Using compost for container production of ornamental wetland and flatwood species native to Florida

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ABSTRACT

Seven ornamental species, coastal plain tickseed *(Coreopsis gladiata* Walt. [Asteraceae]), swamp sunflower *(Helianthus angustifolius* L. [Asteraceae]), climbing aster *(Ampelaster carolinianus* (Walt.) Nesom [Asteraceae] syn = *Aster carolinianus* Walt.), pineland lantana *(Lantana depressa* Small [Verbenaceae]), spotted beebalm *(Monarda punctata* L. [Lamiaceae]), blackeyed Susan *(Rudbeckia hirta* L. [Asteraceae]), and Carolina wild petunia *(Ruellia caroliniensis (J.F.* Gmel.) Steud. [Acanthaceae]) were transplanted in containers filled with a biosolid:yard waste compost, a commercial peat-based mix, or a formulated compost-based mix (4:5:1, compost:pine bark:sand, v:v:v). At 8 wk, plants grown in compost or the medium amended with compost had similar (coastal plain tickseed and swamp sunflower) or greater (climbing aster, pineland lantana, spotted beebalm, blackeyed Susan, and Carolina wild petunia) biomass than plants grown in the peat-based medium. This study suggests that compost may serve as a viable alternative substrate for peat in the production of ornamental wetland and flatwood species native to Florida.

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KEY WORDS

Ampelaster carolinianus, Aster carolinianus, Coreopsis gladiata, Helianthus angustifolius, Lantana depressa, Monarda punctata, Rudbeckia hirta, Ruellia caroliniensis, Symphyotrichum carolinianum, biosolids

NOMENCLATURE

USDA NRCS (2006)

Both environmental and economical implications of peat usage have resulted in the development of new substrate substitutes worldwide, most of which utilize waste by-products. Twenty-one states have banned the dumping of at least some forms of yard trimmings in their landfills (Kaufman and others 2004). There is an abundant supply of commercially available, horticultural-grade composting material in the US. In efforts to utilize organic waste materials, researchers have found that compost can successfully grow a wide range of crops including bedding annuals (Klock-Moore 1999), perennials (Wilson and others 2001), sod (O'Brien and Barker 1995), vegetables (Roe and others 1997), woody shrubs and trees (Fitzpatrick and others 1998), and foliage plants (Fitzpatrick 2001). While the varying types of feedstocks, degree of sophistication of composting facilities, and varying levels of maturity prevent overgeneralizations of its recommended use (Raviv 2005), utilization of urban waste compost products for container media has been well reviewed for ornamental production (Fitzpatrick 2001; Moore 2005). Compost-related ornamental research has addressed various production aspects as well, such as plant nutrition (Wilson and others 2003), species specificity (Wilson and others 2001), salinity (Klock 1997), and irrigation (Wilson and others 2003). Few studies, however, have addressed the use of yard waste/biosolid compost for container native plant production. Th[e] objective of this investigation was to develop a compost-based medium suitable for container production of native plants associated with wetland and flatwood ecosystems.

Florida has more than 2400 native species of plants (Wunderlin and Hansen 2003) that have long-term survival rates because of their early adaptation to our soils, temperature, and rainfall patterns. Interest in and application of native plant use in the landscape is increasing because of the natural beauty, wildlife benefits, and low maintenance requirements characteristic of many natives. About 23 percent of the native flora of Florida is in commercial production (AFNN 2005). Subsequently, container media compositions are being continually modified to optimize native plant production. In an earlier study (Wilson and others 2004), compost was used to grow 4 hammock species native to Florida, including butterfly sage *(Cordia globosa (Jacq.)* Kunth [Boraginaceae]), firebush *(Hamelia patens* Jacq. [Rubiaceae]), scorpion's-tail *(Heliotropium angiospermum* Murr. [Boraginaceae]), and tropical sage *(Salvia coccinea* P.J. Buc'hoz ex Etl. [Lamiaceae]). Wilson and others (2004) reported that compost in the medium used in container production increased plant height of each species evaluated with the exception of H. *angiospermum.* Seven species were chosen for this study based on their native origin, popularity among consumers, and proven performance in Florida landscapes.

MATERIALS AND METHODS

Plant Material and Media Composition

Uniform plugs (4 wk old from cuttings) of coastal plain tickseed *(Coreopsis gladiata* Walt. [Asteraceae]), swamp sunflower *(Helianthus angustifolius* L. [Asteraceae]), climbing aster *(Ampelaster carolinianus* (Walt.) Nesom [Asteraceae] syn = *Aster carolinianus* Walt.) but recognized by Wunderlin and Hansen (2003) as *Symphyotrichum carolinianum* (Walt.) Wunderlin & B.F. Hansen [Asteraceae]), pineland lantana *(Lantana depressa* Small [Verbenaceae]), spotted beebalm *(Monarch punctata* L. [Lamiaceae]), blackeyed Susan *(Rudbeckia hirta* L. [Asteraceae]), and Carolina wild petunia *(Ruellia caroliniensis (J.F.* Gmel.) Steud. [Acanthaceae]) (propagated by S Riefler, Davenport, Florida) *were* transplanted into 3.7 1(1 gal) cylindrical plastic pots filled with a compost-based medium formulated on-site (50% pine bark, 40% compost, and 10% coarse sand, v:v:v) (Tables 1 and 2). Additional containers were filled with compost alone (from the same stock as that used for the compost-based mix) or with 100% peat-based commercial soilless mix (50% pine bark, 40% Florida peat, and 10% coarse sand, v:v:v) (Atlas 3000, Atlas Peat and Soil Inc, Boynton, Florida). Compost was generated by the Solid Waste Authority of Palm Beach County, West Palm Beach, Florida, using a 1:1 ratio (w:w) of biosolids and yard trimmings (screened to 0.64 cm [0.25 in]). Materials were composted for 18 d in an agitated bed system, stockpiled, and then rescreened to 0.64 cm (0.25 in). Within 24 hr following transplanting (initiation of experiment), all plants were top-dressed at a manufacturer's recommended rate of 15 g (0.53 oz) per pot of 15N:3.9P2O5:10K_2O Osmocote Plus (The Scotts Co, Marysville, Ohio) and treated with a 1% granular systemic insecticide imidacloprid (Marathon', Olympic Horticultural Products, Bradenton, Florida) at a manufacturer's recommended rate of 0.37 g/l (0.03 oz/gal) and a broad-spectrum systemic fungicide etridiazole (Banrot, The Scotts Co, Marysville, Ohio) at a manufacturer's recommended rate of 0.9 g/l (0.12 oz/gal). Mean minimum and maximum temperatures in the greenhouse were 18 °C and 32 °C (64 °F and 90 °F) during the experiment.

Plant Growth and Development

Plant height, leaf greenness, dry weight, and flower number were measured after 8 wk. Final plant height was measured from the crown (near soil level) to the shoot apex of the primary stem. Leaf greenness was measured on the third, fourth, fifth, and sixth leaf from the apex of each plant using a SPAD-502 chlorophyll meter (Minolta Camera Co, Osaka, Japan). Flower number was recorded only on the day of harvest and represented flower buds and immature or mature flowers. Shoots were severed at the crown, and roots were manually washed prior to oven drying for 7 d at 70 °C (158 °F).

TABLE 1

Botanical description, habitat, and hardiness of 3 native wetland species of *Florida.*

			
Botanical name	*Coreopsis gladiata*	*Helianthus angustifolius*	*Ampelaster carolinianus*
Authority	Walter	L.	(Walt.) Nesom
Family	Asteraceae	Asteraceae	Asteraceae
Common name	Coastal plain tickseed	Swamp sunflower	Climbing aster
Florida native habitat	Wet flatwoods	Marshes, wet flatwoods	Swamps and river banks
USDA hardiness zone	7A to 10B	6A to 10A	6A to 10B
Form	Perennial (0.6 to 0.9 m)	Herbaceous perennial (1.2 to 1.8 m)	Semi-woody vine-like perennial (2.4 to 3.0 m)
Ornamental features	Leaves lance-shaped; brilliant yellow ray flowers are notched at the ends and accented by maroon disks	Leaves are scabrous above and pubescent beneath; numerous attractive yellow disk and ray flowers	Leaves are sessile and clasp around stems; numerous pink to lavender ray petals accented around yellow disks

Conversion: m*3.3 = ft

TABLE 2

Botanical description, habitat, and hardiness of 4 pineland or flatwood species of Florida.

				
Botanical name	*Lantana depressa*	*Monarda punctata*	*Rudbeckia hirta*	*Ruellia caroliniensis*
Authority	Small	L.	L.	J.F. Gmel.) Steud.
Family	Verbenaceae	famiaceae	Asteraceae	Acanthaceae
Common name	Pineland lantana	Spotted beebalm	Blackeyed Susan	Carolina wild petunia
Florida native habitat	Rocky pinelands	Flatwoods and dry disturbed sites	Sandhills, flatwoods, and open disturbed sites	Sandhills, flatwoods, and hammocks
USDA hardiness zone	8A to 11	5A to 10B	5A to 10B	6A to 10B
Form	Semi-woody evergreen (0.9 to 1.2 m)	Herbaceous perennial (0.9 to 1.2 m)	Herbaceous perennial (0.6 to 0.9 m)	Herbaceous perennial (0.3 to 0.6 m)
Ornamental features	Rugose and aromatic leaves; showy yellow flowers are bracteate heads produced in	Pubescent and aromatic leaves; flowers are accented by showy pink to purplish bracts	Scabrous and pubescent leaves; flowers are showy with yellow rays central disk a dark brown raised at the base and with splashes of maroon	Pubescent, simple leaves; five-petaled purple produced in leaf axils

Conversion: m*3.3 = ft

Experimental Design and Statistical Analysis

A randomized complete block experimental design was used for each species with treatments (3 media) replicated 5 times. Ail data within each species evaluated were subjected to an analysis of variance (ANOVA) and significant treatment means separated by Duncan's multiple range test at $P < 0.05$.

RESULTS AND DISCUSSION

Wetland Species

Use of compost in the medium did not affect plant height, leaf color, shoot dry weight, root dry weight, or the shoot-to-root ratio of coastal plain tickseed or swamp sunflower when compared with the peat-based commercial standard (Table 3; Figure 1). Incorporation of compost in the medium also did not affect plant height, leaf color, or root dry weight of climbing aster; however, it did produce shoot dry weights that were 2.4 to 2.7 times greater than that of plants grown in the peat-based medium (Table 3). A previous study assessed the physical and chemical properties of the compost- and peat-based mixes used in the present study and found that the formulated compost-based medium had a lower initial moisture, pH, total porosity, and container capacity than did the peat-based media, but a higher EC and higher bulk and particle densities (Wilson and others 2004). Also, compost had higher N, P, K, Zn, Cu, Nth, Al, and Fe content than the peat-based media (Wilson and others 2004).

Flatwood Species

Use of compost, or media amended with compost, increased plant height by 49% to 69% for pineland lantana and 85% to 116% for Carolina wild petunia, as compared with the peat-based medium (Table 4; Figure 2). Plant height of spotted beebalm and blackeyed Susan, however, was similar among media. Regardless of the species, media composition did not affect leaf color. Flower quantity was also not affected, with the exception of Carolina wild petunia, where plants grown in peat-based media had 3 to 4.5 times fewer flowers than plants grown in compost or compost-based media (Table 4; Figure 2). Shoot dry weight of plants grown in compost doubled (spotted beebalm and blackeyed Susan), tripled (Carolina petunia), and even quadrupled (pineland lantana), as compared with plants grown in the peat-based mediu in. However, compost increased the root dry weight of only Carolina petunia. This resulted in similar shoot-to-root ratios among species, with the exception of Carolina petunia, which had greater shoot-to-root ratios when grown in compost or compost-based media. These results are consistent with Wilson and others (2004) who evaluated the effects of corn-post on native hammock species and found that shoot dry weights of butterfly sage *Cordia globosa* (Jacq.) Kunth

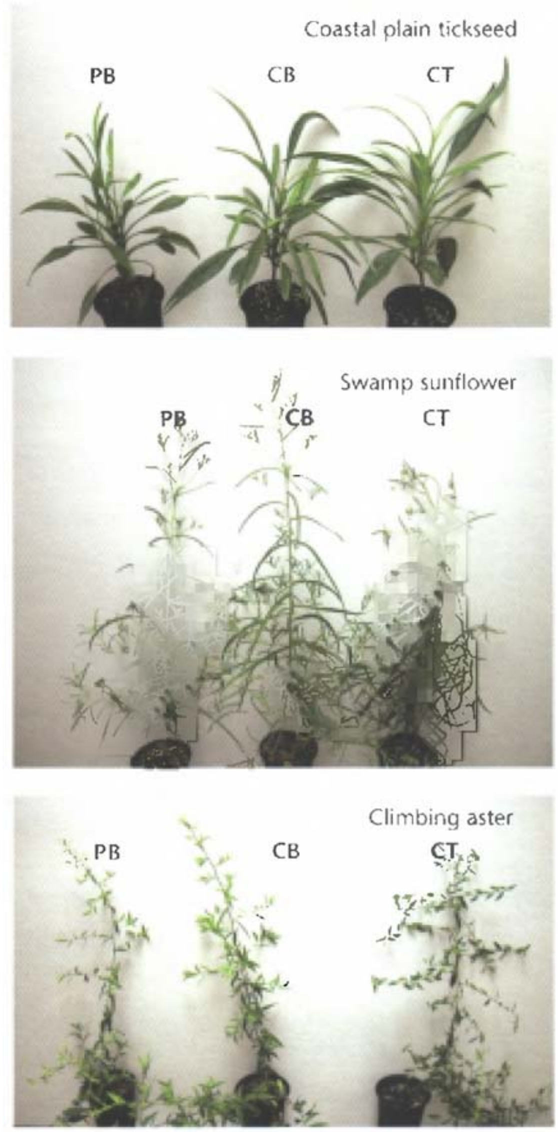

Figure 1. Appearance of Florida native wetland species grown for 8 wk in media amended with compost. PB - peat-based commercial mix (40% Florida peat, 50% pine bark, 10% coarse sand); CB = compost-based mix (40% compost, 50% pine bark, 10% coarse sand); CT = compost (50% yard waste: 50% biosolids)

TABLE 3

Mean plant growth or Florida native wetland species grown for 8 wk in compost or media amended with compost or sedge peat.

Species	Medium	Plant height (cm)	Leaf color (SPAD)	Shoot dry weight (g)	Root dry weight (g)	Shoot:root ratio
Coastal plain tickseed						
	Peat-based	42.6	57.3	6.3	1.4	4.5
	Compost-based	34.1	55.9	9.7	1.7	5.6
	Compost	43.6	52.8	10.0	1.4	7.3
Swamp sunflower						
	Peat-based	95.4	38.6	14.4	0.9	18.7
	Compost-based	95.3	39.5	17.6	0.7	24.7
	Compost	88.9	38.4	20.7	1.0	25.8
Climbing aster						
	Peat-based	71.1	34.1	5.7 b[y]	0.9	6.2
	Compost-based	73.0	25.1	13.8 a	1.6	10.0
	Compost	74.4	29.0	15.3 a	1.9	9.5

Peat-based commercial mix (40% Florida peat, 50% pine bark, 10% coarse sand); compost-based mix (40% compost, 50% pine bark, 10% coarse sand); compost (50% yard waste:50% biosolids).
Y Means within each species were separated by Duncan's multiple range test at P a 0.05.
Conversions: cm/2.54 = in; g/28 = oz

[Boraginaceae]), firebush (*Hamelia patens* Jacq. [Rubiaceae]), scorpion's-tail *(Heliotropinum angiospermum* Murr. [Boraginacea]), and tropical sage *(Salvia coccinea* P.J. Buc'hoz ex Etl. [Lamiaceae]) were 1.5 to 8.0 times greater than that of plants grown in a peat-based medium. It is interesting to note, however, that in previous studies using herbaceous nonnative species, compost (when used in quantities greater than 50%) actually decreased shoot biomass of 7 of the 10 nonnative species evaluated (Wilson and others 2001). Conceivably, the native plants used in this study were not subjected to the years of selection and precisely controlled production practices that many nonnative flowering perennials undergo, and are therefore more responsive to the enriched organic matter composition of compost.

In summary, each native species grown in compost or compost-based media grew as well as or better than those in peat-based media. As the cost of peat Continues to rise due to increases in transportation and mining expenses, utilization of horticultural-grade compost is commercially warranted. These results suggest that compost can serve as a viable alternative to peat for container native plant production.

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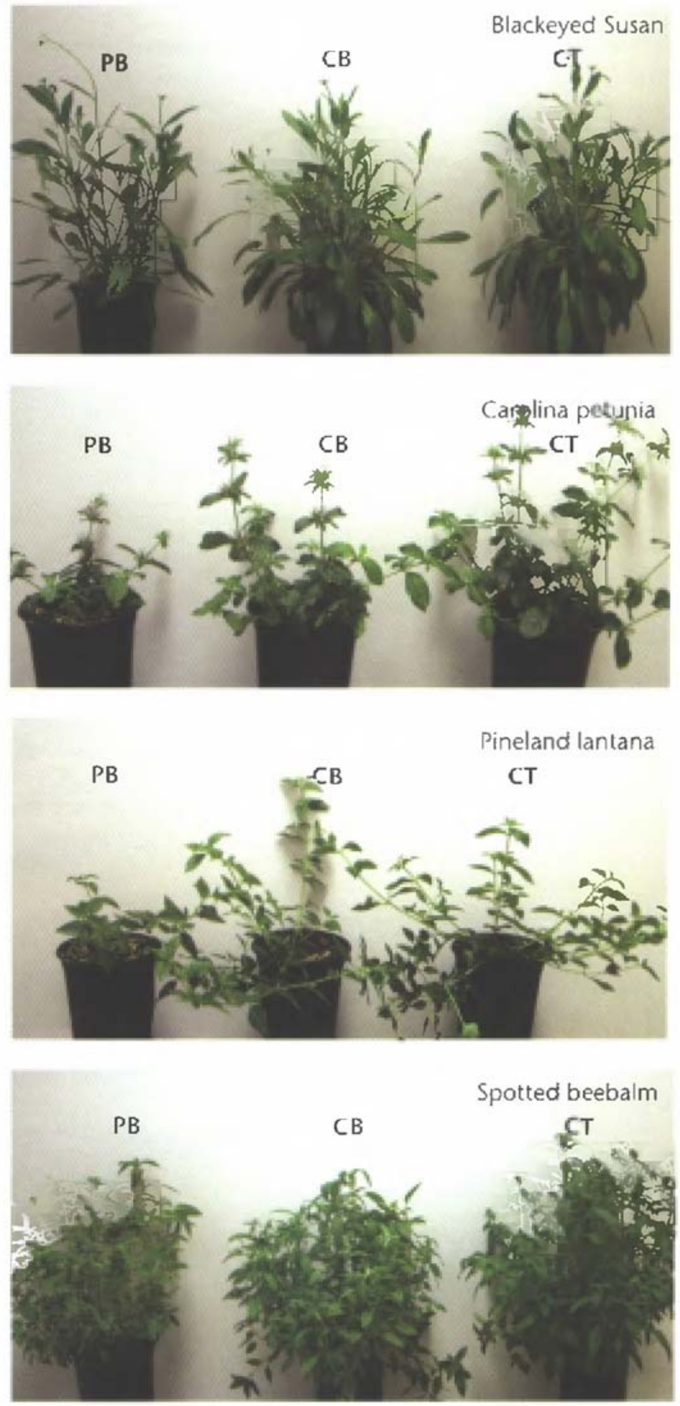

Figure *2.* Appearance of Florida native pineland or flatwood species grown for 8 wk in media amended with compost. PB = peat-based commercial mix (40% Florida peat, 50% pine bark, 10% coarse sand); CB = compost-based mix (40% compost, 50% pine bark, 10% coarse sand); CT = compost (50% yard waste: 50% biosolids)

TABLE 4

Mean plant growth of Florida native pineland or flat wood species grown for 8 wk in compost or media amended with compost or sedge peat.

Species	Medium[z]	Plant height (cm)	Leaf color (SPAD)	Flowers (number)	Shoot dry weight (9)	Root dry weight (g)	Shoot:root ratio
Pineland lantana							
	Peat-based	31.0 b[y]	40.6	0.6	1.9 b	0.4	4.5
	Compost-based	46.3 a	40.9	1.2	5.0 ab	1.3	3.9
	Compost	52.5 a	41.6	1.8	7.9 a	1.8	4.5
Spotted beebalm							
	Peat-based	40.7	44.4	- x	7.6 b	8.9	0.9
	Compost-based	37.7	44.9	-	12.4 a	8.1	1.6
	Compost	39.0	46.0	-	14.8 a	10.0	1.5
Blackeyed Susan							
	Peat-based	50.8	45.4	14.4	5.8 b	7.5	0.8
	Compost-based	40.6	41.2	15.8	7.8 b	6.1	1.4
	Compost	47.9	41.2	26.0	11.8 a	8.0	1.7
Carolina petunia							
	Peat-based	15.0 c	43.6	39.8 c	1.9 c	1.7 b	1.1 c
	Compost-based	27.8 b	42.6	118.8 b	4.4 b	2.3 a	2.0 b
	Compost	32.4 a	46.9	180.6 a	6.5 a	2.5 a	2.6 a

[z] Peat based commercial mix (40% Florida peal, 50% pine bark. 10% coarse sand); compost-based mix (40% compost, 50% pine bark, 10% coarse sand); compost (50% yard waste:50% biosolids).

Y Means within each species were separated by Duncan's multiple range test al *P* > 0.05 (n= 5).

Plants did not flower during time frame of experiment.

conversions: cm/2.54 = in; g/28= oz

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