

Evaluation of biochar for agricultural soil management in California

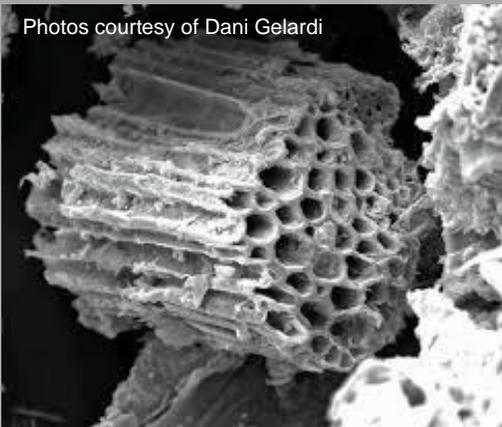
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Guest Speaker

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Biochar is any organic material pyrolyzed in the absence of oxygen. It's considered to be highly stable and to have high surface area and reactivity.

Photos courtesy of Dani Gelardi



Biochars can have very different properties depending on the feedstock, the production temperature, and production method

Biochar—is it a waste product? An agricultural magic bullet? Something in between? In the second session of our Lunchtime Seminar Series for Organic Growers, Dani Gelardi, a PhD Candidate in the UC Davis Environmental Soil Chemistry Lab with Dr. Sanjai Parikh, talked about just what biochar is, and the results of some of her lab's research on biochar's benefits and risks for California growers.

How is biochar made?

In California, biochar is made with different agriculture wastes including almond and walnut shells, livestock manures, and wood from forest thinning operations. It is produced with a range of pyrolysis methods, from on-farm or portable systems to large industrial operations. Industrial operations are often optimized for the production of syngas, or the renewable energy which is produced alongside biochar during the pyrolysis process. These operations may yield less and lower quality biochar.

How do biochars differ?

Biochars can differ in important chemical and physical properties including pH, salinity, water holding capacity, carbon content and stability, nutrient content, and cation exchange capacity. This means that biochar should be selected based on the desired outcome.

Potential benefits of biochar

Biochar's reported benefits include :

- Climate-friendly use of agricultural waste
- Improved water and nutrient retention
- Higher yields

Research: Biochar's benefits (and risks) for California growers

For the past decade, researchers in Dr. Sanjai Parikh's lab at UC Davis have been investigating biochar's potential in California. Here are some of their findings:

- **Crop yields** aren't usually improved. A 3-year study in Yolo and Fresno Counties found that none of the seven biochars tested improved processing tomato yields compared to a no-biochar control, and another Yolo County study found that in the first, third, and fourth years, adding walnut shell biochar to compost or mineral fertilizer did not improve corn yields. However, corn yields were improved in the second year, likely because of the nutrients weathered from the biochar.
- **Soil water** may be retained for longer in soils with biochar, but it probably depends on the biochar type and soil texture. A field study found that plant available water increased with walnut shell biochar application rate in a sandy but not a fine-textured soil. A lab study observed that high rates of softwood or almond shell biochars produced at lower temperatures slowed water flow through both fine and coarse soils, but an almond shell biochar produced at a higher temperature increased it.
- **Other potential benefits of biochar** include use as a climate-friendly substitute for peat moss in the nursery industry and as an additive which may decrease greenhouse gas emissions during the composting process. Research suggests that while these climate-friendly practices may not improve yields, they likely will not reduce them. Overall, biochar application is considered to be one of the more effective strategies for greenhouse gas reduction.
- **Risks of biochar** are mostly related to its potential health impacts. Biochar released into the atmosphere during application can directly contribute to the toxic PM10 fraction of agricultural dust, and some biochars may contain toxins. Risks can be mitigated by adding moisture, buying only from trusted sources, avoiding application on windy days, and wearing correct PPE.

Take-home points & resources

- Biochar is not "one size fits all". Results will be different for different soil types, biochar types, cropping systems, application rates, etc
- In fertile California soils, huge yield benefits aren't likely. However, there may be soil water savings or greenhouse gas reductions
- Take safety precautions!
- Select your biochar with an intended outcome in mind (i.e. water storage, CEC, pH, etc.)

Information on over 1,500 biochars can be found at the UC Davis Biochar Database (<http://biochar.ucdavis.edu>)

Want to know more? Contact Dani Gelardi at dlgelardi@ucdavis.edu