Production of Hardy Garden Mums in *WholeTree* Substrate

Glenn B. Fain, Charles H. Gilliam, Jeff L. Sibley, and Cheryl R. Boyer
Auburn University Department of Horticulture, Auburn, AL 36849
gbf0002@auburn.edu

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Significance to the Industry: A new substrate (*WholeTree*) made from loblolly pine (*Pinus taeda*) was evaluated along with starter fertilizer rates in the production of container-grown, hardy garden chrysanthemums. Results indicated that with adequate nutrition and attention to watering *WholeTree* based substrates are suitable for the production of chrysanthemums and should be considered a viable alternative to standard pine bark and peat moss based substrates.

Nature of Work: Peat moss and pine bark are the primary components of horticultural substrates. Rising transportation cost of peat moss from Canada or Europe is affecting the profitability of many growers (personal grower communication). Similarly rising costs and reduced availability of horticultural grade pine bark has many growers deeply concerned for the future. Many alternative substrates have been evaluated over the years, however the biggest obstacle is the availability of a consistent quality product in quantities great enough to sustain the horticultural industry into the future. Extensive research has been conducted outside the United States on substrate alternatives. Some of the more promising substrates are alternatives made of wood fiber from coniferous trees. Studies in Europe have demonstrated the suitability of substrates made from spruce (*Picea abies*) wood chips as an alternative for peat moss-based substrates in cultivation of lettuce seedlings and tomato transplants (3,4,5). Muro et al., (7) compared a pine fiber substrate (Fibralur) made from sawmill residues to coir and perlite in hydroponic production of tomatoes, and found Fibralur produced similar tomato yields both quantitatively and qualitatively to those of coir and perlite.

Research has also been conducted in the United States on high wood fiber content substrates. Boyer et al. (1), reported that container-grown lantana (*Lantana camara* L.) could be produced in substrates containing from 50% to 100% *WholeTree*. Fain et al. (2), reported that greenhouse-grown marigold in a 4 *WholeTree* : 1 sphagnum peat moss (by volume) substrate equaled those in an 8 sphagnum peat moss : 1 vermiculite : 1 perlite (by volume) substrate. Wright and Browder (8) demonstrated that Japanese holly (*Ilex crenata* Thunb. 'Chesapeake') grown in a substrate made from loblolly pine chips (PC) performed as well as those grown in standard pine bark (PB) substrate when PC received periodic liquid feeds of N-P-K in order to maintain EC readings near those of PB. One concern with the use of high wood fiber substrates is the reported need for higher fertility applications to achieve similar growth to standard substrates (5,6,8)

The objective of this research was to evaluate supplemental starter fertilizer rates in combination with *WholeTree* as an alternative growth substrate or substrate component for container-grown hardy garden chrysanthemum. *WholeTree* is a substrate made from whole pine trees (*Pinus taeda*) harvested (at ground level) from pine plantations at the thinning stage, chipped and further ground to specifications depending on the crops to be grown. *WholeTree* is comprised of all shoot portions of the tree including wood, bark, limbs, needles and cones if present. Concurrent trials were conducted in the summer of 2006 at the USDA-ARS Southern Horticultural Laboratory (SHL) in Poplarville, MS and a grower location in Auburn, AL (AUB). W*holeTree* (milled to pass a ¼" screen) at 100% was compared to 8.5 : 1.5 (by volume) *WholeTree* : peat moss and a standard mum mix of approximately 6 : 3 : 1 (by volume) pine bark : peat moss : perlite. All substrates received a nutrient package consisting of dolomitic lime (5 lbs/yd^3), 0-46-0 (0.43 lbs/yd^3), hydrated lime (0.1 lb/yd^3), gypsum (0.9 lbs/yd^3) and micromax 0.7 lbs/yd^3) and 13-13-13 (9 lb/yd^3 – Nutricote Type 140). In addition all substrates were incorporated with 0, 2, 4, or 6 lb/yd^3 of a supplemental quick release starter charge (7-3-10 Harrell's custom blend). One rooted liner (1.64 in^3 peat plug) was placed into 8-inch mum pans (East Jordan Plastics SP 750), grown outdoors and watered as needed. Data collected was plant growth index, flower bud number, leaf chlorophyll content, root rating, shoot dry weight and plant tissue nutrient content.

Results and Discussion: Results were similar at both SHL and AUB, however due to space constraints only the data from SHL will be reported. By 82 days after potting (DAP) all mums at SHL were considered marketable that received at least 2 lb/yd^3 of starter fertilizer (grower evaluation). Analysis of plant tissue macro nutrient content at 54 DAP revealed no differences regardless of substrate and little difference with regard to supplemental fertilizer rate (data not shown). Visual inspection of plant roots at 54 and 82 DAP revealed no differences in root development (data not shown). At 82 DAP there was a significant linear fertilizer rate response within all substrates for bud number, growth index and plant shoot dry weight (Table 1). At 82 DAP there were no differences (between substrates) in number of flower buds per plant or plant growth index when substrates received at least 4 lb/yd^3 starter fertilizer. In general plants grown in the standard substrate had greater shoot dry weight than those in the other substrates. Analysis of substrate physical properties revealed that the *WholeTree* substrate had more air space and about 20% less water holding capacity than the standard substrate (Table 2). This is most likely a significant contributing factor toward the difference in plant dry weight between these substrates especially considering the plants were watered similarly.

In conclusion, with special attention to nutrition and watering *WholeTree* offers great potential as a substrate or substrate component in place of standard pine bark and peat moss based substrates. An added benefit is that the wide range of particle sizes achieved from the production of *WholeTree* substrate provide needed structure and can eliminate the need for expensive aggregates such as perlite. In future studies, *WholeTree* will be processed to have similar physical properties to the standard substrate being tested in order to minimize the differences in water requirements. What is most promising about *WholeTree* is the possibility of an economically, sustainable substrate that could be available in close proximity to major horticultural production areas throughout the Southeastern United States.

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Table 1. Effects of starter fertilizer rate on growth of Garden Mums in *WholeTree* substrate.

Substrate	Fertilizer[z] (lbs/yd^3)	54 DAP[y] LG[x]	Bud (ct)	82 DAP GI[w] (cm)	Dry Wt[v] (g)
100% *WholeTree*[u]	0	49.1	285	37.4	48.3
100% *WholeTree*	2	50.4	381	38.5	61.1
100% *WholeTree*	4	52.5	418	40.8	70.7
100% *WholeTree*	6	52.6	399	39.6	69.1
85% *WholeTree*:15% Peat	0	50.0	346	37.4	57.6
85% *WholeTree*:15% Peat	2	49.6	403	40.5	67.9
85% *WholeTree*:15% Peat	4	53.3	449	39.7	73.8
85% *WholeTree*:15% Peat	6	51.8	471	41.8	82.1
60% Pinebark:30% Peat:10% Perlite	0	50.6	422	40.2	62.1
60% Pinebark:30% Peat:10% Perlite	2	52.7	376	40.4	74.5
60% Pinebark:30% Peat:10% Perlite	4	53.0	438	41.3	80.0
60% Pinebark:30% Peat:10% Perlite	6	52.4	477	42.3	89.1
	HSD[t]	*5.4*	*90.3*	*3.1*	*14.1*
		Fertilizer Rate Response			
100% *WholeTree*	0, 2, 4, 6	L*[s]	L***Q**	L*	L***Q*
85% *WholeTree*:15% Peat	0, 2, 4, 6	NS	L***	L***	L***
60% Pinebark:30% Peat:10% Perlite	0, 2, 4, 6	NS	L*Q*	L*	L***

[z]Supplemental starter fertilizer (Harrell's 7-3-10 custom blend) incorporated at 0, 2, 4 or 6 lbs per cubic yard.
[y]DAP = Days after potting (one rooted cutting per 8 inch mum pan).
[x]Leaf greenness (chlorophyll content) quantified using a SPAD-502 chlorophyll meter (average of 4 leaves per plant).
[w]Growth index = (height + width 1+ width 2) / 3.
[v]Plant shoot dry weight in grams.
[u]*WholeTree* substrate made form 12 year old *Pinus taeda* mechanically processed to pass a 1/4" screen.
[t]Tukey's honest significant difference (P ² 0.05, n = 8).
[s]Non Significant (NS), linear (L) or quadratic (Q) response at *P* < 0.05 (*), 0.01 (**) or 0.001 (***) based on single-degree-of-freedom orthogonal contrasts.

Table 2. Physical properties of substrates.[z]

Substrate	Air space (% vol)	Container capacity (% vol)	Total porosity (% vol)	Bulk density (g/cm^3)
100% *WholeTree*[y]	55 a[x]	38 c	92.9 a	0.116 b
85% *WholeTree*:15% Peat	47 b	45 b	92.3 a	0.118 b
60% Pinebark:30% Peat:10% Perlite	26 c	59 a	85.1 b	0.163 a

[z]Analysis performed using the NCSU porometer.
[y]*WholeTree* substrate made form 12 year old Pinus taeda mechanically processed to pass a 1/4" screen.
[x]Means (within column) followed by different letters are different (Tukey's HSD (*P* ² 0.05, n = 4)).