
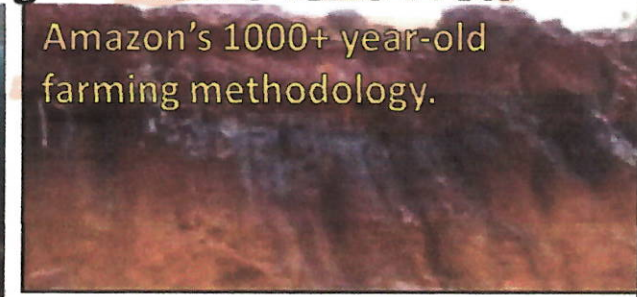
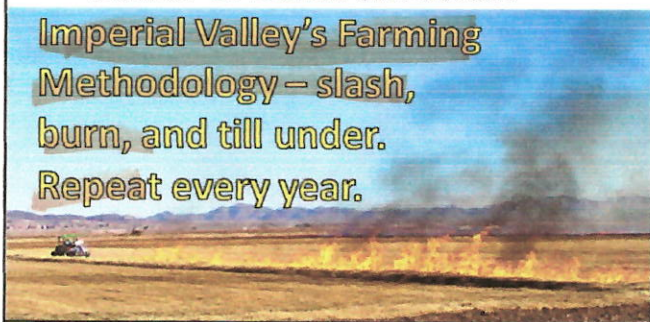
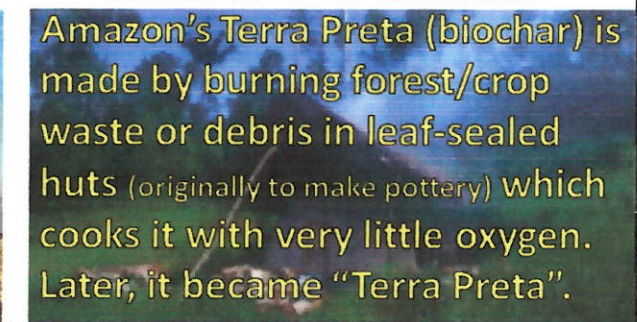
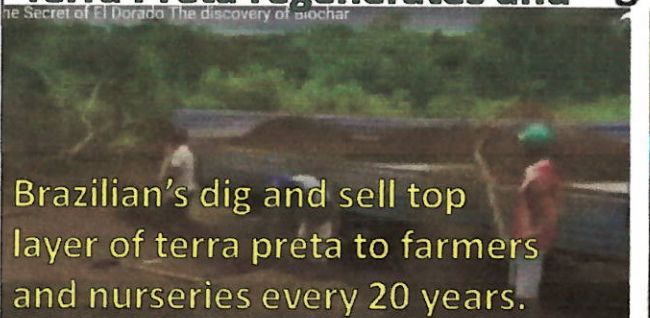

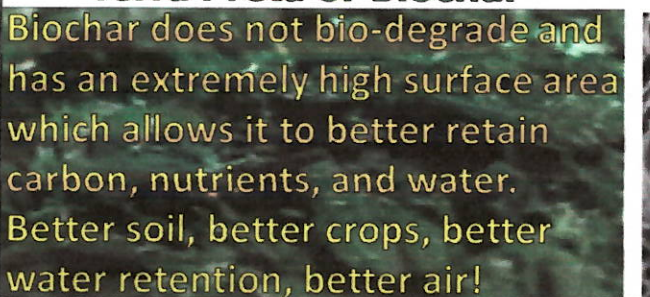

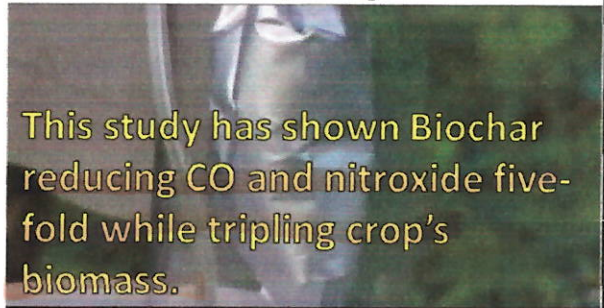
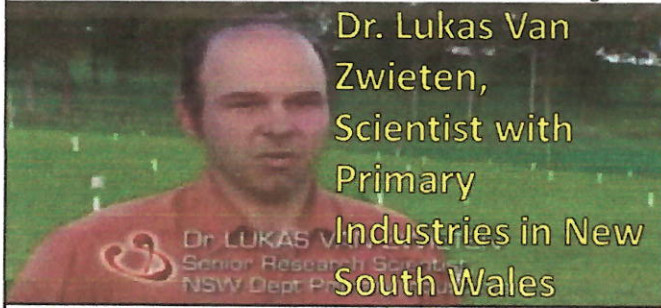


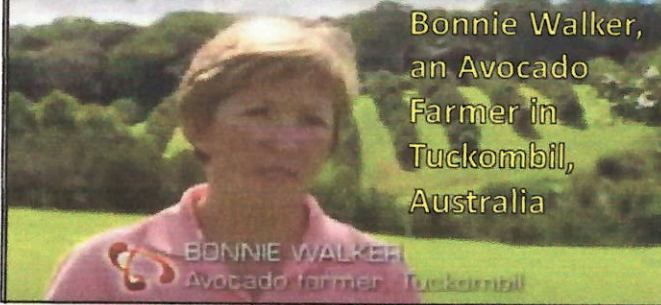
<p><b>Brazil's Amazon Rain Forest Pg 1</b></p> <p>Highly recommend you watch BBC Horizon's documentary "The Secret of El Dorado - Terra Preta"</p> 	<p><b>Brazil's Terra Preta</b></p> <p>Amazon's 1000+ year-old farming methodology.</p> 
<p><b>Slash &amp; Burn Method</b></p> <p>Imperial Valley's Farming Methodology – slash, burn, and till under. Repeat every year.</p> 	<p><b>Slash &amp; Char Method</b></p> <p>Amazon's Terra Preta (biochar) is made by burning forest/crop waste or debris in leaf-sealed huts (originally to make pottery) which cooks it with very little oxygen. Later, it became "Terra Preta".</p> 

<p><b>Terra Preta regenerates and Pg 2</b></p> <p>Brazilian's dig and sell top layer of terra preta to farmers and nurseries every 20 years.</p> 	<p><b>top layer sold every 20 years</b></p> <p>Terra Preta in Brazil (aka Biochar or Agrichar), regenerates naturally with forest tree and plant debris (aka Biomass).</p> 
<p><b>Terra Preta or Biochar</b></p> <p>Biochar does not bio-degrade and has an extremely high surface area which allows it to better retain carbon, nutrients, and water. Better soil, better crops, better water retention, better air!</p> 	<p><b>Microscopic view of Biochar</b></p> 

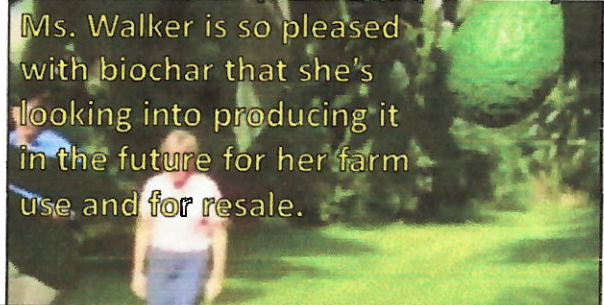
### New South Wales Pilot Study Pg 3 Carbon (CO) Sequestration



### Australian Avocado Grower

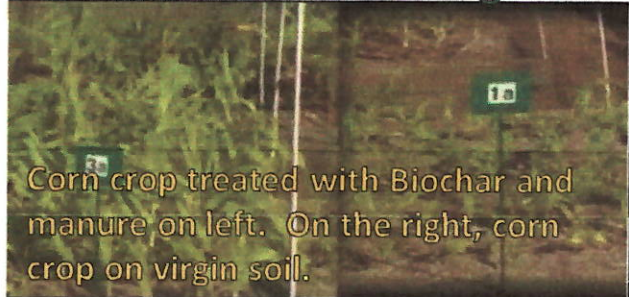


### Increased quality/quantity

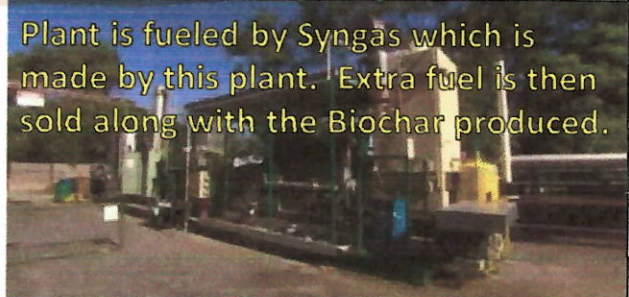


*see pg 17*

### Pyrolysis plant in Australia Pg 4 Biochar & manure vs. virgin soil



### Ordinary garden waste or biomass is fed into Pyrolysis Plant



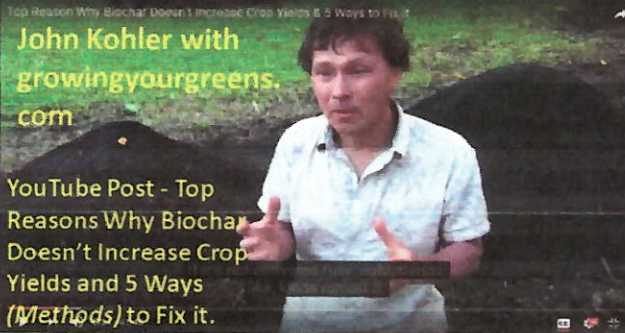
**Kiln is heated 550° (without oxygen) Pg 5 Pyrolysis plant runs on Syngas**



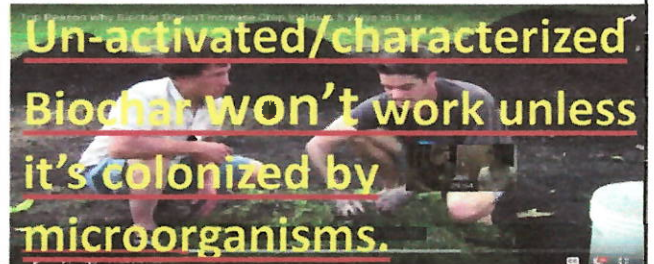
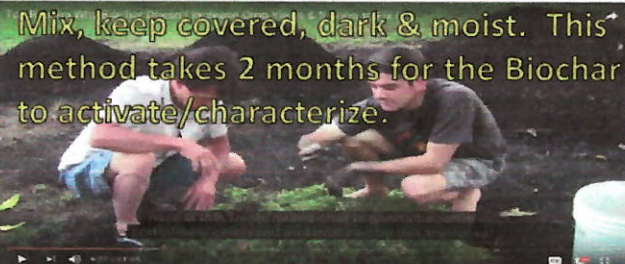
**Waste or Biomass becomes half Syngas fuel and half Biochar. Win Win!**



**Unactivated/characterized Biochar Pg 6 Equal parts grass clippings & Biochar**



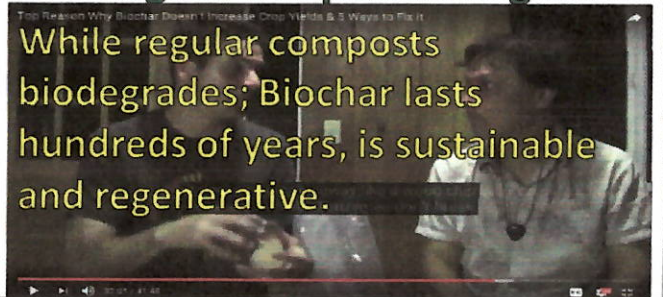
**Mix, keep covered, dark & moist. It takes two months to characterize or activate.**



Mix equal parts biochar & worm castings Pg 7 Mix in 5% flour to activate/colonize.



This method takes 2 weeks to activate. Regular compost biodegrades.



Pg 8  
Select slides from the January 26, 2012 USDA-ARS PowerPoint Presentation

Biochar:  
What is it and what can it do?



Kurt Spokas

USDA-ARS, Soil and Water Management Unit, St. Paul, MN  
Adjunct Professor University of Minnesota – Department of Soil, Water and Climate



Presentation to the Washington County UM Extension Master Gardeners  
Jan. 26, 2012  
Bayport, MN



Pg 9

## USDA-ARS Soil and Water Management Unit St. Paul, MN



- 6 USDA-ARS scientists
  - Nutrient cycling
  - Greenhouse gas
  - Agrochemicals
  - Drainage

• Located on the UM -St. Paul Campus

**MISSION:** Develop and evaluate agricultural management practices that optimize production while reducing impacts on air, soil and water quality.

Pg 10

Biochar

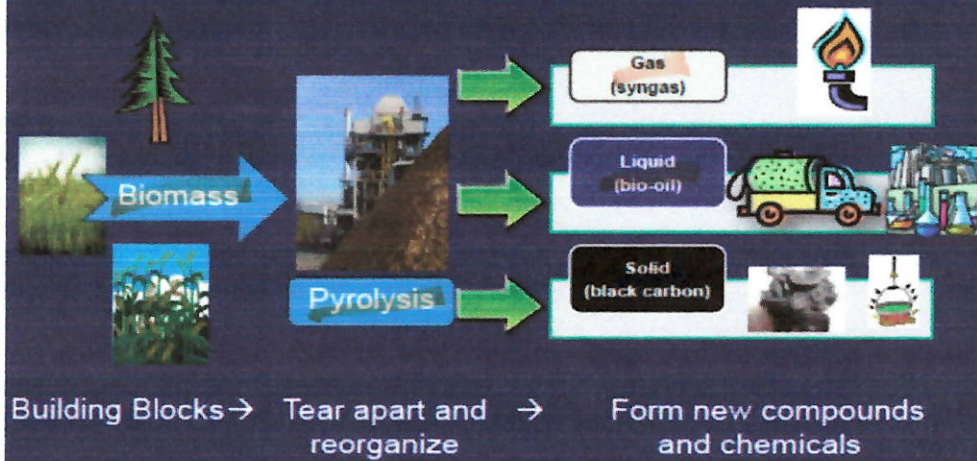
## Formation of Black Carbon: "Pyrolysis"

- ▷ **Pyrolysis** is the chemical decomposition of an organic substance by heating
  - ▷ **Does not** involve reactions with oxygen
    - Typically in the absence of oxygen
  - ▷ Pyrolysis is also used in everyday activity –  
*Cooking → roasting, baking, frying, grilling*
- ▷ Also occurs in lava flows and forest/prairie fires



Pg 11

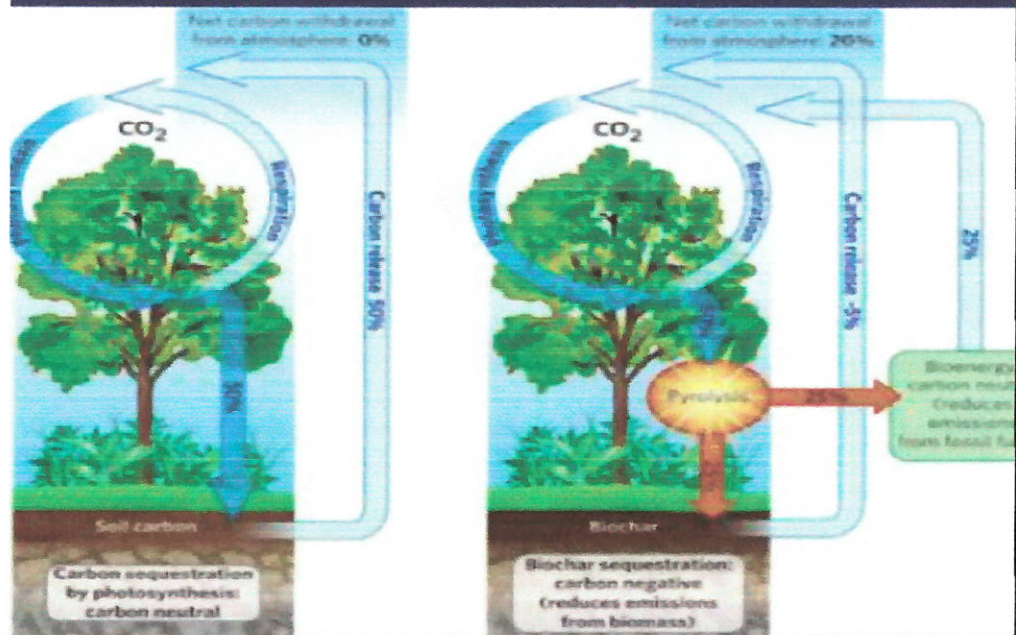
## Overview of Pyrolysis



Pg 12

**Biochar sequesters carbon and is carbon negative.**

## Carbon Cycle (+ Biochar)





**Pg 13**

## Biochar

Gaining significant attention:

- 1. Carbon Storage
  - Biochar can store atmospheric carbon, potentially providing a mechanism for reduction in atmospheric CO<sub>2</sub> levels
- 2. Soil Improvements
  - Improve water quality
  - Improve soil fertility
  - Reduce GHG emissions
- 3. Bioenergy





**Pg 14**

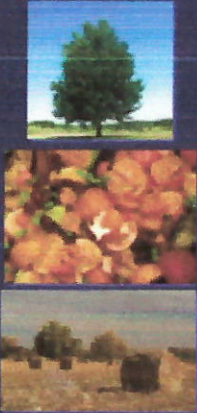
**Biomass (compost) degrades in 0-5 years.**

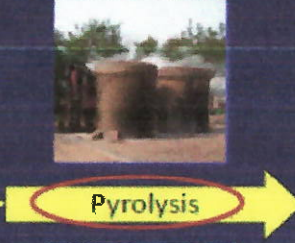
**Biochar degrades in 50 to 1,000,000 years**


## Biochar (Summary)

- Solid residue remaining after the heating of biomass materials (renewable) without oxygen (incomplete combustion) for the purpose of carbon sequestration

Biomass Materials










Easily degradable  
(0-5 yrs)

Recalcitrant carbon form  
(black carbon)  
(>50 to 1,000,000 yrs?)

<p><b>Pg 15</b></p> <p>Increasing our soil's water-holding capacity is crucial for Imperial Valley and the Salton Sea.</p> <p>Imperial Valley Farmer's fallowing further reduced Salton Sea's water levels.</p> <p>Current deliveries of mitigation water to the Salton Sea ends December 31, 2017.</p>	<h2 style="text-align: center;">Proposed Biochar Mechanisms</h2> <ol style="list-style-type: none"> <li>1. Alteration of soil physical-chemical properties             <ul style="list-style-type: none"> <li>✓ <u>pH, CEC, decreased bulk density, increased water holding capacity</u></li> </ul> </li> <li>2. Biochar provides improved microbial habitat</li> <li>3. Sorption/desorption of soil GHG and nutrients</li> <li>4. Indirect effects on mycorrhizae fungi through effects on other soil microbes             <ul style="list-style-type: none"> <li>✓ <u>Mycorrhization helper bacteria</u> → produce <u>uran/flavoids</u> beneficial to germination of fungal spores</li> </ul> </li> </ol> 
---	---

<p><b>Pg 16</b></p> <p>Who is "I"?</p> <p>Environmental Organizations, Federal, State and Local Government Officials, USDA, Farm Bureau, Forward-thinking Farmers, Grant Writers, Study Coordinators, Concerned Parents of Asthmatic Children, Health Care Professionals, and Concerned Citizens.</p>	<h2 style="text-align: center;">So what can I do ???</h2> <ul style="list-style-type: none"> <li>• Become Involved in Research Efforts             <ul style="list-style-type: none"> <li>• Possible participation in collaborative research efforts:                 <ul style="list-style-type: none"> <li>• <b>USDA-ARS</b> Kurt Spokas <a href="mailto:kurt_spokas@ars.usda.gov">kurt_spokas@ars.usda.gov</a></li> <li>• <b>University of MN Extension Service</b> Regional project: Biochar impacts/feedstock dependencies Lynne Hagen <a href="mailto:Lynne.Hagen@co.anoka.mn.us">Lynne.Hagen@co.anoka.mn.us</a></li> </ul> </li> </ul> </li> </ul>   <p style="text-align: right;"><i>"Start wherever you are and start small."</i> Rita Bailey</p>
---	--



**Pg 17**

**Please note Best Energies is part of USDA's Acknowledgement list.**

**\* (See page 4 of this presentation)**

## Acknowledgements

Minnesota Department of Agriculture – Specialty Block Grant Program  
 Minnesota Corn Growers Association

Dynamotive Energy Systems  
 Fast pyrolysis char (CQuest™) through non-funded CRADA agreement

\* Best Energies  
 Slow pyrolysis char through a non-funded CRADA agreement

Northern Tilt  
 Minnesota Biomass Exchange  
 NC Farm Center for Innovation and Sustainability  
 National Council for Air and Stream Improvement (NCASI)  
 Illinois Sustainable Technology Center (ISTC) [Univ. of Illinois]  
 Biochar Brokers  
 Chip Energy  
 AECOM  
 Penn State  
 University of Bonn (Germany)  
 Laboratorio di Scienze Ambientali R. Sartori - C.I.R.S.A. (University of Bologna, Italy)  
 IRNAS-CSIC (Spain)  
 USDA-ARS Biochar and Pyrolysis Initiative

Technical Support : Martin duSaure

Students: Tia Phan, Lindsey Watson, Lianne Endo, Amanda Bidwell, Eric Nooker  
 Kia Yang, Michael Ottman, Ed Colosky, and Vang Yang

"The nation that destroys its soil destroys itself." –Franklin D. Roosevelt

Date	Number	Title	Pg 18	USDA ARS Publication Excerpts
09/23/2013	297636	Biochar impact on improving root growth and water retention capacity		Overall, our results showed promising significance since biochars did improve root growth and the water retention capacity of the Norfolk's E horizon subsoil.
03/18/2014	295066	Carbon mineralization with different sources and sizes of pyrolyzed Biochar		A potential soil depletion solution is the use of Biochar as a soil amendment to enhance soil fertility and offset expenses for fertilizer and lime while reducing greenhouse gas emissions.
06/02/2014	293594	Biochars from agricultural by-products for soil enhancement		Processing various agri by-products into Biochar has gained global attention. Biochar is a solid by-product produced by thermal pyrolysis. <b>Before Biochar is applied to soils, it is useful to chemically and physically characterize (activate) the Biochar</b> to insure the integrity of the soil health is maintained.
06/05/2014	294853	Effects of Biochars produced from lignocellulosic and animal manure.		<b>Globally, by the year 2050, population will increase to 10.4 billion people meaning average crop yields will need to increase by 60 to 120% of current production. Declining land availability will be another major drivers for improving food production.</b> Agricultural land can be made more fertile by the addition of Biochar which improves soil fertility, increases carbon contents and reduces nutrient leaching losses.
02/06/2017	324912	Effects of Biochars produced from municipal waste.		Human activities have degraded soil and reduced the pool of soil carbon. This can be mitigated by producing Biochars from the pyrolysis of mixed organic solid waste materials thereby addressing solid waste issues and enabling CO sequestration.

**Pg 19****Scientific American Article**By [Anne Casselman](#) on May 15, 2007**Special Report: Inspired by Ancient Amazonians, a Plan to Convert Trash into Environmental Treasure****New bill in U.S. Senate will advocate adoption of "agrichar" method that could lessen our dependence on fossil fuel and help avert global warming**

[Democratic Senator] Ken Salazar of Colorado is drafting a stand-alone bill on this, and he may also promote it as part of the Farm Bill," notes Reed. The Farm Bill, whose terms are decided every year, determines what agricultural initiatives can be funded by the U.S. government. Inclusion in the Farm Bill would virtually guarantee subsidies for research and application of the agrichar process.

**The use of char also promises to combat marine dead zones, like that in the Gulf of Mexico caused by nitrogen- and phosphorus-rich agricultural runoff.** Char reduces the need for man-made fertilizers by helping the soil retain nutrients.

**Amazonian Origins**

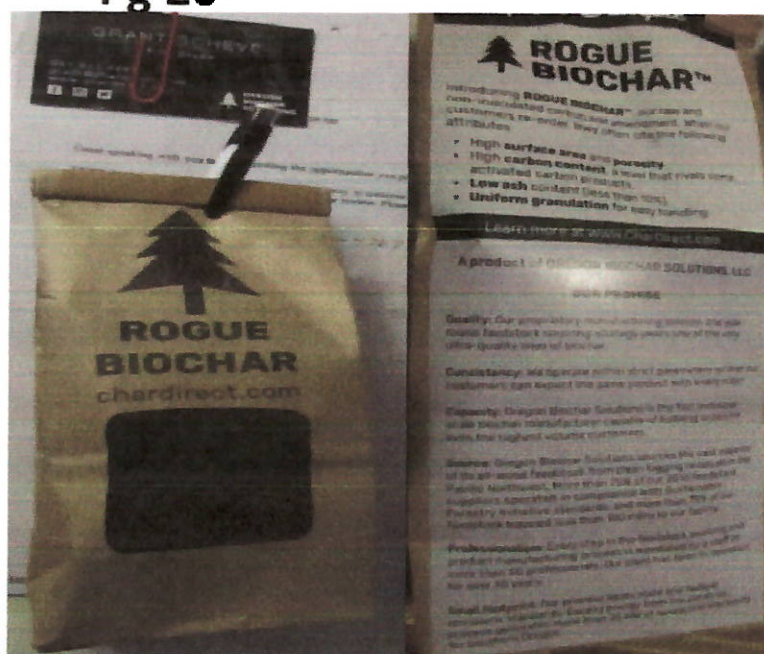
Agrichar is not a recent invention. Rather, it is a modern-day attempt to re-create the *terra preta*, or dark soils that cover some areas of the Brazilian Amazon. These soils were created over thousands of years by pre-Columbian Indians, who covered their fields with the charred remains of domestic and agricultural trash. This practice boosted the carbon content of the soils from a meager 0.5% to 9%.

**"This is actually slash-and-char agriculture," Brown notes, contrasting it with the modern day slash-and-burn variety.** "Instead of biomass being burnt down to a fine ash, charcoal remains, just like after a campfire." In addition to retaining nutrients, the **porous charcoal helps microorganisms colonize and build up the soil.** Charcoal is known for remaining stable over long periods of time, and alternating rainy and dry seasons preserve it even more. "You basically are drying out a steak," explains Danny Day, president of Eprida, a renewable energy development company based in Athens, Ga. "So you get beef jerky, which will last you for years." **Even today, the Amazonian dark earths are so fertile that farmers continue to till them.**

**Pg 20**

Go to Oregon Biochar Solutions website at [www.CharDirect.com](http://www.CharDirect.com), register, and get free sample. If possible ask for an additional sample and share it and this presentation.

My contact is Grant Scheve, VP of Sales. He's always made time to answer my questions and help me get informed. He can be reached at (541) 941 4767. [grant@chardirect.com](mailto:grant@chardirect.com).



**Suggestions:****Pg 21**

- View “Terra Preta” documentary on YouTube.
- A USDA Pilot Study based in Imperial Valley is needed. Forward-thinking Farmers, IID Representatives, Government and Private Agencies and Biochar companies need to collaborate, write some MOU’s and apply for grants.
- Educate and inform those around you because you don’t know who they know. Make an impact on our (and future) generation’s quality of life.
- Pat yourself on the back for reading and forwarding this message. *(see page 20 on how to get a sample of Biochar)*