Biochar: An Ancient History Leads to Modern Uses

Biochar is a product made when organic solids are slow-burned in the absence of oxygen in a contained system. This man-made technology of burning is called pyrolysis. Biochar is made like charcoal, but contains no petroleum, is made sustainably from biowaste products (herbaceous or woody crop residues, non-salvageable timber and slash, animal manure, and more), and is applied to soil for two benefits: long-term carbon storage and as a soil amendment. It is predicted that at least 50% of the carbon in any piece of waste turned into biochar becomes stable, locking away that carbon into the soil for a period of several to hundreds of years, offsetting its contribution as a greenhouse gas in the form of carbon dioxide. As people who work with plants, our primary interest is the potential for biochar to improve soil quality, growth, and yield.

The similarity of biochar to the organic matter found in ancient "Terra Preta" soils led scientists to theorize that biochar application to other soils could be beneficial. Terra Preta (dark earth) is a dark and loamy soil found in scattered pockets of the Amazon. Those pockets of soil are widely believed to have been amended or mulched with charcoal waste from pre-Columbian Indian hearths thousands of years ago. Research in the 1900s and early 2000s showed that Terra Preta soils have higher nutrient availability, higher cation exchange capacity, greater water retention, and greater porosity/aeration than the neighboring native soil, resulting in improved crop growth.

These results have fueled hundreds of studies in the U.S. on the effects of freshly-made biochar on plant and soil health. Trials in both agricultural soils and potted plants have shown mostly positive results, many of which are similar to the research on Terra Preta soils. Studies have also examined whether biochar helps plants defend against soilborne diseases, and some have been promising, showing that growth of beneficial rhizobacteria and mycorrhizal fungi is greater in the biochar soils.

It should be noted that some crop studies have shown decreased plant growth. These results, however, may be attributed to temporarily high pH, toxins present on the char surface (such as tannins), nutrient imbalances, or simply inherent nature. Problems like these may be corrected as pH neutralizes, or are prevented through proper biochar preparation of washing the char and "charging" it with compost or fertilizer. More research is needed to properly quantify the effects of biochar application in different climates and cropping systems. You can track all the latest research at The International Biochar Initiative.

HOW BIOCHAR WORKS

Biochar does not contain any nutrients; it is the physical properties that provide the benefits. Biochar's negative charge attracts positively charged plant nutrient ions (calcium, potassium, magnesium, etc.), preventing them from leaching out of the soil, and making them readily available to the plant roots. In addition, the high surface area and porosity of biochar attract and hold water and provide a refuge for beneficial organisms.

HOW TO USE BIOCHAR

Studies have shown that applying raw biochar alone in poor soil has little benefit to plants and may retard growth for at least 6 months. Biochar should be rinsed in water and then "charged" by mixing it almost half and half with compost or with a fertilizer. As far as how much to use, research trials have tested a wide variety of rates, and the recommended results of 1 to 10 tons/acre show that, "it depends"; certainly the soil type and crop play a role. One option is to apply low rates over a period of 2-3 years to slowly build up the content in the soil. But because effects on crops and soil types are still being investigated, it may be wise to wait for solid recommendations.

It is important to note that not all biochars perform the same: it depends on the biomass source, the temperature of pyrolysis, and the size of the product. There are several online options to purchase small batches, and they are not cheap. Gardeners interested in trying packaged biochar products should ref-

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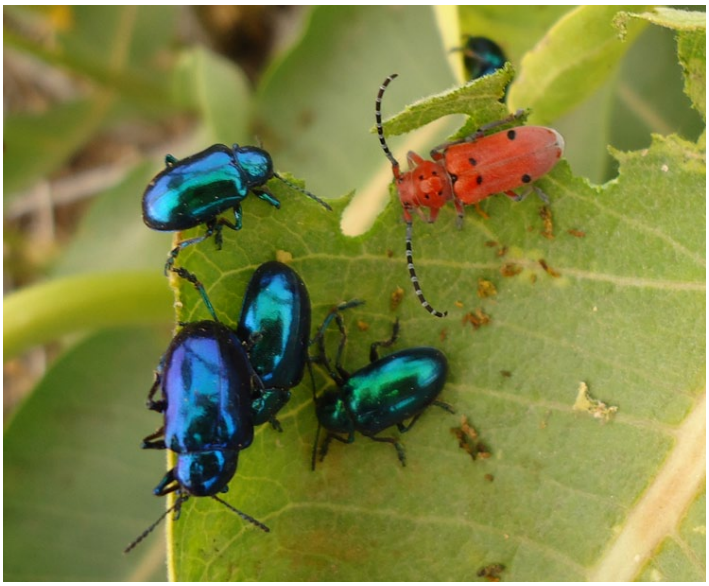
Where is biochar being used?

- Greenhouse growers are using it in potting media to improve water-holding capacity.
- Cacao growers in South America are applying it to young trees to shorten the number of years to production by half.
- Several non-profits are creating biochar gardens throughout Third World nations to benefit depleted soils.
- Large food companies such as Nestle and Kraft are investigating biochar in food production.
- Tree care companies are experimenting with biochar as a remediation tactic for stressed trees.
- Botanic gardens are making their own char and using it in compost mixes.
- Scientists are exploring it for soil reclamation and mining remediation due to its sorption characteristics and relatively high pH.
- Foresters in the West are exploring biochar production from dead trees (largely beetle killed) as a value-added product and an alternative to slash and burn.



Featured Picture of the Quarter

Part of what we do in the Utah Pests group is monitor for insects and diseases on plants. Seeing pests "co-mingling" is common, but rarely in such a colorful arrangement. The cobalt milkweed beetle (*Chrysochus cobaltinus*) and red-femured milkweed beetle (*Tetraopes femoratus*) are both native insects that specialize on milkweed plants. Like monarchs, both species can afford to be colorful due to the protection that the ingested milkweed toxins provide from predators. They do provide a warning when disturbed: the cobalt milkweed beetle will emit a foul liquid and the red-femured milkweed beetle will "squeak".

Image by Erin Petrizzo, USU Research Assistant

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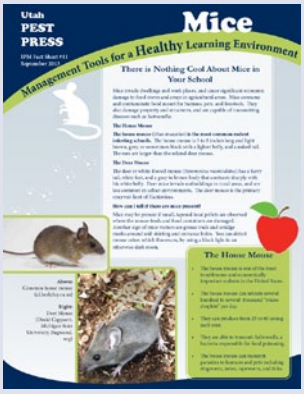
erence label instructions. The International Biochar Initiative has developed standards for biochar production (and testing). Experimental trials are continuing throughout the world, the USDA is providing funds for research, and citizen science projects have been enacted (Sonoma Biochar Initiative (California), and The Big Biochar Experiment (England)). Improved recommendations for agriculture and landscape industries and residential sites are just a few years down the road.

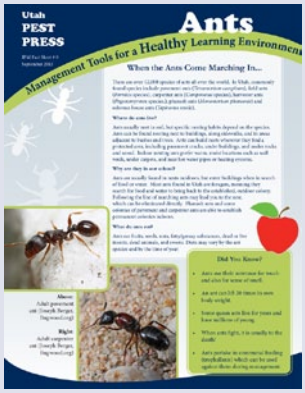
- Marion Murray, IPM Project Leader, and
Britney Hunter, Assistant Professor, Hort., Davis County

For Additional Information:

Cox, Justine (ed.). 2012. Biochar in Horticulture. NSW Trade and Investment. 104 pp.

"Pest Press" Fact Sheets





Several new "Pest Press" fact sheets, are 2-page fact sheets on a wide variety of pests, located on the new School IPM website (utahpests.usu.edu/schoolIPM).

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