# Clean Chip Residual: A New Substrate Component for Container-Grown Plants

**C.R. Boyer , G.B. Fain[2], C.H. Gilliam , T.V. Gallagher[3]**
**H.A. Torbert[4] and J.L. Sibley**
**Auburn University, Department of Horticulture, Auburn, AL 36849**
**[2]USDA-ARS Southern Horticultural Laboratory, Poplarville, MS 39470**
**[3]Auburn University, School of Forestry & Wildlife Sciences, Auburn, AL 36849**
**[4]USDA-ARS National Soil Dynamics Laboratory, Auburn, AL 36832**
**boyercr@auburn.edu**

**Index Words:** peat moss, pine bark, clean chip residual, *Ageratum, Salvia*

**Significance to Industry:** This study evaluated a potential new substrate for the nursery industry. Results indicate that uniform crops of annual plants can be grown in clean chip residual with the addition of 0, 10 or 20% peat moss. Use of this product could provide an alternative to traditional pine bark and combinations of pine bark: peat moss based substrates.

**Nature of Work:** A variety of container substrates have been evaluated since the 1950s. Aged pine bark with the addition of a percentage of sand and peat moss make up the majority of container substrates used in nurseries throughout the southern US. Unfortunately, the future availability of pine bark is declining due to reduced forestry production, increased importation of logs (no bark), and use of pine bark as a source of fuel (3). It is important to explore alternatives to traditional pine bark substrates; potential substrates must be readily available, sustainable, pest-free, easily processed & shipped, as well as economical.

A new trend in harvesting pine trees is mobile in-field equipment, which processes trees into “clean chips” for pulp mills leaving behind a product composed of about 50% wood, 40% bark and 10% needles. This product, “clean chip residual” (CCR), is either sold for boiler fuel, or more commonly, spread across the harvested area. If the processed product is sold for boiler fuel the approximate cost is $3-4 per cubic yard. In-field harvesting operations are occurring across the Southeast and their numbers are increasing annually. Estimates show as much as 25% of the total biomass harvested is CCR, and approximately 32 cubic yards of CCR is generated per acre during a standard thinning operation. This yield can be greater with improved forestry practices. Several million acres in the Southeast are currently in forestry production and CCR processing has potential to provide a sustainable media resource that is able to meet the continuing needs of the nursery industry.

A recent study by Wright and Browder (5) showed that whole chipped pine logs (“clean chips”) could be used successfully for nursery crop production with proper nutrition and irrigation. A study by Fain and Gilliam (1) successfully used substrates composed of whole pine trees to produce container-grown nursery crops. Use of these substrates resulted in plants that were similar in size to plants grown in pine bark alone.

The objective of this work was to evaluate fresh Clean Chip Residual (CCR) as a substrate component for production of container-grown annuals. The CCR used in this study was obtained from a 10 year old pine plantation near Evergreen, AL. Loblolly pine (*Pinus taeda*) were being thinned and processed for clean chips using a total tree harvester (Peterson DDC-5000-G Portable Chip Plant, Peterson Pacific Corp., Eugene, OR). CCR was further processed through a horizontal grinder with 4 inch screens (Peterson 4700B heavy duty grinder, Peterson Pacific Corp.) before being sold to a pulp mill for boiler fuel. The sample used in this study was processed again to pass a ¾ or ½ inch screen. These two CCR sizes were used alone or blended with either 10 or 20% peat and compared with a standard control, pine bark. Treatments evaluated are listed in Table 1.

This study was initiated at Paterson Greenhouse, Auburn University in Auburn, AL on April 12, 2006. Each substrate blend was incorporated with 12 lb/yd$^3$ 15-9-12 Osmocote control release fertilizer (5-6 month); 5 lb/yd$^3$ dolomitic limestone and 1.5 lb/yd$^3$ Micromax (Scotts Co.). Two annual species, *Ageratum houstonianum* 'Blue Hawaii' and *Salvia* x *superba* 'Vista Purple', were transplanted from standard 36 cell flats and grown in trade gallon containers, placed on elevated benches in the greenhouse and hand watered. Plants were arranged by species in a randomized complete block with seven single plant replications. Pour-through extractions were conducted at 1, 15 and 30 days after planting (DAP) to test media pH and electrical conductivity (EC). Media shrinkage was measured at 7 and 41 DAP. Leaf chlorophyll content was quantified using a SPAD-502 Chlorophyll Meter (Minolta, Inc.) at 30 DAP. Growth indices ([height + width1 + width2] / 3 (cm)) were recorded at 30 days after planting. Shoot dry weight was recorded at the conclusion of the study (41 DAP).

**Results and Discussion:** No differences among treatments were observed for media shrinkage at either 7 or 41 DAP. Substrate pH measurements were within acceptable ranges (5.5 to 6.5) for the duration of the study. Substrate EC measurements were generally high (3090-2560 µS/cm) among all treatments 1 DAP. At 15 DAP all substrate EC levels except 100% pine bark and 100% ¾" CCR remained above the recommended range of 1200 to 1500 µS/cm for established plants (2, 4), but had decreased since 1 DAP. Substrate EC levels at 30 DAP indicated only one treatment in the recommended range (100% pine bark); all other treatments were above recommended levels.

*Ageratum* exhibited similar growth among all treatments (Table 1). *Salvia* exhibited reduced growth in two treatments when compared to 100% pine bark: both 9:1 and 4:1 ¾ inch CCR: Peat. Chlorophyll content (Table 1) of *Ageratum* was greater than or equal to 100% Pine Bark. No differences in leaf chlorophyll content of *Salvia* were observed. *Ageratum* shoot dry weight (Table 1) indicated no differences among treatments. *Salvia* shoot dry weight was the greatest with all Pine bark treatments and all 4:1 Peat treatments, however all treatments were similar to 100% pine bark.

Similarities among treatments in this study indicate that CCR is an economically viable and sustainable substrate for containerized plant production in nurseries. Species included in this test showed little or no differences compared to control treatments, indicating that growth in CCR can produce crops that are as marketable as those grown in pine bark. More studies need to be conducted in order to determine appropriate irrigation and fertilizer regimes as well as document the growth responses of other plant species grown in CCR.

**Literature Cited:**


1. Fain, G.B. and C.H. Gilliam. 2006. Physical properties of media composed of ground whole pine trees and their effects on vinca (*Catharanthus roseus*) growth. HortScience 40:510.
2. Lang, H.J. 1996. Growing media testing and interpretation, p. 123–140. In: D.W. Reed (ed.). Water, media and nutrition for greenhouse crops. Ball Publ., Batavia, Ill.
3. Lu, W., J.L. Sibley, C.H. Gilliam, J.S. Bannon, and Y. Zhang. 2006. Estimation of U.S. bark generation and implications for horticultural industries. J. Environ. Hort. 24:29-34.
4. Warncke, D.D. and D.M. Krauskopf. 1983. Greenhouse growth media: Testing and nutrition guidelines. Mich. State Univ. Coop. Ext. Bul. E-176.
5. Wright, R.D. and J.F. Browder. 2005. Chipped pine logs: a potential substrate for greenhouse and nursery crops. HortScience 40:1513-1515.

**Table 1.** Effects of various substrates on growth of two species of annual plants (*Ageratum houstonianum* 'Blue Hawaii' and *Salvia* x *superba* 'Vista Purple').

| | Substrate electrical conductivity (mS/cm) | | | Leaf chlorophyll content 30 DAP | | Shoot dry weight (g) 41 DAP | |
|---|---|---|---|---|---|---|---|
| **Treatment[y]** | **1 DAP[x]** | **15 DAP** | **30 DAP** | ***Ageratum*** | ***Salvia*** | ***Ageratum*** | ***Salvia*** |
| 100% PB | 2.96[w] abc | 1.08 f | 0.70 c | 35.2 b | 53.2 a | 10.4 a | 16.0 abc |
| 100% ½" CCR | 2.56 d | 1.46 ef | 1.55 bc | 39.6 a | 53.8 a | 7.9 a | 13.7 c |
| 100% ¾" CCR | 2.71 cd | 1.87 cde | 1.58 bc | 37.4 ab | 54.1 a | 8.8 a | 14.0 c |
| 9:1 PB:PEAT | 3.06 ab | 1.52 ef | 1.57 bc | 34.9 b | 55.3 a | 9.2 a | 17.6 a |
| 9:1 ½" CCR:PEAT | 2.74 bcd | 2.16 bcd | 1.85 bc | 36.6 ab | 55.0 a | 8.4 a | 14.0 c |
| 9:1 ¾" CCR:PEAT | 2.86 abcd | 2.28 bc | 2.51 ab | 37.3 ab | 54.0 a | 9.7 a | 14.7 bc |
| 4:1 PB:PEAT | 3.09 a | 1.67 de | 1.79 bc | 36.5 ab | 54.6 a | 9.1 a | 18.7 a |
| 4:1 ½" CCR:PEAT | 2.94 abc | 2.87 a | 2.13 ab | 35.4 b | 54.3 a | 8.7 a | 16.9 ab |
| 4:1 ¾" CCR:PEAT | 2.58 d | 2.61 ab | 3.19 a | 36.1 b | 53.7 a | 7.8 a | 16.9 ab |

Leaf chlorophyll content determined using a SPAD-502 chlorophyll meter (average of 5 leaves per plant).

[y]Treatments were: PB = pine bark, CCR = clean chip residual, PEAT = sphagnum peat moss. The ¾" and ½" designations indicate the size of screen for grinding CCR.

[x]DAP = days after planting.

[w]Values within column followed by a different letter are significant using Duncan's Multiple Range Test (*P*=0.05).