

Figure 1. Non-fibrous wood component, pine wood chips (PWC) were first manufactured at North Carolina State in 2010 as an alternative to perlite.

This is the third article in a four-part series highlighting the production and use of pine wood chips as aggregates in greenhouse substrates.

# Fertilization Requirements

## For Pine Wood Chips As An Alternative To Perlite

by **GARRETT OWEN, BRIAN E. JACKSON, BRIAN E. WHIPKER and WILLIAM C. FONTENO**

In our last article (June 2014 issue), we discussed our research findings evaluating the activity and efficacy of plant growth regulator drench applications to a substrate amended with 20 percent pine wood chip (PWC) aggregates. To continue with our theme in highlighting the use of PWC aggregates (Figure 1) as an alternative to replace perlite in greenhouse substrates (Figure

2), this article will focus on evaluating the fertility requirements.

### Proper Fertilization Can Minimize Nutrient Loss

While communicating with growers around the United States, it is all too common to hear them express a level of uncertainty about the use of wood-based substrates or components as an alternative for peat and pine bark. In the past, the perception and reluctance to use wood-based materials in growing mixes has derived from stories concerning the use of sawdust and resulting nitrogen (N)-deficient crops.

Since the initial concept to use sawdust as a substrate or substrate component, numerous universities have developed techniques to process wood, thus yielding wood components that have been intensively studied and reported as successful. However, consistent with previous reports about sawdust and crop health, researchers observed that plant growth in substrates composed of wood, or large portions of wood, had a ten-

### Coming Up

**AUGUST – Liming And pH Modification Using Pine Wood Chips**

dency to become N-deficient as a result of high rates of N immobilization.

Such reports evaluated and compared the plant growth of multiple floriculture and nursery plants grown in 100 percent wood-based substrates to traditional peat or pine-bark-based substrates. Results of these studies indicated similar or minor differences in growth if plants were irrigated and fertilized more often in the 100 percent wood substrates, compared to peat or pine-bark-based substrates.

Generally, reduced plant growth in wood-based substrates is only a concern when fertility levels (primarily N) are below optimal recommended levels for plant growth and development. For example, work by Wright et al., (2008) found that 'Baton Rouge' chrysanthemums grown in a 100 percent wood-based substrate required an additional 100 ppm N, compared to plants grown in a peat-lite substrate composed of 45 percent peat, 15 percent perlite, 15 percent vermiculite and



Figure 2. Comparison of pine wood chips (left) that have been engineered to have the same particle size as this coarse-grade of perlite (right).



25 percent bark (by volume).

Therefore, to counteract microbial N immobilization from a wood-based substrate or a substrate containing wood, growers must use a fertilization program that will supply additional nutrients needed by plants and minimize nutrient waste and loss from leaching. However, to our knowledge there is no information available regarding fertility recommendations for optimal plant growth in peat-based substrates amended with PWC.

### Perlite Versus PWC Aggregates In Peat-Based Substrates

At North Carolina State University, we have developed a wood processing technique that produces bilocular and non-fibrous PWC aggregates as a perlite replacement. We investigated peat-based substrates formulated with 10 percent, 20 percent or 30 percent perlite or PWC aggregates. However, based on conversations with growers to determine the most common substrate formulation, we will present and discuss our findings of the substrates amended with either 20 percent perlite or PWC aggregates (Figure 3).

We prepared our peat-based substrates by amending either 20 percent perlite or PWC aggregates (by volume) and adjusted substrate pH to 5.8. Two plant species were trialed: 'Profusion Orange' zinnia and 'Moonsong Deep Orange' African marigold (Figure 4, A and B). For zinnia, seeds were double sown directly into the substrates and after six days, seedlings were thinned to one seedling per pot, whereas the African marigold plugs were transplanted into the prepared substrates.

At each irrigation event, drip rings (Figure 5) were used to fertilize each plant with either a constant liquid feed rate of 100, 200 or 300 ppm N, provided by equal N combinations of Peters Professional 20N-10P-20K Peat-Lite Special containing 8.1 percent ammonium ( $\text{NH}_4\text{-N}$ ) and 11.9 percent nitrate ( $\text{NO}_3\text{-N}$ ) and



Figure 3. Peat-based substrate amended with 20 percent (by volume) pine wood chips.

Ultrasol Cal-Mag 13N-0.9P-10.8K Water Soluble Seedling Plus containing 0.3 percent  $\text{NH}_4\text{-N}$  and 12.7 percent  $\text{NO}_3\text{-N}$ . Using the Pour-Thru method, we extracted and measured substrate solution pH and electrical conductivity (EC) with a handheld Hanna pH meter on a weekly basis for six weeks. For each species at the first sign of anthesis, a final growth index (GI) [(height + widest width + perpendicular width)  $\div$  3] and plant dry mass were determined.

### Fertility Recommendations For PWC-Amended Substrates

Results of our study indicate substrate solution EC levels and pH values as recommended by Whipker, et al., (2001) can be achieved for optimal plant growth in PWC-amended substrates. At 200 ppm N, zinnia substrate solution EC was similar for both perlite- and PWC-amended substrates. For zinnia plants grown in perlite-amended substrates, recommended EC levels were maintained from 14 to 42 days after planting (DAP), while PWC-amended substrates maintained recommended EC levels from 14 to 49 DAP. A steady decline of EC levels from 14 to 49

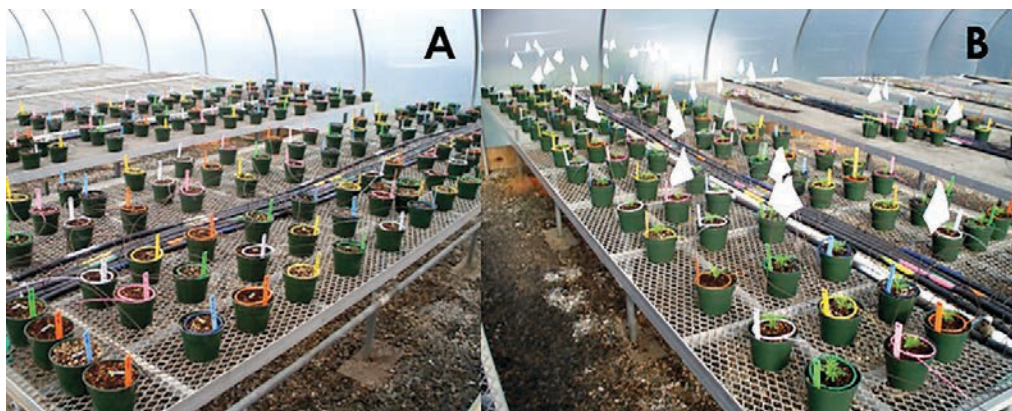


Figure 4. Overview of 'Profusion Orange' zinnia (A) and 'Moonsong Deep Orange' African marigold (B) grown in peat-based substrates amended with perlite or PWC and fertilized with 100, 200 or 300 ppm nitrogen.



DAP was observed when plants were fertilized with the insufficient N rate of 100 ppm N, compared to a steady increase in EC levels when plants received 300 ppm N.

Substrate solution EC of marigold plants was not influenced by aggregate type but rather by increasing N rate, and followed a similar trend to the zinnias.

Figure 5.  
Example of a drip ring that delivered water-soluble fertilizer rates of 100, 200 or 300 ppm nitrogen to 'Profusion Orange' zinnia and 'Moonsong Deep Orange' African marigold.



**MGS Horticultural USA**  
is changing its name.

in the future, you can look for :



[PlantProducts.com](http://PlantProducts.com)

Our new website, **PlantProducts.com** (currently under construction) should be ready to launch during Cultivate 14.

50 Hazelton Street,  
Leamington, ON N8H 3W1  
248 661-4378 | [info@PlantProducts.com](mailto:info@PlantProducts.com)



**PLANTPRODUCTS®**

MGS Horticultural = **PLANTPRODUCTS®**

MGS Horticultural USA is changing our name. Last June, we bought Plant Products' Canadian distribution business and its name, **Plant Products**. This is a name that is widely recognized in the horticultural industry. We think it's an easier name to remember, so in the future, you can look to Plant Products for your solutions for nutrition and pest management.

Our staff will have new business cards and email addresses but our phone numbers stay the same.

**Visit us at our booth #1628 at  
Cultivate 14 (OFA Short Course).**

Plant Products, a division of MGS Horticultural Inc.

**Everything you need to grow.**



**PLANTPRODUCTS®**

For both species, substrate solution pH was influenced by increasing N rate and followed the normal response of decreasing pH with increasing N rate.

The recommended substrate solution pH 6.2 to 6.5 for both zinnia and marigold plants, was achieved in both substrates, when fertilized at 100 ppm N. The substrate solution pH of both species did not reach recommended pH values when fertilized with 200 or 300 ppm N. Maximum plant growth for zinnia (Figure 6) and marigold (Figure 7) was obtained when plants received 200 and 300 ppm N, respectively, and overall maximum shoot dry weight of both species was determined when plants were fertilized with 200 ppm N.

Based on the results of this study and the visual quality of plants grown in PWC-amended substrates, it is recommended that plants be fertilized with a water-soluble fertilizer between 100 to 200 ppm N, without any additional N needed for optimal plant growth.

The absence of significant nitrogen tie-up (immobilization) in substrates containing 30 percent PWC (or less) is most likely the result of the large particle size of the PWC aggregates. The PWC particles are larger and have less surface area than wood substrate components that have been previously developed/processed and evaluated in the past by researchers in the U.S. The uniqueness of

drift®  
groundcover roses



## Drift® Roses are the only TRUE groundcover roses

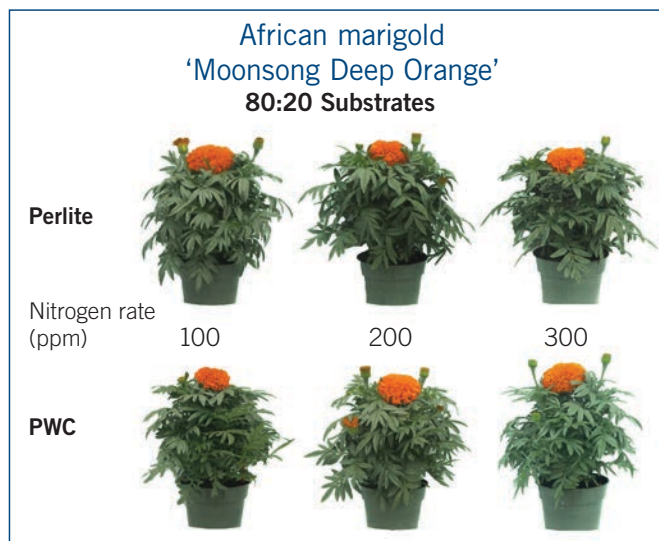
First, test. And test. And test some more. Then introduce. That's what we've been doing for over 117 years. It has served us well, but more importantly, it has served you and your customers well.

Make Drift® Groundcover Roses a part of your business today. Contact us for more information 1-800-457-1859

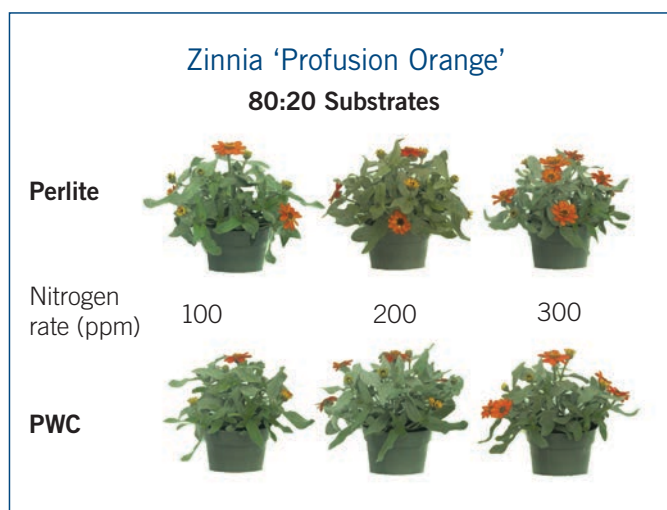


www.starrosesandplants.com

## Production Growing Media



**Figure 6.** Comparison of 'Profusion Orange' zinnias grown in a peat-based substrate amended with 20 percent perlite (top) or pine wood chips (bottom) and fertilized with 100, 200 and 300 ppm nitrogen from a water soluble fertilizer.



**Figure 7.** Comparison of 'Moonsong Deep Orange' African marigolds grown in a peat-based substrate amended with 20 percent perlite (top) or pine wood chips (bottom) and fertilized with 100, 200, and 300 ppm nitrogen from a water soluble fertilizer.

the particle size of PWC is not fibrous like previous pine tree substrate materials, hence the lack of degradation and nitrogen depletion observed during greenhouse production.

When substituting PWC for perlite in greenhouse substrates, no adjustments to cultural practices or production of zinnia and marigold plants are needed. However, frequent monitoring of substrate solution EC and pH is recommended, as well as matching a suitable fertility program to the crop. The fertility recommendation provided here can maintain proper substrate solution EC levels and pH values, provide maximum plant growth and reduce excess N applied to zinnia and mari-

gold plants grown in substrates amended with 20 percent PWC (by volume). **GG**

Garrett Owen ([owenw@purdue.edu](mailto:owenw@purdue.edu)) is a Ph.D. student in floriculture at Purdue University in the Department of Horticulture and Landscape Architecture. Brian E. Jackson ([brian\\_jackson@ncsu.edu](mailto:brian_jackson@ncsu.edu)) is an assistant professor and co-director of the Horticultural Substrates Laboratory in the Department of Horticultural Science at North Carolina State University. Brian Whipker ([bwhipker@ncsu.edu](mailto:bwhipker@ncsu.edu)) is a professor in the Department of Horticultural Science at North Carolina State University. William C. Fonteno ([wcf@ncsu.edu](mailto:wcf@ncsu.edu)) is a professor and co-director of the Horticultural Substrates Laboratory in the Department of Horticultural Science at North Carolina State University.

### References

Whipker, B.E., J.M. Dole, I.J. Cavin, J.L. Gibson, W.C. Fonteno, P.V. Nelson, D.S. Pitchey, and D.A. Bailey. 2001. Plant root zone management. N.C. Comm. Flower Growers' Assn., Raleigh, N.C.

Wright, R.D., B.E. Jackson, J.F. Browder, and J.G. Latimer. 2008. Growth of chrysanthemum in a pine tree substrate requires additional fertilizer. *HortTechnology* 18:111-115.