GROWERTALKS

Features

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The Biochar Mix

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It turns out that throwing “biochar” into a soil mix is kind of like telling someone to “fertilize” a crop with no further instructions: you need the right kind at the right ratios. And each plant has its own idea of the perfect fit.

Biochar—essentially burned organic matter— is thought to have once been an agricultural tool in the Amazon and has a rich history of use in Asia and Europe. For the last two decades, the horticulture industry has had its sights on biochar as an additive that offers a sustainable way to sequester carbon while also improving growing conditions. In particular, biochar has earned a position as a substitute for peat moss and perlite in the horticulture world.

Biochar is, as the name implies, organic matter that’s “charred,” i.e., at a high temperature without oxygen present. That heating process is technically referred to as pyrolysis. But not all biochar is the same.

What kind of biochar is it?

The beauty of biochar is that is can be made from any kind of organic matter: dumped plant materials from your greenhouse, grasses, rice hulls, corn stover, manure, tree chips or sawdust, or practically any other organic material. In some regions, it may be agricultural by-products, such as cotton gin trash or poultry litter. This organic matter is often called “feedstock.”

Just as varied as the feedstock sources are the temperatures at which biochar is produced and the resulting physical and chemical properties.

Mike Evans at the University of Arkansas led research that evaluated biochar made from different feedstocks. In a report submitted to the USDA on the project, he noted the significant differences between biochar products, even when the production method was identical.

“This research was significant because it clearly demonstrated that, with respect to its use as a substrate component, biochar cannot be thought of, or referred to, as being a single entity,” he said. “Different biochar products will have very different chemical properties and end users (greenhouses and nurseries) must know the specific chemical properties of a specific biochar product to know if it can be used as a substrate component and if its use would necessitate changes in the fertilization program.”

In particular, the feedstock used can greatly increase biochar’s pH and electrical conductivity. The University of California at Davis has developed a biochar database (biochar.ucdavis.edu) to help users compare data on a variety of biochar feedstocks.

How it’s used

Biochar can be used for remediation to bind heavy metals and acids that contaminate soils. Golf courses turn to enriched biochar for more natural turf management, relying on it to reduce fungicides and fertilizer use. Golf course trials have also shown that adding biochar can make greens more resilient during droughts and improve drainage during wet periods.

In field agriculture, biochar gets added to the soil. In the home garden, we're starting to see biochar products added to the soil and compost. And in the greenhouse, biochar is now available as a component of media mixes.

The pros

In this industry, biochar has been positioned as a sustainable alternative to sphagnum peat, perlite and composted bark. In many cases, if the appropriate feedstock is used, it can be used for organic growing, so long as it conforms to the biochar standards set by the Organic Materials Review Institute (OMRI).

Some research studies have found increases in plant growth, root development, nutrient retention and crop production with the use of biochar, but these increases are also uniquely tied to other factors—such as the ratio of biochar used, the type of biochar, the rate of fertilization and the plant species. Much of the research and case studies on biochar focus on field agriculture, where they've found good success with biochar increasing yields and water retention. Work in the container production world is less abundant, but it continues to increase each year.

Because biochar breaks down so slowly—taking thousands of years—it also offers long-term consistency and becomes a good candidate to sequester carbon. Growers and researchers are also attracted to biochar because it can be produced on a local or regional basis and can be an inexpensive alternative to peat or perlite.

A literature review published in Bioenergy (Vol. 5, Issue 2) of 371 independent studies clearly found variability on the effects of biochar, but also stated that "the addition of biochar to soils resulted, on average, in increased aboveground productivity, crop yield, soil microbial biomass, rhizobia nodulation, plant K tissue concentration, soil phosphorus, soil potassium, total soil nitrogen and total soil carbon compared with control conditions."

The cons

There's no lack of enthusiastic endorsements on the benefits of biochar, but a review of the research on biochar reveals a mixed bag of findings. Why? Go back to the idea that biochar isn't one product. It's dozens of products whose properties and benefits vary based on what you use to make the biochar. Then throw in the fickle growing requirements of each plant variety.

Use the wrong biochar feedstock or too much biochar and you may be looking at reduced growth rates and other problems.

Mixing ratios

When researcher Andrew Margenot at the University of California—Davis tried to grow marigolds by substituting biochar for peat in a 70:30 peat to perlite mixture, they did see some high pH levels, up to 10.9. They were using biochar made from softwoods, which is known to have a high pH. When their media had a high amount of biochar, the marigolds struggled in their first few weeks, showing signs of nitrogen deficiency, in line with a high pH. But by the time the marigolds started to flower, the pH had neutralized and their growth was equivalent to those grown in peat moss, with no negative effects from the biochar.

Other attempts at using 100% biochar for the media have been less successful. At the University of Arkansas, they found that growing strawberries in wood biochar as a soilless substrate was "unsuitable" due to its low water-holding capacity.

Many trials have found sweet spots with a mix of biochar in the growing media. As little as 1% to 5% (by weight)

added to a coconut fiber-tuff substrate improved both tomato and pepper growth in one study out of Israel.

In a study published in HortScience (Vol. 47, Issue 8), adding 10% biochar, by volume, to peat-based root substrate increased the root substrate macronutrient retention capacity. Research in the Journal of Food, Agriculture and the Environment (Vol. 11, Issue 1) looked at Gomphrena pulchella Fireworks and concluded that up to 30% biochar could be added to a peat-based mix without any significant impacts on plant quality.

The USDA Agricultural Research Service looked at biochar made from sugarcane feedstock and concluded that it had high water-holding capacities, and that squash and melon seedlings grown with 25% to 50% biochar did particularly well (Journal of Agricultural Science, Vol. 10, No. 2).

A team led by Yanjun Guo at Texas A&M recently evaluated biochar and fertigation combinations on the production of Poinsettia Prestige Red. Overall, they found that when using a biochar made from pine wood, they could add up to 80% biochar to the peat-based media mix without any negative effects on the poinsettias. But growing in 100% biochar led to reduced plant growth, and when combined with high fertigation rates, they saw more root rot and bract necrosis as well (Horticulture, Vol. 4, Issue 1).

Additional studies out of Texas A&M have seen success with pine wood biochar and growing chrysanthemums and tomatoes in containers in the
greenhouse.

Air it out

Some biochars can emit ethylene. Research by Will Fulton and a team at Oregon State University found that different types of biochar emitted a range of ethylene concentrations for varying periods. They concluded, however, that storing biochar in the open for 90 days following its charring process would easily make it safe to use in the greenhouse environment.

Before you grow

Know the chemical and physical properties of your biochar. With a growing body of research on various feedstocks and crops—and much of it coming from university horticulture programs in the U.S.—you should have a good starting point to begin with. Trial it in your production setting to confirm you have a feedstock and media recipe that works for you. **GT**