ON-FARM PRODUCTION AND USE OF BIOCHAR FOR COMPOSTING WITH MANURE

- UBET - Umpqua Biochar Education Team
- Project of SURCP – South Umpqua Rural Community Partnership
- 2015 Conservation Innovation Grant - NRCS
UBET -- Umpqua Biochar Education Team
Jim Long and UBET

Jim – we miss you!
Umpqua Community College is making our kilns. We hope this could be the start of a new industry in Oregon making biochar from forestry waste.
Project objectives & goals

• Farmers in Oregon often have forest land and forestry residue that they burn for disposal
• Farmers with livestock have manure that can be a problem to handle
• Combine two waste steams to create value
  • Help farmers make biochar
  • Test different methods of composting manure and biochar
  • Determine economic costs and benefits to farmers
  • Share what we learn
Participating Farmers

**Farm Livestock and Acreage**

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Project Deliverables

- Design and build kilns at Umpqua Community College
- Onsite demonstration workshops for biochar production and use in compost and manure management
- A biochar use and monitoring plan for each farm
- Guide sheets for public distribution – one on biochar production and one on biochar use and monitoring.
Morrison-Fontaine Forestry
Biochar + Manure = Potatoes
Design Parameters for Forestry Kiln

- Sized for feedstock
  - Logs 4 to 5 feet long
  - Up to 6” diameter
  - Log rick fits better in pyramid shape than cone

- Portable but Durable
  - Less than 200 lbs
  - 14 gauge steel

- Ergonomic for loading
  - Only 2 feet high

- Economical
  - Pyramid shape cheaper to fabricate than cone
  - $600 for Kiln – 5’ top base, 4’ bottom base, 2’ high sides
Oregon Kiln
Tipton Ranch
Michaels Ranch
Siskiyou Alpaca
Willow Witt Ranch
Willow Witt wood - inaccessible
East Fork Ranch
Daisy Hill Farm
Daisy Hill Farm
Tierra Buena Worm Farm
Tierra Buena Worm Farm
Composting Workshop – Tierra Buena
Composting Workshop – Frog Farm
Biochar Composting Challenges

• Determining C:N ratio of ingredients
• Crushing biochar to correct particle size
• Mixing
• Monitoring compost quality
  • Temperature
  • pH
  • Growth tests
Possible Benefit of Biochar to Compost

- Only occurs if you have C:N right
- Also depends on C:N impact of biochar

Biochar increases the temperature in a compost process, accelerating the time needed for material decomposition.\textsuperscript{4,6,7}
What is the C:N of biochar?

• Typically, only about 10-30% of the total C in biochar is mobile and available*
• C:N could be about 100:1 or greater – it depends on the biochar
• IMPORTANT: Biochar influences C:N by absorbing N
• Tip: Charge Biochar with liquid N (urine or urea) before adding to compost with lots of “browns.”

Aged Cow Manure – Not enough Nitrogen

Cow Manure Compost with and without Biochar

- Ambient T
- A Compost T
- B Compost T
What happens with high N manure

![Nitrogen transformation diagram](image)

**Figure 1.** Nitrogen transformation during manure composting (adopted from [18]). A: Ammonification; I: Immobilization; M: Mineralization; V: Volatilization; D: Dissolution; Nf: N-fixation; N: Nitrification; DN: Denitrification; L: Leaching loss.

A Successful Pile

2 parts biochar; 2 parts fresh, hot, smelly dairy manure; 3 parts goat barn waste. Pile was hot for weeks. Never turned. Lots of worms at the end.
EM-1 for manure composting

- In Germany, sauerkraut juice is sprayed in cattle barns to control ammonia odor and kill pathogens
- EM-1 from Teraganix (bokashi starter) can also be used
- It’s the acidity that kills pathogens
- EM-1 includes lactic acid bacteria, yeasts, photosynthetic bacteria with >30 species
- EM-1 bacteria thrive and outcompete pathogens
- Acidity also prevents liquid ammonium from volatilizing into gaseous ammonia, preserving N
Biochar and EM-1 in the Rabbitry
Biochar Particle Size

- Particle size makes a difference
- Finer particles will have more mobile carbon
- Finer particles also have more available surface area to adsorb N

- Larger particles have benefits for bulking and aeration
- A mix of particle sizes is probably best – ½” minus is a good goal
Mixing

- Fine grained biochar is harder to mix than coarse
- Intent was to have animals mix it, but instead it was applied after cattle had left winter barn and mixed with a tractor
The Bedding Factor
Biochar Composting – Manure

1. Spread biochar on bedding
2. Spray with EM-1
3. Animals crush and blend biochar with manure and bedding
4. Clean barn and pile
5. Adjust biochar/bedding amounts for HOT pile
How to monitor Biochar Compost

- Temperature - easy
- Moisture - easy
- pH – easy
- ORP (Oxidation-Reduction Potential) – implications unclear
- EC (Total Dissolved Solids) – not specific
- NPK – specialized testing lab, $$$
- Worm avoidance tests - unreliable
- Seed germination and plant growth tests - YES

Testing protocols at:
Testing for pH

- Cheap pH meters do not work with biochar
- pH paper is much more accurate
- Lab quality pH meter is good
- See protocols here:
Germination and Plant Growth

Left: composted biochar vs. plain potting soil

Right: biochar and worm castings vs. plain potting soil
Snake Avoidance Test?

A baby snake was enjoying the moist, cool space under the pile of biochar. This biochar passed the "Snake Avoidance Test!"
Getting ready for next burn season
Next Steps: Need to Automate

Skidworks

“3 Yd. Dump Hoppers”
Wilson Biochar Associates specializes in biochar technology and market development. We provide strategic advice and services to businesses and organizations.

- Technology Assessment
- Research and Analysis
- Project Development

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