important when a practice such as irrigation exacerbates a pest problem such as the one caused by black vine weevil.

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Evaluation of Media Consisting of a Cotton Waste for the Production of Tropical Foliage Species[1]

Yin-Tung Wang[2]
Texas A&M University Agricultural Research and Extension Center
2415 East Highway 83
Weslaco, TX 78596

Abstract

Media consisting of composted cotton waste (CW) alone and CW in combination with bark or peat moss or both were evaluated for producing two tropical foliage species. Asian bell tree (*Radermachera sinica* (Hance) Hemsl.) grew satisfactorily in media with 25% or 50% CW, but had less dry weight when produced in CW-amended media with 50% bark. Australian umbrella tree (*Brassaia actinophylla* Endl.) had less dry weight when produced in media having 50% or more CW. Australian umbrella tree responded the most favorably to the medium containing 25% CW, 50% bark and 25% peat moss which resulted in the poorest Asian bell tree. Plant response to media consisting of CW appeared to be species dependent. Although there were differences in the initial pH of leachates collected from potting media, the differences were small at the termination of this experiment. The electrical conductivity of the leachate varied considerably among various media.

Index words: Container-grown crops, potting medium, pH, electrical conductivity

Species used in this study: Asian bell tree (*Radermachera sinica* (Hance) Hemsl.); Australian umbrella tree (*Brassaia actinophylla* Endl.)

Significance to the Nursery Industry

Composted cotton burrs or cotton gin trash has been used in the landscape for adding organic matter to mineral soils. Results from this study showed that composted cotton burrs may also be used satisfactorily for the production of selected tropical foliage plants. Incorporation of composted cotton waste into potting media may be practical due to the abundance of this material in some areas of the United States. However, it is important that it be used at proper proportions in relation to other ingredients for best plant growth.

Introduction

Producers of nursery crops are interested in cost-effective media that also provide improved growth of containerized plants. Since roots of potted plants grow in a limited volume of medium, managing the medium to provide a good rhizospheric environment with proper physical and chemical properties is important for production of quality plant materials.

Although plant species produced in containers are capable of growing in a wide range of soil types and potting media (3, 5, 7, 8, 11), studies have identified optimum medium composition for specific species or cultivars to obtain optimum growth and quality (2, 6, 15). With the increasing cost of peat moss, which has traditionally been used in potting media, various cost-effective alternative materials have been tested and sometimes improved plant production has resulted. For example, ligustrum (*Ligustrum japonicum* Thunb. var. rotundifolium Blume) and dwarf oleander (*Nerium oleander* L.) in media with urban waste products grew 25% larger than plants grown in a conventional medium containing peat moss (4). Composted bagasse (sugarcane fiber) was used successfully for the production of several

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[2]Associate Professor.

Table 1. Particle size distribution of the composted cotton waste. Means are averages of four replicates.

Particle size (mm)	Distribution (% weight) Mean ± SE
> 8.0	7.93 ± 1.23
8.0–6.3	6.26 ± 0.34
6.3–4.0	28.57 ± 3.07
4.0–2.0	41.84 ± 1.97
2.0–1.0	10.80 ± 1.50
1.0–0.5	2.41 ± 0.34
< 0.50	2.00 ± 0.42

ornamental plant species, however, incorporation of fresh bagasse in medium resulted in slow plant growth (12).

The cotton industry generates a large amount of wastes from the processing of harvested cotton. Properly composted cotton waste has a C:N ratio of 13 and a cation exchange capacity of about 200 milliequivalents per 100 cm^3 (1). It was shown to have potential for poinsettia production (16). Since tropical foliage plant species have different requirements for light and nutrition than potted flowering species, it was not known whether this cotton waste product is useful in producing foliage plants. Objectives of this study were to evaluate growth of two tropical foliage plant species in response to media having various proportions of composted cotton waste during summer production and to monitor media pH and total soluble salts.

Materials and Methods

The one and a half-year-old cotton waste was composted for 8 weeks and had a bulk density of 0.26 g/cm^3 (15.7 lb/ft^3) when dry. The material had 70% total porosity when dry and 19% air-filled porosity at 1 centibar of moisture tension. Eighty liters (21 gal) of the composted cotton waste was mixed with 4 l (1.1 gal) of water for 3 minutes in a rotary mixer. The addition of water was necessary to prevent the small particles from being lost during mixing. To determine the particle size distribution, four 100 g (3.5 oz) air-dried samples were sieved for three minutes with a CSC-Meinzer sieve shaker (Model 18480-033, CSC Scientific Company, Inc., Fairfax, Va) adjusted electronically to give 150 shakes per minute. U.S. standard testing sieves with openings of 8.0, 6.3, 4.0, 2.0, 1.0, and 0.5 mm (5/16 in, 1/4 in, and 5, 9, 16, and 32 mesh, resp.). The materials remained on each sieve and those passing through the 0.5 mm sieve were weighed and each fraction was expressed as a percentage of the total weight.

Nine potting media consisted of composted cotton waste, composted pine bark and Canadian sphagnum peat moss in various proportions (Table 1). The media was designed with the ratios of the three components in such a way that, in several treatments, plant response to substituting one ingredient for another could be determined. The ingredients of each were mixed in a rotary mixer for three minutes with a small amount of water added. All media received 3.5 kg/m^3 (5.6 lb/yd^3) dolomitic limestone and 1 kg/m^3 (1.6 lb/yd^3) Micromax. Seedling plants of Asian bell tree (*Radermachera sinica* (Hance) Hemsl.) and Australian umbrella tree (*Brassaia actinophylla* Endl.) were obtained from a commercial nursery and planted on June 23, 1989 in 2 l (≈0.5 gal) pots. The greenhouse had one layer each of 73% polypropylene light exclusion fabric and 0.15 mm (6 mil) clear polyethylene, having approximately 420 $\mu mol \cdot m^{-2} \cdot s^{-1}$ (≈3000 ft-c) maximum light. Plants were fertilized weekly with 24N-3.5P-13.8K (Peters 24-8-16) water soluble fertilizer at 0.84 g/l (1.1 oz/10 gal). Each pot received 7.5 g/pot (≈0.25 oz/pot) of 18N-2.6P-10.3K (18-6-12) Osmocote slow release fertilizer on July 5, 1989. Daminozide (B-Nine formulation) at 2500 ppm was sprayed on the foliage of all plants on July 24. Medium leachates were collected on June 30, August 11, and September 28 as previously described (14) for the determination of pH and electrical conductivity (indicative of the soluble salt level).

This experiment was terminated on September 29, 1989. The number of leaf pairs and the length, width and number of leaflets were recorded on the uppermost, fully expanded leaf of Asian bell tree. Australian umbrella tree was evaluated for plant width, stem diameter, leaf number, as well as the length, width, petiole length and area of the youngest matured leaf. Plant height and dry weight were determined for both species. There was one plant per pot as an experimental unit and treatments were replicated 10 times in a randomized complete block design.

Table 2. Growth of Asian bell tree (*Radermachera sinica*) as affected by medium composition[z].

Ratio CB:BK:PM	Height (cm)	Uppermost leaf Length (cm)	Uppermost leaf Width (cm)	Uppermost leaf Leaflet no.	No. leaf pairs	Dry wt. (g)
4 0 0	25.6	21.9	21.1	48.9	12.8	13.2
3 1 0	27.6	22.2	20.6	48.4	13.0	14.8
3 0 1	28.6	23.3	20.5	61.9	13.3	14.9
2 1 1	26.8	22.2	20.0	52.8	13.3	15.8
1 2 1	25.8	23.1	20.8	43.3	12.8	12.8
1 1 2	28.6	24.9	22.9	59.1	12.1	16.9
1 1 0	27.7	21.3	19.9	44.1	13.1	13.3
1 0 1	28.7	23.1	21.5	51.0	13.4	15.5
0 1 1	29.9	23.7	20.7	53.4	12.6	16.8
$LSD_{0.05}$	3.2	2.1	2.0	10.9	0.9	1.7

[z]Composted cotton waste was used in most media at various proportions. CW-cotton waste; BK-bark; PM-peat moss. The medium with equal volumes of bark and peat moss was used as the control.

Table 3. Growth of Australian umbrella tree *Brassaia actinophylla* as affected by medium composition[z].

Ratio CB:BK:PM	Height (cm)	Width (cm)	Stem dia. (mm)	Leaf no.	Youngest matured leaf: Length (cm)	Youngest matured leaf: Width (cm)	Youngest matured leaf: Petiole length (cm)	Youngest matured leaf: Area (cm^2)	Dry wt. (g)
4 0 0	24.7	51.3	9.1	13.9	29.6	30.0	15.2	349	10.1
3 1 0	25.4	51.3	9.1	14.0	28.0	28.6	16.5	348	10.1
3 0 1	24.6	53.4	9.2	14.5	28.6	29.1	15.5	347	11.0
2 1 1	24.5	49.6	9.4	15.3	26.9	26.6	15.4	315	10.2
1 2 1	31.6	55.8	10.4	16.1	31.7	32.9	18.6	436	16.2
1 1 2	29.1	53.8	9.7	16.1	29.5	30.2	17.5	332	14.4
1 1 0	28.5	54.5	9.5	15.4	30.7	31.0	17.1	394	13.0
1 0 1	27.2	52.8	9.6	15.6	30.4	30.6	16.7	318	12.2
0 1 1	30.7	54.6	10.0	14.6	31.5	32.0	18.3	421	13.1
$LSD_{0.05}$	4.1	5.7	1.0	1.8	4.2	4.6	2.7	97	2.8

[z]Composted cotton waste was used in most media at various proportions. CW-cotton waste; BK-bark; PM-peat moss. The medium with equal volumes of bark and peat moss was used as the control.

Results and Discussion

The composted cotton waste had approximately 85% of the particles > 2.0 mm (9 mesh) (Table 1). The majority of the particles (70%) were smaller than 6.3 mm (1/4″) and larger than 2 mm (9 mesh). Only 4.4% of the material was < 1 mm (16 mesh).

Growth of Asian bell tree in most media compared favorably with that of the control (0:1:1, equal volumes of bark and peat moss, no cotton waste) with a few exceptions (Table 2). Plants grown in 100% composted cotton waste or in media containing cotton waste and 50% pine bark (1:2:1 and 1:1:0 by vol), regardless of whether peat moss was added, were shorter and/or had smaller leaves or less dry weights than the control. Media containing 50% cotton waste or peat moss and 25% of each of the other two ingredients (2:1:1 and 1:1:2 by vol) produced plants similar to the control. However, substituting half of the cotton waste or peat moss in the above media with bark (1:2:1 by vol) resulted in poor plant response. In media consisting of 50% peat moss, the cotton waste could replace bark to make the other half of the media giving similar plant growth (1:0:1 and 0:1:1 by vol). Verkade (13) also reported that medium composition had a drastic effect on the growth of this species. Plants produced in a medium consisting of sphagnum peat moss: perlite: vermiculite (3:1:1, by vol) was superior to those grown in a mixture consisting of equal volumes of sphagnum peat moss and south Florida limestone sand.

In contrast to Asian bell tree, the medium consisting of 50% bark and 25% of each of the other two ingredients (1:2:1 by vol) resulted in the best growth of Australian umbrella tree (Table 3). Substituting half the bark in the 1:2:1 medium with cotton waste (2:1:1 by vol) resulted in shorter plants with smaller leaf areas and less dry weights. Media having 100% composted cotton waste or 75% cotton waste and 25% bark produced smaller plants than the control (equal volumes of bark and peat moss).

For both species, media consisting of 50% or more composted cotton waste had high initial pH values, ranging from 7.1–7.4 with the 50% peat moss having lower pH levels between 6.0 and 6.5 (Tables 4 and 5). During the experimental period, the high initial pH declined while the low initial pH increased, resulting in little or no difference in the final pH values among media. For a given medium, leachate from the growing medium of Australian umbrella tree was 0.2–0.3 unit lower than that from Asian bell tree, suggesting that roots of different plant species can interact with the growth medium resulting in differential pH changes over the same period of production time. The data also suggest that the amount of liming material necessary to adjust the pH of a potting medium may depend upon the

Table 4. EC and pH of medium leachate from Asian bell tree (*Radermachera sinica*)[z].

Ratio CW:BK:PM	pH 6/30	pH 8/11	pH 9/28	EC (dS/m) 6/30	EC (dS/m) 8/11	EC (dS/m) 9/28
4 0 0	7.39	6.94	6.73	5.57	5.28	4.70
3 1 0	7.37	6.72	6.74	4.05	5.73	4.86
3 0 1	7.15	6.82	6.66	5.40	4.76	4.97
2 1 1	7.08	6.70	6.69	4.02	5.69	5.53
1 2 1	6.54	6.51	6.67	3.00	5.56	4.46
1 1 2	6.54	6.55	6.47	3.22	5.58	6.48
1 1 0	7.05	6.51	6.77	3.52	5.74	4.38
1 0 1	6.64	6.75	6.51	6.06	5.85	5.48
0 1 1	5.98	6.82	6.56	2.32	5.34	5.15
$LSD_{0.05}$	0.08	0.37	0.12	0.39	NS	0.72

[z]Composted cotton waste was used in most media at various proportions. CW-cotton waste; BK-bark; PM-peat moss. The medium with equal volumes of bark and peat moss was used as the control.

Table 5. EC and pH of medium leachate from Australian umbrella tree (*Brassaia actinophylla*)[z].

Ratio CW:BK:PM	pH			EC (dS/m)		
	6/30	8/11	9/28	6/30	8/11	9/28
4 0 0	7.40	6.88	6.40	5.97	3.21	3.98
3 1 0	7.31	6.69	6.41	5.23	3.45	4.01
3 0 1	6.94	6.77	6.36	6.02	3.19	4.12
2 1 1	7.11	6.58	6.41	3.67	3.48	4.14
1 2 1	6.46	6.64	6.46	2.55	3.28	4.13
1 1 2	6.50	6.77	6.11	2.86	3.03	4.68
1 1 0	6.94	6.56	6.45	3.30	3.46	3.85
1 0 1	6.77	6.71	6.25	4.77	3.33	4.40
0 1 1	5.88	6.82	6.38	2.11	3.12	3.89
$LSD_{0.05}$	0.06	0.29	0.18	0.43	0.38	0.53

[z]Composted cotton waste was used in most media at various proportions. CW-cotton waste; BK-bark; PM-peat moss. The medium with equal volumes of bark and peat moss was used as the control.

species being grown in order to keep the pH in the proper range of 5.5 to 6.5 (9).

Leachates from media with 50% or more composted cotton waste all had higher initial EC, relative the leachate EC of the control (Tables 4 and 5). Initial EC was reduced by replacing 25% the cotton waste with bark (3:1:0), but not by replacing with peat moss (3:0:1). For each species, EC values of leachates collected from various media varied only slightly in August, with higher EC in leachates collected from Asian bell tree. The medium containing 25% cotton waste, 25% bark and 50% peat moss (by vol) had the highest EC at experiment termination. Initial EC did not necessarily reflect the final EC of the leachate, i.e., a medium (1:1:2) with a low initial EC had relatively high EC at the end of the experiment and vice versa (Tables 4 and 5).

Results of this experiment suggest that composted cotton waste may be used successfully to produce tropical foliage plants. Its cost of $19.3 per cubic meter ($14 per cubic yard) is less expensive than peat moss and bark which make it suitable for container plant production for certain areas. Incorporation of more than 50% composted cotton waste should be avoided or poor plant growth may result. However, there may not be an universal mix which would be the best for producing all species, as previously reported by Poole and Waters (10). The composted cotton waste used in this experiment was well processed and did not result in any weed growth in pots.

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