GROWERTALKS

Features

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Feeding the Fiber

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Peat has long been the standard for soilless media because of its favorable physical and chemical properties; however, rising costs and supply chain challenges have encouraged the industry to explore additional new options. Wood fiber is a promising alternative substrate component that can be utilized at various incorporation rates by volume and brings new considerations for fertility management. Wood materials differ from peat in carbon-to-nitrogen (C:N) ratio, water-holding capacity and microbial activity, all of which can alter nutrient availability to plants. For growers, this means traditional fertility programs may need to be modified when using wood substrates.

Nitrogen deficiency is commonly observed as lower leaf chlorosis and overall plant stunting. In severe cases, entire leaf necrosis may be observed. | Photo: Patrick Veazie.

Signs of nitrogen deficiency

Nitrogen immobilization has been reported as one of the largest challenges associated with incorporating wood fiber into soilless substrates. Nitrogen immobilization occurs when microorganisms decompose carbon-rich organic materials, such as wood, and consume available nitrogen from the root zone.

Nitrogen deficiency is first observed in the lower foliage as chlorotic leaves that can progress to necrosis or lower leaf loss (Figure 1). Because wood fiber has a high C:N ratio compared to peat, microbes require supplemental nitrogen to balance their metabolism during decomposition. This microbial demand can temporarily reduce the plant-available nitrogen that's supplied through water-soluble fertilizers, resulting in potential deficiencies in crops if fertility programs aren't adjusted.

The extent of immobilization is closely tied to the proportion of wood fiber in the substrate. At lower incorporation rates (e.g., 10% to 20% by volume), immobilization is typically modest and can often be managed with standard fertilization practices. However, at higher rates of wood fiber incorporation (>70% or more), nitrogen drawdown has been reported to be more pronounced.

Nitrogen deficiency symptoms, such as chlorosis and reduced growth, may appear in sensitive crops if nitrogen supplementation is insufficient. One must balance providing enough fertilizer to overcome any N immobilization; however, it's important to remember the fertilizer type and that applying too much fertilizer can impact plant form and substrate pH.

Adjusting fertility rates

Fertilizer type plays a critical role in substrate pH management because different nitrogen forms influence acidity in opposite ways. Ammonium (NH_4^+) and urea-based fertilizers tend to lower substrate pH. When ammonium is taken up by roots or oxidized by microbes to nitrate (NO_3^-), hydrogen ions (H^+) are released, increasing substrate acidity. If fertility programs rely heavily on ammonium, pH can drift below the desirable range of 5.5 to 6.5, leading to issues such as iron or manganese toxicity.

In contrast, nitrate-based fertilizers are basic in reaction. Uptake of nitrate by roots consumes negatively charged ions, resulting in hydroxide (OH^-) release, which gradually raises substrate pH. Fertilizers supplying calcium nitrate or potassium nitrate, for example, often help maintain or increase pH when substrates trend acidic.

The balance between ammonium and nitrate forms is therefore a key management tool for maintaining stable substrate pH. In wood fiber–amended substrates, where microbial activity is high and pH can fluctuate more rapidly, fertilizer selection becomes even more important. A program dominated by ammonium may drive pH down too quickly, while a nitrate-heavy program may allow pH to rise excessively. By adjusting the ammonium-to-nitrate ratio, growers can counter pH drift and maintain nutrient availability throughout production.

Symptoms of low substrate pH may be observed as iron and manganese toxicity of the lower foliage, with development of lower leaf purple-black coloration and, in severe cases, necrosis. | Photo: Brian Whipker.

Fertility rate has a direct impact on substrate pH and electrical conductivity (EC). As the fertility rate increases (ppm N), the substrate EC will initially remain low (<1 $mS \cdot cm^{-1}$) as plants and microbes rapidly utilize the applied nutrients. Over time, as fertility inputs accumulate beyond the immediate uptake capacity of the crop and microbial community, EC values begin to rise in the root zone. When the EC begins to rise in the root zone, an inverse relationship between EC and substrate pH is observed. As substrate EC increases, substrate pH decreases, resulting in potentially low pH symptoms. These low pH conditions can lead to excessive accumulation of iron (Fe) and manganese (Mn) in lower leaves, which may cause toxicity symptoms such as bronzing or purplish-black discoloration (Figure 2).

As substrate EC increases, substrate pH decreases, resulting in potentially low pH-induced symptoms. While N immobilization has been observed in wood fiber substrates >70% by volume, it's important to understand that there's a balance between increasing your fertility rate to offset N immobilization, but not increasing N fertility to result in increased EC, leading to potential low pH problems. Monitoring substrate pH and EC levels throughout the crop production cycle is important to optimize plant growth while minimizing fertility inputs.

Incorporating wood fiber into soilless substrates presents both opportunities and challenges for greenhouse production. While wood is a potential alternative to perlite or as a peat extender, its unique physical and chemical properties require growers to carefully reconsider fertility management strategies. Balancing nitrogen immobilization based on the incorporation rate is a critical point to not over- or under-apply fertility to maximize plant growth, minimize inputs and maintain an optimal substrate pH. At the same time, fertilizer type and rate strongly influence root-zone chemistry. The balance between ammonium and nitrate forms is especially important, as ammonium can drive pH lower, while nitrate-heavy programs may allow pH to increase when the fertility rate is equivalent to plant uptake. However, the fertility rate further complicates this balance, with higher inputs increasing EC and often driving pH downward regardless of whether the fertilizer is acidic, neutral or basic, potentially creating low pH conditions for crops.

Successful use of wood substrates depends on finding the right equilibrium, providing enough nitrogen to offset immobilization without over-fertilizing to the point of excessive EC or pH. This requires consistent monitoring of pH and EC throughout production and making timely adjustments to fertilizer formulation and application rate. By integrating careful fertility management with knowledge of wood fiber's behavior in the root zone, growers can maintain crop quality, optimize nutrient use and fully realize the potential of wood-based substrates as a sustainable alternative to peat. **GT**

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