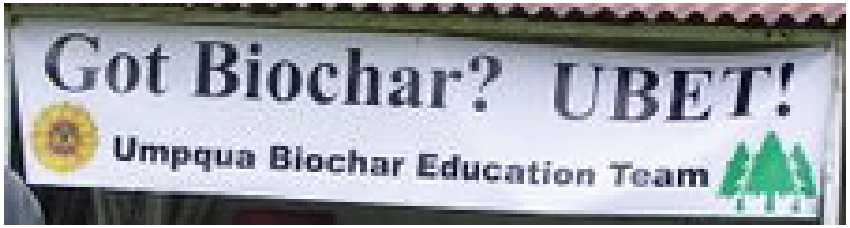
ON-FARM PRODUCTION AND USE OF BIOCHAR FOR COMPOSTING WITH MANURE

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



SURCP.ORG

UBET -- Umpqua Biochar Education Team

Jim Long and UBET

Jim – we miss you!

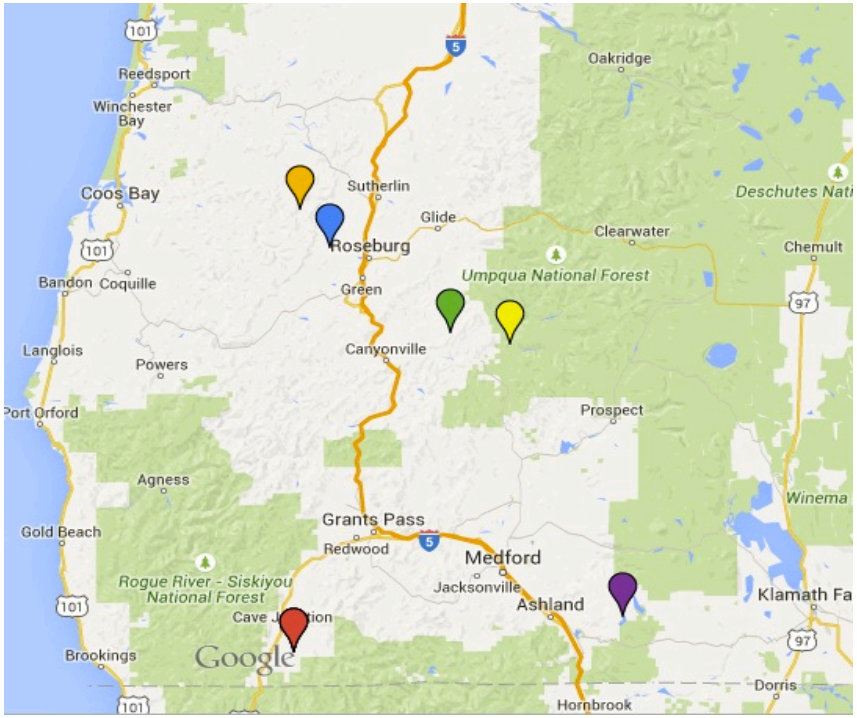
UCC Welding Department

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						
cows	pigs	sheep & goats	fowl	horses	pasture acres	woodlot acres
250					200	
600		325			1150	120
	12	37	100		35	3
		47			35	43
	60	60	200		30	250
			18		1	
		17	73		6	6
		3	36	17		
850	72	489	427	17	1457	422

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

WigWam 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

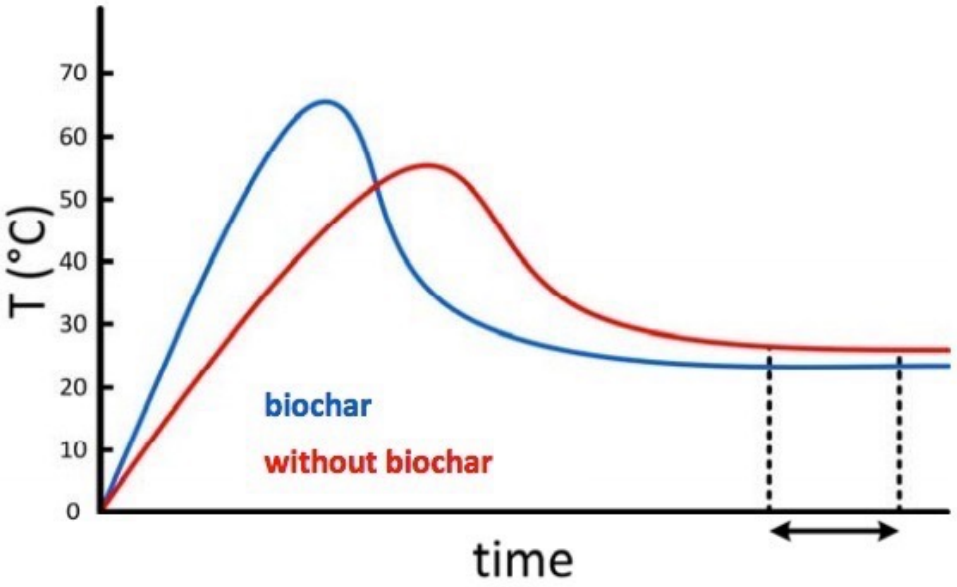
Composting Workshop – Tierra Buena

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



Biochar increases the temperature in a compost process, accelerating the time needed for material decomposition[4, 6, 7]

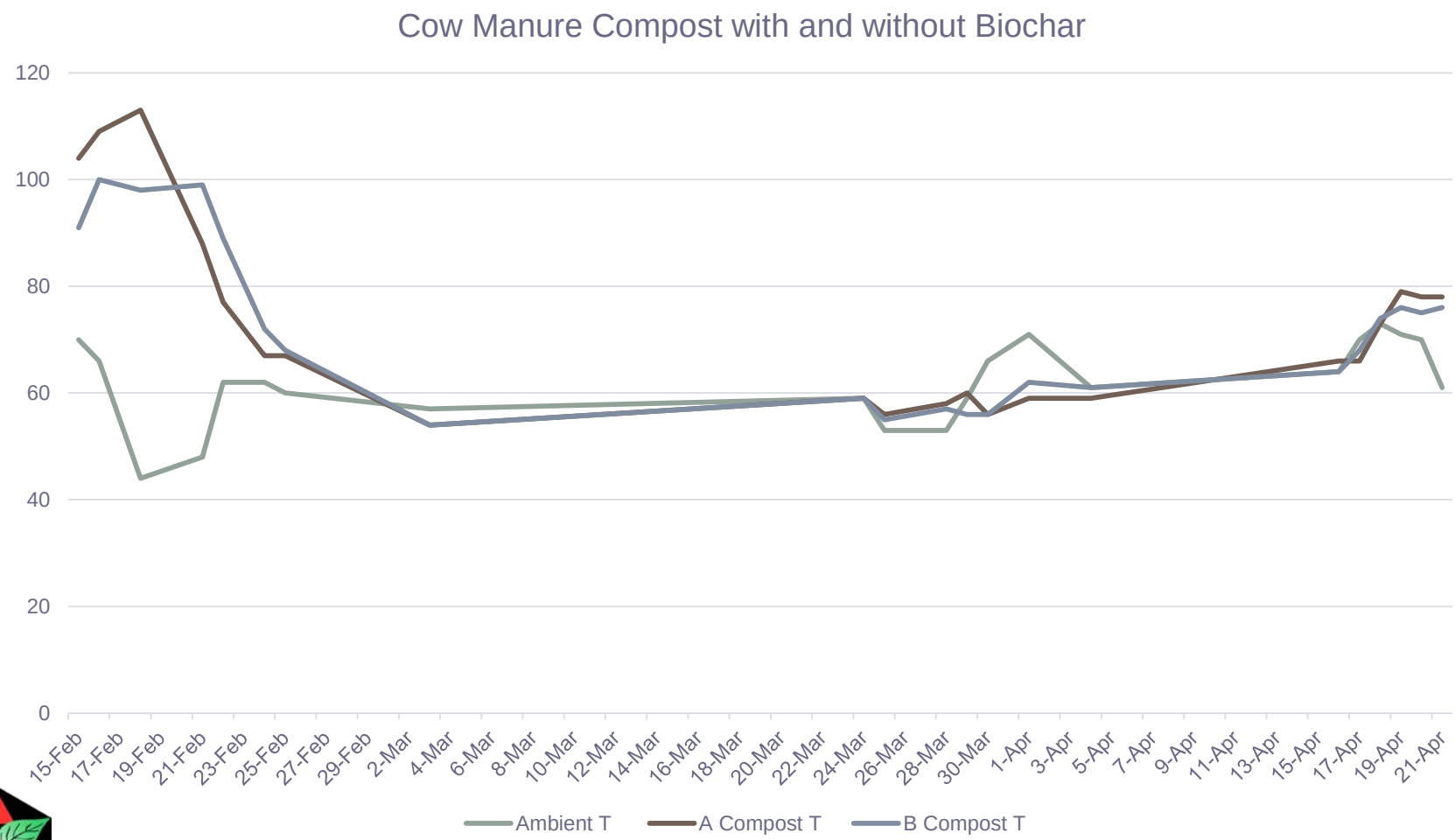
- Only occurs if you have C:N right
- Also depends on C:N impact of biochar

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.”

*http://www.terra-char.com/uploads/2/3/7/9/23790961/composting_with_biochar.pdf

Aged Cow Manure – Not enough Nitrogen



What happens with high N manure

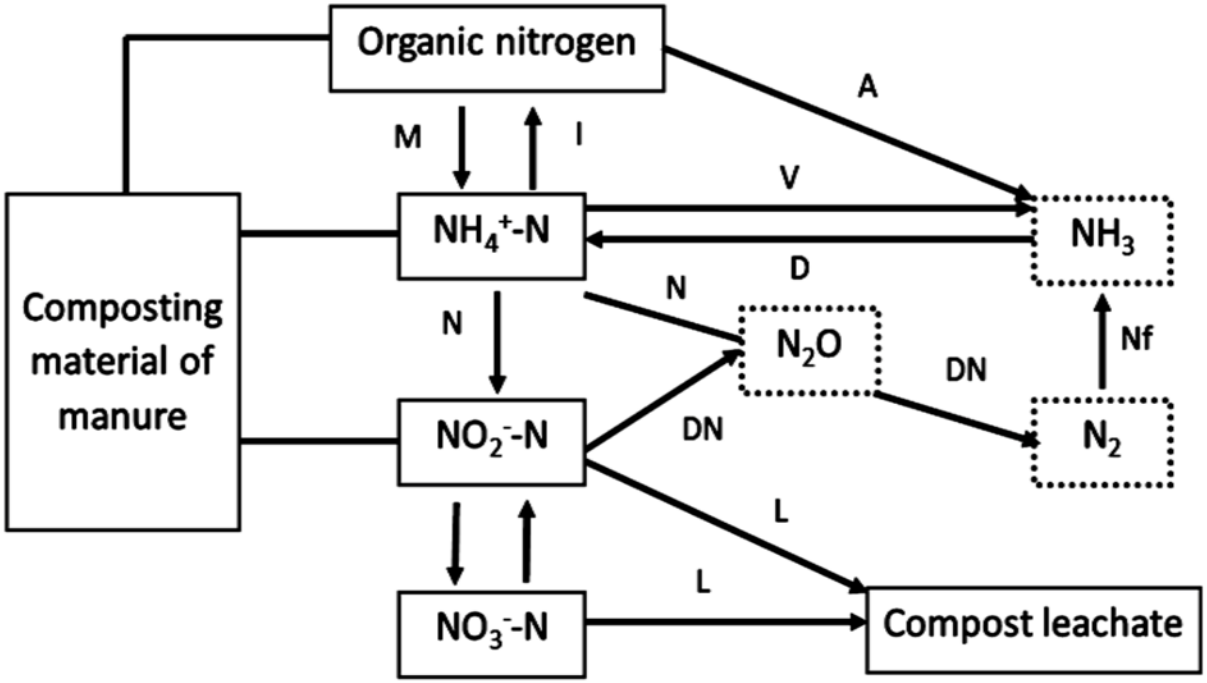


Figure 1. Nitrogen transformation during manure composting (adopted from [18]). A: Ammonification; I: Immobilization; M: Mineralization; V: Volatilization; D: Dissolution; Nf: N-fixation; N: Nitrification; DN: Denitrification; L: Leaching loss.

Jia, X., Yuan, W., & Ju, X. (2015). Short Report: Effects of Biochar Addition on Manure Composting and Associated Emissions. *Journal of Sustainable Bioenergy Systems*, *05*(02), 56–61.

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

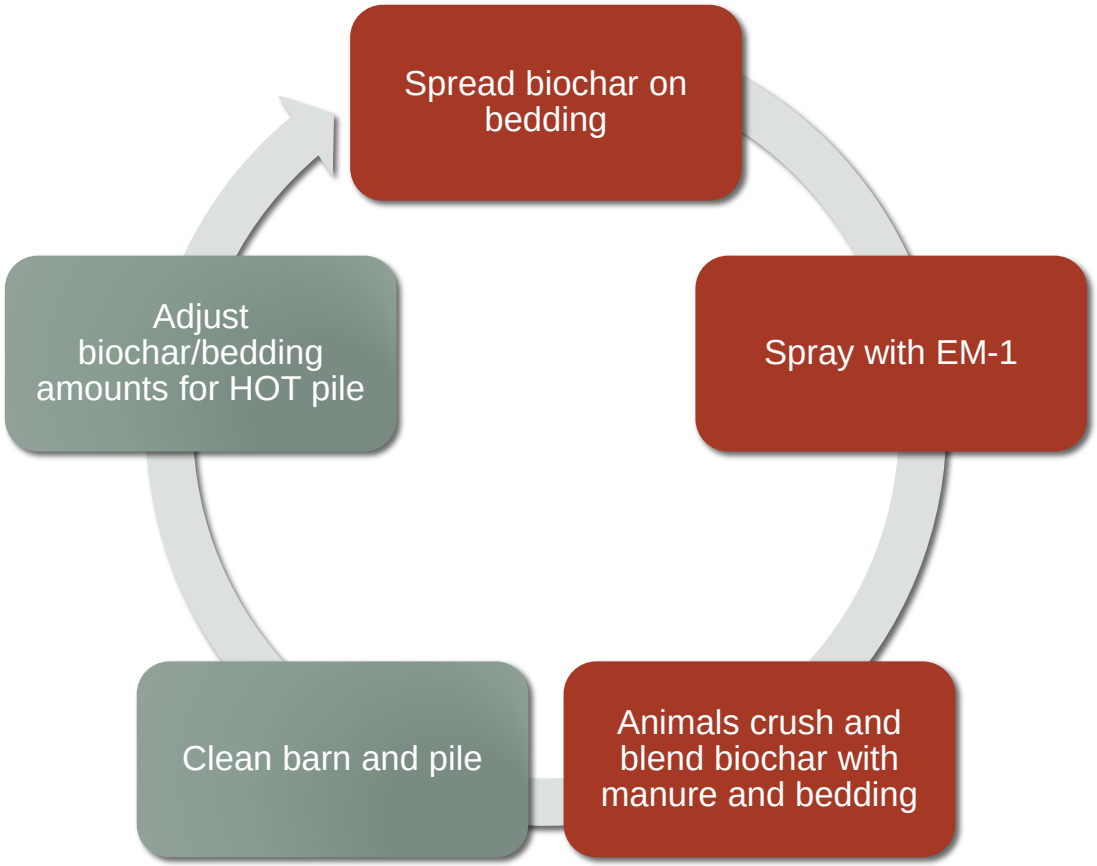
- Particle size makes a difference
- Finer particles will have more mobile carbon
- Finer particles also have more available surface area to adsorb N
    - Larger particles have benefits for bulking and aeration
    - A mix of particle sizes is probably best – ½” minus is a good goal

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

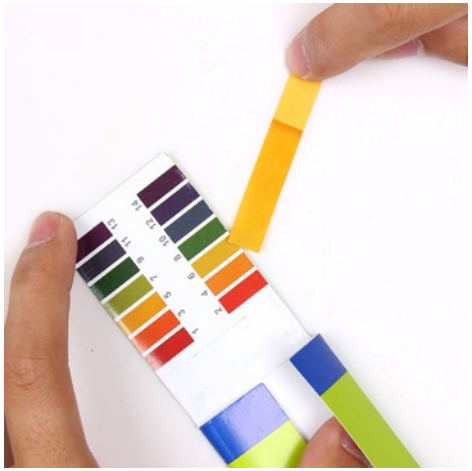


How to monitor Biochar Compost

- 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:
- http://ubetbiochar.blogspot.com/p/biochar-experiment-protocols.html

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:
- http://ubetbiochar.blogspot.com/p/biochar-experiment-protocols.html



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

THANK YOU!

UBETBiochar.blogspot.com

Wilson Biochar Associates

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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