b	48.4 b	1703 b	4162 b	15.6 b
Compost	2.43 a	30.7 a	12.7 c	10410 a	7150 a	47143 a	3096 b	102.3 a	166.4 a	115.6 a	3749 a	10557 a	34.8 a

[z] Data measured prior to transplanting.

[y] Peat-based commercial mix consists of 4 peat : 5 pine bark : 1 coarse sand (by volume). Compost-based mix consists of 4 compost : 5 pine bark : 1 coarse sand (by volume). Compost consists of 1 yard waste : 1 biosolids (w : w).

[x] Means separation by Duncan's Multiple Range Test, 5% level.

Table 3. Mean plant growth, leaf color, flowering, and dry weight of blanket flower (*Gaillardia pulchella*) grown in peat- and compost-based media after 10 weeks.

Medium[z]	Growth index[y]	Leaf color (SPAD)	Flower (no.)	Shoot dry weight (g)	Root dry weight (g)	Shoot : root ratio
Peat-based	36.8[x]	36.4	10.6	14.1 b	2.7	6.2
Compost-based	41.7	35.4	11.0	20.4 a	3.7	5.7
Compost	39.6	36.8	12.6	19.4 a	3.0	6.6

[y] Peat-based commercial mix consists of 4 peat : 5 pine bark : 1 coarse sand (by volume). Compost-based mix consists of 4 compost : 5 pine bark : 1 coarse sand (by volume). Compost consists of 1 yard waste : 1 biosolids (w : w).

[y] Measured as [(plant height + width 1 + width 2)/3].

[x] Means separation by Duncan's Multiple Range Test, 5% level.

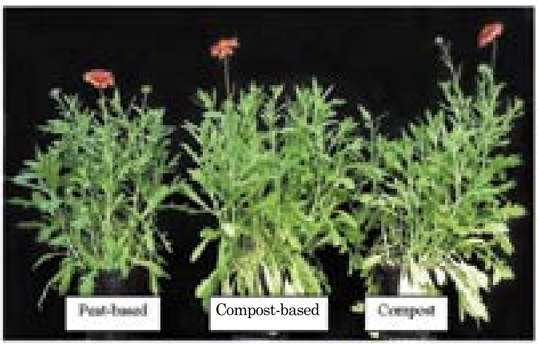

Figure 1. *Gaillardia pulchella* grown in peat- and compost-based media for 10 weeks.

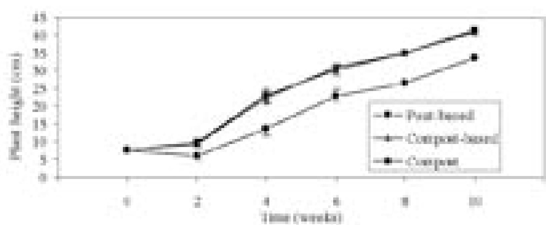

Figure 2. Bi-weekly plant height of blanketflower (*Gaillardia pulchella*) grown in compost and peat-based media. Vertical bars represent standard error for each treatment at each time interval.

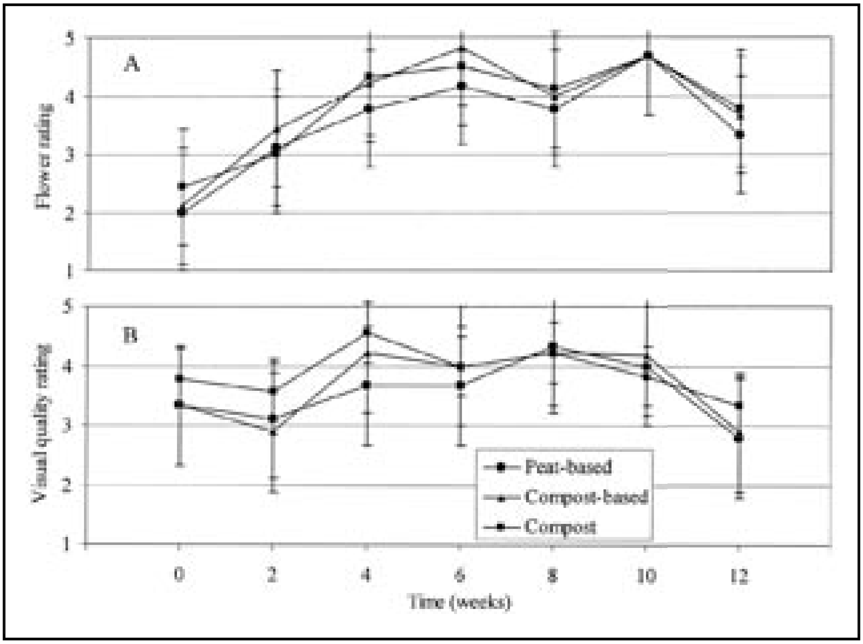

Figure 3. Post-transplant flower (A) and visual quality (B) assessment of blanketflower (*Gaillardia pulchella*) grown in peat- and compost-based media. Flower ratings and visual quality (color and form) were based on a scale of 1–5. Vertical bars represent standard error for each treatment at each time interval.

seedlings grown in compost-based media maintained a height advantage over those grown in un-amended soil. Compost had no effect on growth index, leaf color, flower number, root dry weight, or shoot : root ratio. Shoot dry weight was 45% greater in compost-based media than in peat-based media (Table 3).

Subsequent to field transplanting, plants received similar flower and visual quality ratings regardless of initial container medium used (Fig. 3). This can be significant for *Gaillardia* landscape performance since it is native to sandy soils (minimal organic matter content).

In the past, variation within and between commercial compost facilities reduced the quality of compost for horticultural enterprises. Horticultural grade composts of sufficient quantity and quality are now being produced by private enterprises and public municipalities and marketed at economical values. Therefore, composts may be a viable substitute for peat use in containerized nursery media, while maintaining sufficient plant growth, development, and ultimately, plant quality.

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