

# TerraChar'ge

## your soil battery

optimum fertility, growth & health

### Frequently Asked Questions

#### What is Biochar?

"**Biochar**" is a new word created in 2008 to identify charcoal made to put in soil. This practice began 6000 years ago in the western Amazon by indigenous tribes to make one of Earth's most fertile soils. Amazon rainforest soils are notorious as poor, acid, unproductive, low in carbon. Yet, Portuguese settlers so highly valued these high-carbon, nearly-black, soils, they gave them a special name: *terra preta* ("dark earth").

**Biochar** is fine-grained charcoal, high in stable organic carbon, suited to put in soil. Carbon burns hottest, and thus, burns last. Carbon is mostly what remains after plant or animal biomass is heated over 500 degrees C with little oxygen. This charcoal residue retains 25 to 50 percent of the original biomass carbon.

This definition excludes fossil fuels, geological carbon, and industrial synthetics (plastic).

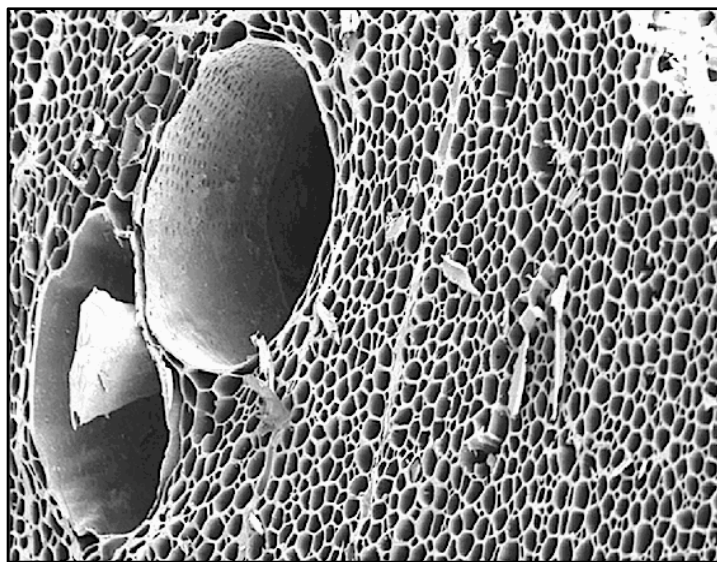
#### How does biochar benefit soil?

Biochar is not a fertilizer, nor a nutrient.

Rather, biochar delivers other essential services to soil, cells and plants. Many are due to biochar's microscopic structure of very tiny pores (*photo below*). Plants are hollow pipes and tubes—plumbing to move water around. Charcoal is so lightweight because it's empty inside.

Biochar's three most important benefits to soil:

First, biochar micropores (*below*) are a super sponge to soak up water, then very slowly release it back into soil. Thus, biochar keeps soil wetter longer. Biochar expands any soil's water cycle capacity.



Second, biochar attracts and holds atoms with electric charge: *ions*. We know charcoal has strong *adsorption* potential to pull "*pollutant*" ions out of water. But in soil, ions are "*nutrients*." Biochar *adsorps* nutrients to capture their electric charges. Soil with any carbon—especially biochar—has huge capacity to store electric charge, thus is prepared to power plant growth.

Third, biochar is habitat for microbes. With water, nutrients and empty space, microbes move in. Fungi, bacteria and all their buddies by the billions. We don't eat our houses, and microbes don't eat biochar. They live in it.

Biochar is super-stable for 1500+ years, so microbes build symbiotic communities with complex infrastructures. Thus, biochar allows soil to become fully alive with these least of all life forms. Like coral reefs in the sea, a similar "soil reef" effect on land—blossoming the **Soil Food Web**.

#### How is soil like a battery?

Carbon is black because it absorbs energy. Not just light—carbon absorbs many other forms of energy. Science recently found nano-carbon *graphene* sheets have huge capacity and speed to store electrons. Beyond lithium, the next batteries will be carbon.

Soil carbon also stores energy as electrons and ions. We measure this as Cation Exchange Capacity (CEC), Anion Exchange Capacity (AEC), pH (acid/alkali balance), and Conductivity (electron mobility).

Biochar in soil greatly increases CEC and AEC, improves Conductivity, buffers and stabilizes pH. This increases soil's capacity to hold electric charges, and deliver energy to plants to power growth.

**TerraChar** delivers both carbon charge capacity, and the mineral and microbial charges, to your soil battery.

#### What is TerraChar'ge?

**TerraChar'ge** is made by pyrolysis of oak scraps with technology developed by America Energy Solutions (AES) in Columbia, Missouri. This hardwood biochar is screened to small pieces—a ready-to-use, fine-textured soil additive.

This raw biochar is "charged" by mineral ions and microbes for optimum effect on soil and plants. "Charging" can simply soak in water with sea solids. Other minerals are added, depending on soil needs. Allow 24 hours for

full spectrum elements to adsorb into biochar micropores.

**TerraChar** is further charged by microbial cultures. This living aspect is delicate, dynamic, and needs special handling and timely delivery. Microbes live in biochar micropores, form complex feeding networks and symbiotic partnerships with plant roots. These living cells impart an extra charge of coherent organic energy to water and soil.

## What are sea solids?

Sea solids are full spectrum minerals are harvested from one of Earth's richest marine ecosystems. About 3.5% of seawater is these sea solids. Seawater floods dry lake beds, then evaporates from shallow solar ponds, leaving a thin crust of crystals. The only processing is grinding and screening to uniform small particle size.

Sea solids have every element that dissolves in water, including trace elements. For two billion years, water dissolved minerals from rocks and soils to carry these elements to the sea. This sea solution was stirred, spun, waved, circulated, oscillated, irradiated, and precipitated into Earth's most complete, balanced blend of elements.

Sea solids are natural, full spectrum fertilizer that supplies a complete menu of all the elements needed by biology. Most crucial are the trace elements. We get the most from these least of all the nutrients.

## What is "Full Spectrum" fertility?

Biology recognizes over 24 elements are essential for human nutrition. Most are trace elements, needed at parts per million or less: Iodine, Iron, Cobalt, Chromium, Copper, Zinc, Vanadium, Manganese, etc. The power of trace elements is they are key co-factors in vitamins, enzymes, hormones, and genetics. As example, Iodine affects the thyroid gland and neurological development.

"**Full Spectrum**" is the idea biology doesn't depend on a few elements, but uses them all in balanced blends. Recent research hints some elements are needed at less than parts per million—even parts per trillion. Cutting edge science suggest such *nano-nutrients* & *pico-elements* affect enzymes, cell membranes, hormones, DNA replication, immunity, reproduction.

Human health needs this complete menu of minerals for optimum cell and organ function. Unrefined sea solids are Nature's optimum full spectrum mineral source—the original, ultimate seasoning. Charging char with full spectrum sea solids assures cells and soil biology get all and every element needed for optimum biological function.

## What is "Carbon-Smart"?

Plants fix carbon out of air into carbohydrates: sugar. Plants build their bodies from sugar spun into cellulose fibers, use sugar for energy, store it as starch.

If we burn biomass in minimal oxygen, we capture up to 50% of the carbon as char to stay in soil 1500+ years. Thus, biochar "sequesters" carbon out of air into soil.

Better yet, properly done, next year, soil with biochar will grow more biomass, fix more carbon as sugar, yield more biochar. Each year after, more and more carbon is sequestered in a positive, increasing cycle.

Even better, in soil, biochar reduces emitted methane, nitrous oxide and other greenhouse gases. Biochar also lowers leaching and loss of nitrate, phosphate and other



nutrients, thus reduces fertilizer use, improves fertilizer efficiency and water quality.

"**Carbon-Smart**" farming sequesters carbon in soil by such synergies of multiple mineral and microbial pathways. **Carbon-smart** farming is 21<sup>st</sup> Century farming.

## Can biochar address climate change?

NOAA climate scientist James Hansen studied the biochar strategy to sequester carbon, including in his computer simulations. In August 2009, Dr. Hansen wrote:

*Biochar produced in pyrolysis of crop residues, forestry wastes and animal manures can restore soil fertility while storing carbon for centuries to millennia. Biochar helps soil retain nutrients and fertilizers, reduce greenhouse gas emission such as N<sub>2</sub>O. Replacing slash-and-burn agriculture with slash-and-char using farm and forestry wastes can provide CO<sub>2</sub> drawdown of ~8 ppm or more in 50 years."*

In brief, Dr. Hansen believes biochar can work to lower CO<sub>2</sub> and greenhouse gases in Earth's air. But such success will be celebrated two generations from now.

