Innovations in Biochar

New CSP enhancement helps forest owners convert tree debris to soil-friendly, carbon-storing biochar

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It started as a backyard hobby fueled by curiosity in rural Southwest Oregon....and just three years later, it transformed into a new conservation approach that forest owners all over the country can use with financial assistance from USDA.

The benefits of this new approach are incredible—improved soil health, enhanced soil water holding capacity, increased plant growth and vigor, cleaner air quality, and perhaps most importantly, locals say, the ability to sequester carbon forever.

The secret lies in a substance called biochar.

Biochar is a modern technology that returns carbon to the soil in the form of long-lasting charcoal. It's made by baking biomass (such as tree wood, plants, manure, and other organic materials) without the oxygen that could cause it to burn completely to ash.

It all started with a Conservation Innovation Grant…

In Oregon, innovations in biochar for agricultural use have taken off, thanks to a Conservation Innovation Grant funded by the Oregon USDA Natural Resources Conservation Service (NRCS).

NRCS awarded a grant to the South Umpqua Rural Community Partnership in 2015 for a project called "On-Farm Production and Use of Biochar for Composting with Manure."

CIGs are competitive grants that drive public and private sector innovation in resource conservation. CIG projects inspire creative problem-solving that boosts production on farms, ranches, and private forests - ultimately, they improve water quality, soil health, and wildlife habitat. NRCS Oregon invests in state-level CIG projects every year.

"CIG is like a down payment on future planning and implementation," said Jay Gibbs, acting state conservationist for NRCS Oregon. "Projects need to have a line of sight to the landowner, with the goal of making innovative approaches accessible on a larger scale through other NRCS cost-share programs."

Kelpie Wilson, a consultant with Wilson Biochar Associates, spearheaded the CIG project and worked with a dozen farmers in Douglas, Josephine and Jackson counties. The project also engaged multiple volunteers, students

and partner agencies, including researchers from the USDA Agricultural Research Service.

Landowner Ken Carloni designed his own kiln to create biochar.

Kelpie Wilson of Wilson Biochar Associates holds a lightweight biocharred piece of wood.

The Problem: Waste and What to Do With It

“The primary goal of our CIG was to transform two types of farm waste: animal manure and woody debris, into a high-quality compost that will improve farm soils,” Wilson said. “Healthier farm soils high in organic matter will also improve pasture and crop production.”

Forestland in Southern Oregon requires routine thinning and slash treatments to reduce the risk of catastrophic wildfire, and to remove weeds and invasive vegetation that can impact pasturelands.

Thinning forests reduces the amount of vegetative "fuel" that can cause a wildfire to burn hotter and rise higher into the canopy to cause catastrophic damage. Having adequate spacing in between trees with less ground fuels significantly reduces the risk of a catastrophic wildfire. It also improves the health and vigor of the trees because they no longer compete as much with neighboring trees for water and sunlight.

After a thinning project, landowners typically pile the woody debris that isn’t suitable for commercial timber production and burn it down to ashes in the

open air. This practice is common, but it generates considerable smoke pollution.

This woody debris in rural Oregon is considered “stranded biomass” – meaning it’s not economical to transport small amounts of material from remote landscapes to a central industrial-sized bioenergy or composting facility.

This CIG project offered farmers and forest owners a practical, affordable solution to re-use waste by burning it to create biochar directly on the farm, using a variety of small-scale kilns. The biochar can then be applied on the farm to improve soil health.

Animal manure is also a source of on-farm waste that can be challenging to manage, especially when trying to reduce odors. The CIG also experimented with mixing biochar with animal manure to help control nutrient loss through better manure management. The most efficient process they discovered was to use biochar directly in the barn, where it can capture nitrogen from urine and manure as it is generated—a huge help for odor control!

The project also applied different mixes of composted manure mixed with biochar to use as a fertilizer for pastures. Local partners are optimistic that lessons learned from the manure trials can also help farmers improve odor controls and improve soil health.

Pictured: An Oregon Kiln is used to make biochar by burning woody debris.

Ring of Fire

The project designed and fabricated a variety of kilns used to burn biomass to create biochar. The key to burning is that the flame is on the top of the kiln—which burns particulates in smoke and limits oxygen flow to the char layers below the flame, preventing the char from burning all the way to ash.

Participating landowners designed their own kilns to suit the size of the biomass and the conditions on the farm. Even the local community college got involved. Students in the welding program at Umpqua Community College fabricated kilns for the project.

Farmers and forest owners performed field trials using various kiln designs and burning different sizes and types of biomass. They fine-tuned the designs along the way, resulting in several kiln designs that can easily be replicated and fabricated for wide spread use.

Making CSP History in Oregon

Perhaps one of the most valuable takeaways from the CIG project is the development of a new enhancement for the Conservation Stewardship Program, which now allows CSP forestry participants to convert their woody debris into biochar. CSP is the largest voluntary conservation program by acreage in the U.S.

Forest owner Ken Carloni of the non-profit group, Yew Creek Land Alliance, is the first landowner in Oregon to use the new biochar enhancement through his CSP contract.

The primary objective of Ken's CSP contract is to thin overcrowded conifer stands on his forest lands to restore oak habitat. Removing excess conifer opens up the canopy for oak trees so they no longer compete with conifers for water and sunlight.

Oak restoration is a goal in this part of Oregon because of its unique habitat value for wildlife. In fact, most of Western Oregon was dominated by oak landscapes before modern day human settlement. Preserving this important part of Oregon's natural history and ecology is a priority for conservationists, Native American tribes and state and local natural resource agencies.

Instead of doing a traditional open pile burn, which generates a lot of smoke, Ken cleanly burns the debris in a kiln that he designed himself, creating biochar.

"The cool thing about this is nobody thinks it's a bad idea—everybody hates to see waste," Ken said.

Ken was most interested in producing biochar because of the implications surrounding climate change.

"That carbon is stored forever in biochar," Ken said. "And we are improving soil productivity and increasing tree growth."

More Resources on Biochar

For a deeper dive into the science of biochar and the on-farm applications explored through this CIG project, check out these online resources:

- CIG Final Report and Practice Guidelines, On-Farm Production and Use of Biochar for Composting with Manure (PDF)

- How to Make Biochar in a Burn Pile (PDF)

- Using a Flame Cap Kiln (PDF)

- Kiln Construction Drawings, Oregon Kiln and Ring of Fire Kiln (PDF)

- How to Use Biochar in Barns (PDF)

- How to Use Biochar in Compost (PDF)

- Plant Bioassays to Evaluate Biochar Compost (PDF)

- Wilson Biochar Associates Website

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