Availability of Clean Chip Residual as a Growth Substrate in the Southeast United States

*C.R. Boyer[1, 2], T.V. Gallagher[3], C.H. Gilliam[2], G.B. Fain[2], H.A. Torbert[4], and J.L. Sibley[2]

[1]Kansas State University, Department of Horticulture, Forestry and Recreation Resources, Manhattan, KS 66506
[2]Auburn University, Department of Horticulture, Auburn, AL 36849
[3]Auburn University, School of Forestry & Wildlife Sciences, Auburn, AL 36849
[4]USDA-ARS National Soil Dynamics Laboratory, Auburn, AL 36832

crboyer@ksu.edu

Index Words: pine bark, CCR, container-grown plant production, alternative media, wood fiber, forestry, nursery

Significance to Industry: Residual chipping material (also called clean chip residual or CCR) has potential use as a growth substrate in the nursery industry. The objective of this study was to quantify the amount and type of CCR material available in the Southeast United States for possible horticultural use by surveying working chipping operations on pine plantations. Fourteen operators in four states were contacted to evaluate on site status of residual material including composition (wood, needles, bark), equipment use, and destination of the material. Results indicate that more than 40% of CCR is left in the plantation and that many chipping operations are willing to supply it to the nursery industry.

Nature of Work: Clean chip residual is a by-product of harvesting small-caliper trees on a plantation for use as pulp for the paper industry. Material not used as pulp (needles, bark, wood) is either left on the plantation or sold to a pulp mill as boiler fuel. If not sold, disposal of residual is an additional cost charged to the pulp (1). Recent work has evaluated this material for use as a substitute for traditional potting materials (generally pine bark) and demonstrated viability of CCR for use in some annual, perennial and woody crops. Boyer et al. (2) demonstrated that *Ageratum* and *Salvia* grown in CCR or combinations of CCR and peat produced similarly sized plants when compared to a traditional pine bark substrate. Later, Boyer et al. (3) evaluated eight perennial species in CCR and reported similar results among all treatments. Several woody crops were also evaluated for growth in CCR over the course of one year (4). Results for woody species were similar to growth responses of annual and perennial crops. Since the use of CCR as a nursery and greenhouse substrate is currently being evaluated for plant growth response, it is sensible to characterize the availability and properties of CCR.

Fourteen chipping operations were surveyed in person or by phone in the summer of 2007, though it is believed that there may be up to 30 such roving operations in the Southeast United States. Samples, if available and usable (processed twice in the field) were obtained by filling two 5-gallon buckets with fresh material, weighing, and evaluating the age and height of the stand. Samples were further evaluated by sending subsamples to Brookside Laboratories, Inc. (New Knoxville, OH) for soil-less media nutrient analysis. Substrate N was determined by combustion analysis using a 1500 N analyzer (Carlo Erba, Milan, Italy) (data not presented). Remaining nutrients were determined by microwave digestion with inductively coupled plasma-emission spectrometry (ICP) (Thermo Jarrel Ash, Offenbach, Germany) (data not presented). Three subsamples from each location were dried in a 105 °C forced air oven for 48 h before being separated into components (bark, wood, needles and indistinguishable) by weight. Indistinguishable material consisted of particles too fine to determine whether they were bark, wood or needles. Data were analyzed using Waller-Duncan k ratio t tests ($P \leq 0.05$) using a statistical software package (SAS® Institute, Cary, NC).

Results & Discussion: Sites, operations and material varied greatly in this survey (Table 1). One was a woodyard operation (logs only; Cottondale, FL), another consisted of hurricane-damaged trimmings (Hattiesburg, MS), and one was operating on land where wildfire had destroyed plantations (Waycross, GA). Some locations did not have samples consistent with previously evaluated CCR (or were unsuitable material) and thus were interviewed, but data from these locations is not included in the composition analysis. Unsuitable material was of unknown origin and/or composed of mixed hardwood and softwood. Most locations were ‘traditional’ chipping operations and many loggers were willing to expand their market to the horticultural industries. Residual material varied depending on the plantation age, species composition, site quality, and natural actions such as fire or flood (5). Average substrate pH for all the samples ranged from 4.3 to 5.5 (data not shown). Electrical conductivity (salts) was low in all samples (0.16-0.41 mmhos/cm; data not shown). Iron was high at three locations while Mn was high at 4 locations (data not shown). Other locations maintained levels of micronutrients within suggested ranges for media and plants (as stated by Brookside Laboratories, Inc., New Knoxville, OH). Composition of wood, bark and needles varied according to the age and management of the plantation. Values for percent wood ranged from 14.2% (Waycross, GA) to 50.5% (Evergreen, AL), though none of the location samples were significantly different. For bark the highest percentage was 68.5% (at Waycross, GA) and the lowest 16.1% (Evergreen, AL). The greatest percentage of needles (19.2%) was found at Jasper, GA (a young plantation, 8-9 years) and the least (0.10%) at Cottondale, FL (woodyard operation). Overall, the composition of CCR evaluated in this study was 37.7% wood, 36.6% bark, 8.8% needles, and 16.9% indistinguishable (Table 1). Of the operations interviewed, an estimated 27.5% of the total site biomass is composed of CCR and 44.3% is left in the field (Table 1).

Several challenges to implementing CCR as a substitute for pine bark exist. The primary challenge is communication: the forestry industry is generally unaware of the potential use of their material in horticultural industries. Another challenge is delivery: will individual operators deliver to nurseries or will pine bark suppliers elect to carry CCR along with pine bark? Extra costs may be incurred for live-bottom trailers or processing through a hammer mill. Currently, CCR represents a more sustainable future for horticultural substrates as pine bark becomes less available and more expensive for growers. This study demonstrates that there are adequate amounts of CCR to supply the needs of horticultural industries, and, while more study is needed to determine suitability of material from every chipping operation, CCR obtained from 'traditional' pine plantation thinning operations should perform well for production of many species.

Literature Cited:

1. Baughman, R. K., B.J. Stokes, and W.F. Watson. 1990. Utilizing residues from in-woods flail processing. In: Stokes, B.J., ed. Harvesting small trees and forest residues: Proceedings of the International Energy Agency, task 6, activity 3 workshop. Auburn, AL: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station: 21-30.
2. Boyer, C.R., G.B. Fain, C.H. Gilliam, T.V. Gallagher, H.A. Torbert, and J.L. Sibley. 2008. Clean chip residual: A substrate component for growing annuals. HortTechnology 18:423-432.
3. Boyer, C.R., G.B. Fain, C.H. Gilliam, T.V. Gallagher, H.A. Torbert, and J.L. Sibley. 2008. Clean chip residual as a substrate for perennial nursery crop production. J. Environ. Hort. 26:239-246.
4. Boyer, C.R., C.H. Gilliam, G.B. Fain, T.V. Gallagher, H.A. Torbert, and J.L. Sibley. 2009. Production of woody ornamentals in clean chip residual substrate. J. Environ. Hort. 27:56-62.
5. Burns, R.M. and B.H. Honkala. 1990. Silvics of North America: 1. Conifers; 2. Hardwoods. Agriculture Handbook 654. U.S. Department of Agriculture, Forest Service, Washington, DC. 877 p.

Table 1. Distribution of components and site biomass of CCR at several chipping sites.

Location of operation	Wood (%)	Bark (%)	Needle (%)	Indistinguishable (%)	Site biomass composed of CCR (%)[z]	CCR left in field (%)[z]
Cuthbert, GA	44.7 a[y]	35.7 bcd	12.1 b	7.5 a	25	0
Dothan, GA	--[x]	--	--	--	--	0
Cottondale, FL	38.9 a	48.8 abc	0.10 e	12.2 a	15	0
Waycross, GA	14.2 a	68.5 a	8.7 bcd	8.7 a	--	100
Greenville, GA	31.4 a	59.7 ab	0.96 e	8.0 a	20	100
Barnett Crossroads, AL	35.7 a	28.0 cd	5.3 cde	31.0 a	35	20
Lucedale, MS	49.2 a	22.9 cd	12.0 b	15.9 a	25	0
Hattiesburg, MS	--	--	--	--	35	0
Atmore, AL	50.4 a	18.8 d	14.2 ab	16.6 a	25	0
Clanton, AL	--	--	--	--	--	100
Jasper, GA	35.4 a	31.3 cd	19.2 a	14.1 a	50	100
Summerville, GA	--	--	--	--	20	100
Adairsville, GA	26.5 a	36.2 bcd	10.6 bc	26.7 a	--	100
Evergreen, AL	50.5 a	16.1 d	4.7 de	28.7 a	25	0
Total	*37.7*	*36.6*	*8.8*	*16.9*	*27.5*	*44.3*

[z]Estimate reported by loggers conducting chipping operation at each site.
[y]Means within column followed by the same letter are not significantly different based on Waller-Duncan k ratio t tests (α=0.05, n=3).
[x]No sample obtained, interview only.