Effect of Cotton Gin Compost and Pine Bark Substrate Blends on Root Growth of Two Horticulture Crops

Brian E. Jackson, Amy N. Wright and Jeff L. Sibley
Auburn University, Dept. of Horticulture, Auburn, AL 36849
jacksonb@vt.edu

Index Words: Agricultural Waste, Horhizotron^{TM}, Establishment, Media, *Ficus benjamina, Lantana camara* 'Hot Country'

Significance to Industry: 'Hot Country' lantana and weeping fig were grown in PB substrates containing 0, 40, 60, and 100% CGC. Results suggest that PB can be replaced or amended with CGC for an increase in root growth rate when compared to root growth in 100% PB. Utilizing CGC as a substrate or substrate component with PB can provide a reliable and beneficial substrate option for production of horticultural crops.

Nature of Work: Pine bark (PB) and peat (P) are two of the most common substrate components currently used in horticultural crop production. The supply, consistency, and cost of these materials has often been a concern for growers throughout the United States. These concerns have prompted the search for alternative substrates and substrate components that can be successfully utilized for quality crop production. Cotton is a major agronomic crop grown in the southeast United States. Cotton gin trash (CGT) is the term used to describe the by-products of the cotton ginning process that includes the leaves, stems, hulls, and some lint (2). Composted cotton gin trash (CGC) has been shown to be a useful substrate component for production of bedding plants, floral crops, and woody ornamentals (1, 3).

Frequently excluded from horticultural research, root growth and root system architecture are important factors influencing plant performance and survival (6). A healthy, functioning root system increases the surface area available for the uptake of water and nutrients. In addition, roots provide physical support, storage, and anchorage needed by plants (4, 5). Understanding root growth and development is important to improving plant quality and production success.

The objective of this study was to utilize the Horhizotron^{TM} to evaluate root growth of weeping fig (*Ficus benjamina* L.) and 'Hot Country' lantana (*Lantana camara* Mill. 'Hot Country') when grown in various blends of PB and CGC. The Horhizotron provides a simple, non-destructive method for measuring root growth and development in various root environments and substrates, and it allows roots to be observed and quantified as they grow from the original root ball and penetrate into the surrounding substrate (6).

Treatments were four substrate blends of milled PB and CGC that included by volume: 100:0 PB:CGC, 60:40 PB:CGC, 40:60 PB:CGC, and 0:100 PB:CGC. Pine bark substrate was used as the control for comparison to the CGC amended treatments. Based on initial pH values varying rates of dolomitic limestone were added to substrates to achieve pH levels of 6.0. 100:0 PB:CGC was amended with 2.1 kg·m^{-3} (3.6 lb·yd^{-3}), and 60:40 PB:CGC was amended with 1.1 kg·m^{-3} (1.8 lb·yd-3). No amendment was made to 40:60 PB:CGC and 0:100 CGC substrates where pH was already near the desired range of 6.0. Weeping fig and 'Hot Country' lantana were removed from 11.3 liter (3 gal) containers and placed in separate Horhizotrons on greenhouse benches at the Paterson Greenhouse Complex, Auburn University. Root balls of all plants were positioned in the center of each Horhizotron. Each of the Horhizotron's four quadrants were randomly filled with one of the substrate blends to the height of the root ball. Horhizotrons with weeping fig and 'Hot Country' lantana were hand watered daily and fertilized once weekly with a solution of 20N-8.8P-16.6K (Pursell Industries, Sylacauga, AL) applied at the rate of 200 ppm N. This study was a randomized complete block design with each Horhizotron representing an individual block. There were five blocks per species.

Root length and location in the quadrant profile were measured as newly formed roots grew out from the root ball and along the face of the glass quadrants. A transparent grid placed on the two glass sides of each quadrant allowed observation and measurement of the five longest roots on each side of the quadrant. Roots of weeping fig and 'Hot Country' lantana were measured 7 days after planting (DAP) and then once weekly using the same method. Over the course of the study root measurements were discontinued when roots reached the end of the Horhizotron quadrant. At the conclusion of the study root development in each quadrant was evaluated visually using a rating scale of 0-5 (Table 1). Data were analyzed using GLM procedures. Regression analysis of root growth over time was performed for all species within each substrate treatment. Fisher's Least Significant Difference (P = 0.05) was used to separate means of the visual root evaluation at the end of the experiment.

Results and Discussion: Both species exhibited linear rates of root growth over the course of the experiment in all four substrates (Figures 1 and 2). At all measurement dates there was more root growth in CGC amended substrates than in 100% PB for weeping fig. At 21 DAP, root growth of weeping fig in substrates containing 60 and 100% CGC reached the end of the quadrants and were no longer measured (Figure 1). At 28 DAP, roots of weeping fig in the substrate containing 40% CGC reached the end of the quadrants (data not shown). Roots of weeping fig grown in 100% PB were the last to reach the end of the quadrants at 35 DAP (data not shown). 'Hot Country' lantana exhibited more root growth in all treatments containing CGC compared to 100% PB through the third measurement date (3 weeks) at which time, roots in these treatments had grown to the end of their quadrants (Figure 2). Roots of 'Hot Country' lantana in 100% PB took twice as long (6 weeks) to reach the end of the quadrant (data not shown). Root ratings of weeping fig and 'Hot Country' lantana were significantly higher across all substrates containing CGC when compared to 100% PB (Table 2). At the conclusion of this study root development in all CGC blended substrates was considerable enough to firmly hold the substrates together when plants were removed from the Horhizotrons. The quadrant containing 100% PB shattered upon being pulled from the Horhizotron, a result of less root proliferation in that substrate. This experiment provides strong evidence that roots can grow effectively and vigorously in substrates containing CGC, facilitating successful establishment and production of horticultural crops.

Literature Cited:

1. Cole, D.M. 2003. Cotton gin compost as a horticultural substrate. M.S. Thesis. Auburn University. Auburn, AL.
2. Hills, D.J., R.G. Curley, J.K. Knutson, J.N. Seiber, W.L. Winterlin, R.S. Rauschkolb, G.S. Pullman, and C.L. Elmore. 1981. Composting treatment for cotton gin trash fines. Trans. Amer. Soc. Ag. Eng. 24:14-19.
3. Owings, A.D. 1994. Cotton gin trash as a medium component in production of ‘Golden Bedder’ coleus. Laes Mimeo Series. La. Ag. Exp. Sta. 95:7-8.
4. Waisel, Y., A. Eshel, and U. Kafkafi. 2002. Plant Roots, the Hidden Half. Third Ed. Marcel Dekker, Inc. New York.
5. Wraith, J.M. and C.K. Wright. 1998. Soil water and root growth. HortScience 33:951-959.
6. Wright, A.N. and R.D. Wright. 2004. The HorhizotronTM: A new instrument for measuring root growth. HortTechnology 14:560-563.

Table 1. Visual rating scale for root development.

Rating	Overall Growth
0	no root growth
1	20% of the quadrant face was filled with roots
2	40% of the quadrant face was filled with roots
3	60% of the quadrant face was filled with roots
4	80% of the quadrant face was filled with roots
5	100% of the quadrant face was filled with roots

Table 2. Effect of substrate on root development of two species.

Species	PB: CGC Ratio[z]	Root Rating
weeping fig	100:0	2.6c[y]
	60:40	3.8b
	40:60	4.5a
	0:100	4.4ab
‘Hot Country’	100:0	2.0b
lantana	60:40	4.2a
	40:60	4.5a
	0:100	4.7a

[z]PB = pine bark, CGC = cotton gin compost.

[y]Means separated within species by Fisher’s Protected LSD at *P = 0.05.*

Figure 1. Root Growth of weeping fig measured in seven day increments after transplanting (DAP) when grown in pine bark (PB) and three PB amended cotton gin compost (CGC) substrate blends.

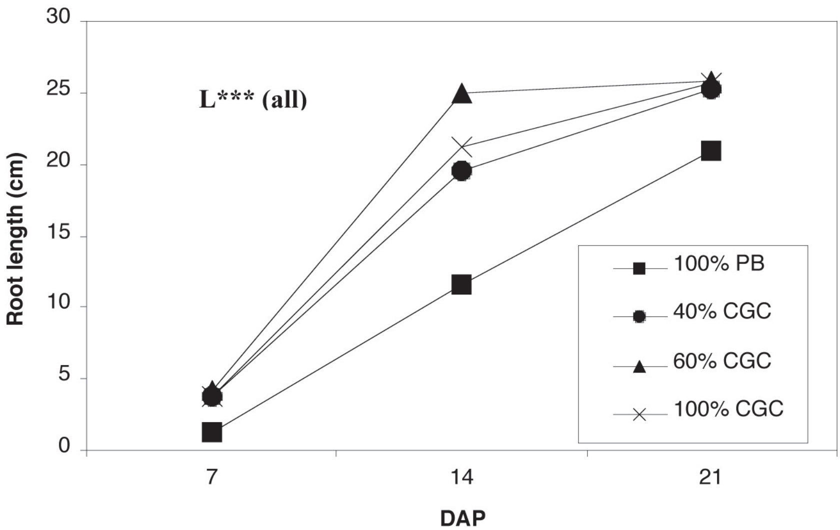

Figure 2. Root Growth of ‘Hot Country’ lantana measured in seven day increments after transplanting (DAP) when grown in pine bark (PB) and three PB amended cotton gin compost (CGC) substrate blends.