

Liming Requirements And pH Modification For Pine Wood Chips As An Alternative To Perlite

The last article of a four-part series highlighting the use of pine wood chips in growing substrates reveals that growers do not need to adjust their production practices when 20 percent pine wood chips are used as a perlite replacement.

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In our last article (July 2014 issue), we discussed our research findings evaluating fertility requirements of bedding plants grown in a substrate amended with 20 percent pine wood chip (PWC) aggregates. To continue and finish 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 liming requirements and pH modification.

Many growers express a level of uncertainty concerning wood-based substrates or wood components as an alternative for peat and pine bark. Among the many questions, the most common are those regarding requirements of pre-plant limestone addition and recommended rates for pH adjustment for optimal plant growth.

Initial pH Plays A Role In Using Pine Wood Chips

Managing substrate pH is one of the many challenges during production of greenhouse crops. To address this, growers must first be aware of the initial pH of



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).

the intended substrate or substrate components. For example, peat moss is naturally acidic with a pH 4.0 to 4.5, whereas investigators found 100 percent pine wood-based substrates to have a pH range of 5.0 to 6.4 (depending on the season of harvest among other factors). Knowing the initial substrate pH will help determine if the standard practice of adjusting (raising) pH of the formulated substrates with limestone to a desirable pH range



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

(5.4 to 6.4 for most greenhouse crops) is needed. If so, what is the recommended rate when PWC is substituted for perlite in a peat-based mix?

At NC State, we have developed a wood processing technique that produces blockular 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).

Determining The Right Balance For Adding Limestone

We prepared our peat-based substrates by amending either 20 percent perlite or PWC aggregates (by volume) and determined initial substrate pH using the saturated media extract method (SME). Substrates were then amended with dolomitic limestone at rates of 0, 3, 6, 9, 12 or 15 lbs-yd³ and 'Moonsong Deep Orange' African marigold plugs were transplanted into the prepared substrates (Figure 4). Using the Pour-Thru method, we extracted and measured substrate solution



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

pH and electrical conductivity (EC) with a handheld Hanna pH meter on a weekly basis for five weeks. A final growth index (GI) [(height + widest width + perpendicular width) ÷ 3] and plant shoot and root dry mass were determined.

At zero weeks after transplant (WAT), substrate pH for both 20 percent perlite and PWC-amended substrates were similar at the 0 lbs-yd³ lime rate. Over time (1 to 4 WAT), substrate pH increased as lime rate increased (Figures 5 and 6). For both substrates, the addition of 0 and 3 lbs-yd³ of lime did not adjust substrate pH to the recommended pH range of 6.0 to 6.5 for optimal marigold growth (Whipker, et al., 2000). As a result of low substrate pH, visual symptoms of iron toxicity were observed. To increase substrate pH to the recommended pH range for marigolds, lime rates of 9 to 15 lbs-yd³ were required. Therefore, substrates containing 20 percent perlite or PWC aggregates required similar rates of lime.

For both 20 percent perlite and PWC-amended substrates, marigold GI increased with increasing lime rate up to 9 lbs-yd³ and declined thereafter. Marigold GI were similar between both substrates and among all lime rates with the exception of the 6 lbs-yd³ lime rate, where GI of plants grown in the 20 percent PWC-amended substrate were 2.9 cm larger than those grown in the perlite amended substrate (Figure 7). Similarly, shoot dry mass for both substrates were similar among all lime rates with the exception of the 6 and 9 lbs-yd³ lime rate, where the average shoot dry mass of plants grown in the 20 percent PWC-amended sub-



Figure 4. Overview of 'Moonson Deep Orange' African marigold grown in peat-based substrates amended with perlite or PWC and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

strate were 0.85 and 1.05 g greater, respectively, compared to those grown in the 20 percent perlite-amended substrate (Figure 8). Root dry mass of marigold plants were similar between both substrates and among all lime rates, with the exception of 9 lbs-yd³ rate, where root dry mass of plants grown in the 20 percent PWC-amended substrate were 0.55 g larger, compared to those plants grown in the 20 percent perlite-amended substrate (Figure 9).

Know Your Substrate pH And Understand Plant Requirements

Based on these results, PWC aggregates can be a suitable alternative for perlite in greenhouse substrates at 20 percent (by volume) for the production of marigolds (Figure 10).

As a means to determine recommended lime rates for PWC-amended substrates, this study has demonstrated the variation in substrate pH associated with lime rates and plant growth. Therefore, the importance of un-

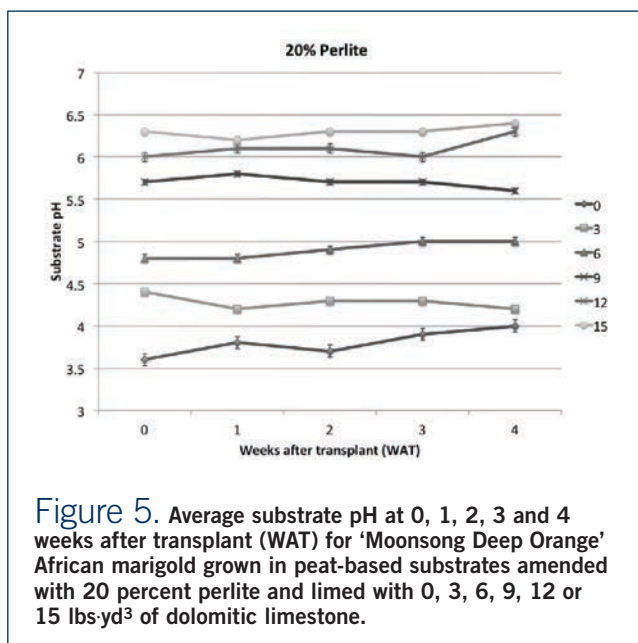


Figure 5. Average substrate pH at 0, 1, 2, 3 and 4 weeks after transplant (WAT) for 'Moonson Deep Orange' African marigold grown in peat-based substrates amended with 20 percent perlite and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

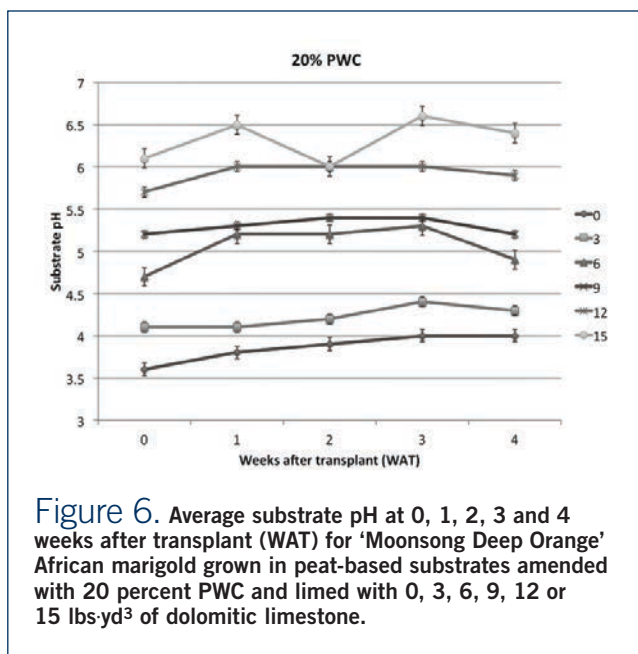


Figure 6. Average substrate pH at 0, 1, 2, 3 and 4 weeks after transplant (WAT) for 'Moonson Deep Orange' African marigold grown in peat-based substrates amended with 20 percent PWC and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

derstanding green-house substrates, their components and the proportion in which they are formulated, is vital in regard to limestone amendment and the increased interest of using alternatives.

Acknowledging the initial pH of substrates and substrate components should be considered before formulating substrates for greenhouse crop production. The common practice of amending a standard rate of lime to a substrate can impact durability of substrate pH and crop performance. It is recommended here to initially test substrate components before amending substrates with pre-plant

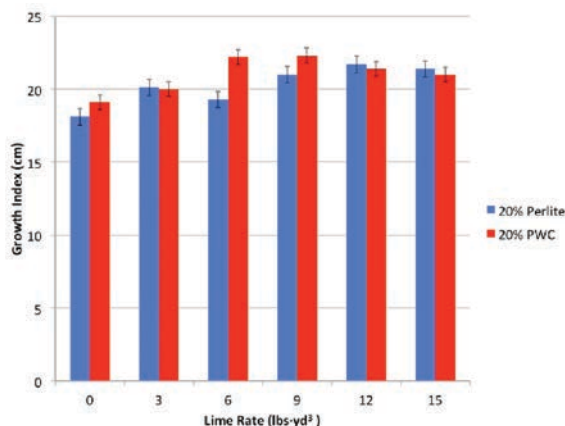


Figure 7. Comparison of 'Moonsong Deep Orange' African marigold growth indices (GI) (cm) grown in substrates amended with 20 percent perlite (blue) or PWC (red) aggregates and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

limestone application rates and PWC aggregates.

For commercial greenhouse production, changes in cultural practices are not needed when substituting perlite with

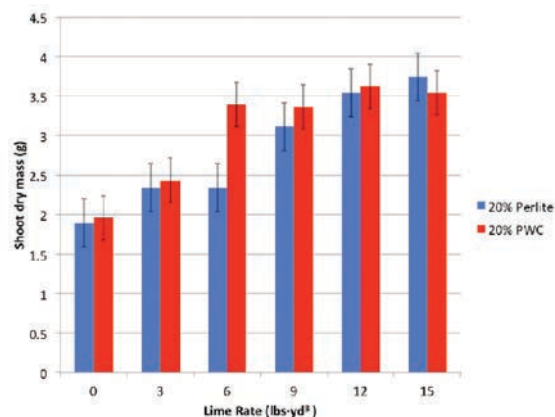


Figure 8. Comparison of 'Moonsong Deep Orange' African marigold shoot dry mass (g) grown in substrates amended with 20 percent perlite (blue) or PWC (red) aggregates and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

PWC aggregates. Understanding plant requirements is vital in terms of plant quality. As observed in this study, iron toxicity related to low substrate pH affected plant growth and visual quality. It is recommended for substrates containing 20 percent PWC aggregates (by volume) to be amended with dolomitic limestone rates of 6 to 9 lbs-yd³ for optimal



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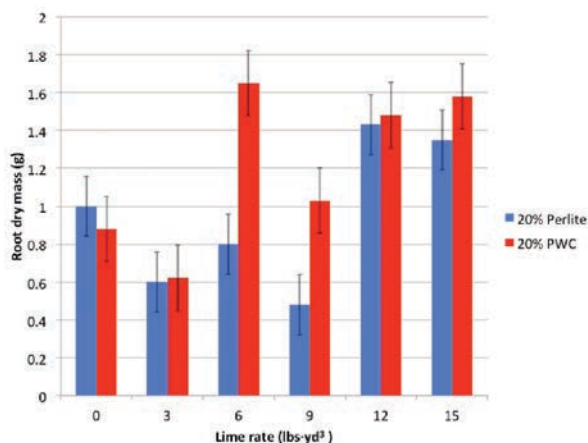


Figure 9. Comparison of 'Moonsong Deep Orange' African marigold root dry mass (g) grown in substrates amended with 20 percent perlite (blue) or PWC (red) aggregates and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

marigold growth and quality. Overall, PWC can be used in production of greenhouse crops without changing cultural practices and offers greenhouse growers in the United States a regional and readily available alternative to perlite. **GG**

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80:20 Substrates

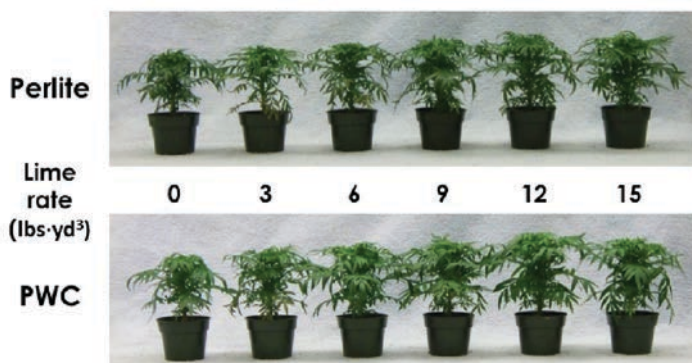


Figure 10. Comparison of 'Moonsong Deep Orange' African marigolds grown in a peat-based substrate amended with 20 percent perlite (top) or pine wood chips (bottom) and limed with 0, 3, 6, 9, 12 or 15 lbs-yd³ of dolomitic limestone.

izing in plant nutrition, plant growth regulators and problem diagnostics.

References: Jackson, B.E., R.D. Wright, and N. Gruda. 2009b. Container medium pH in a pine tree substrate amended with peatmoss and dolomitic limestone affects plant Growth. *HortScience* 44:1983-1987. 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.

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