Answers to Many of Your Biochar Questions

1. **What is biochar?**
   Biochar is made of carbon. Biochar has a cellular-like structure that has enormous internal surface area. Biochar is manufactured from selected clean biomass (such as forest industry waste material) utilizing a carefully controlled high temperature, oxygen exclusion process called pyrolysis. The granular product, biochar, has specific properties that optimize composition, screen size and physical structure for use as an amendment to enhance sustainable soil fertility and other applications. It is a remarkably effective soil amendment to help your plants, garden and crops grow!

   To learn more about biochar, please visit https://www.charterra.ca/about-biochar/

2. **What is the difference between biochar and common charcoal?**
   Common charcoal is manufactured from a variety of biomass materials and process conditions. It is primarily used as a fuel. Common charcoal contains binders or other substances that could affect beneficial soil microorganisms and be unsuitable for growing plants for human consumption.

3. **What are the benefits of using biochar to amend soils?**
   Among the many benefits, these are the most significant:
   - Biochar surfaces are highly porous and retain moisture and nutrients. making it an attractive habitat for beneficial microorganisms to thrive in a close, and often symbiotic relationship with plant roots.
   - Biochar porosity yields a large surface area to which nutrients can adhere and become ionized. When ionized, nutrients are more bio-available for uptake by plant roots and microorganisms.
   - Biochar particles can be manufactured with consistent sizing for a particular soil application. Biochar amended soils have an increased pliability that enables roots and microorganisms to grow and move through the soil more easily.
   - Biochar particles create air channels in the soil which improves oxygen penetration and provides aerobic conditions for beneficial bacteria and healthy plant roots.
   - Biochar stores carbon in the soil in a resilient, stable form that remains intact for decades and centuries. As such, it provides a method of removing CO_2 from the atmosphere—one of very few natural methods of accomplishing this.

4. **How should I apply biochar?**
   Biochar has many physical benefits for soils, including a high cation attraction to retain nutrients but it does not contain nutrients when it is in its raw state when freshly produced. Before planting, biochar can be charged with nutrients through blending with compost, compost “tea” and to shorten the time to condition the biochar mixture and enhance its effectiveness in your soil. Conditioning the biochar with nutrients before it is amended into the soil makes biochar a great carrier and reservoir of nutrients for plants and microorganisms.

Combining food waste/garden remnants with biochar when composting is a highly effective method for the home gardener. The biochar captures the nutrients in the composting process and will present them for plant use when the co-composted material is added to the soil or spread over the garden surface. Biochar works well with any composted materials. The use and inclusion of biochar enhances compost in home or commercial operations.

5. **What is biochar made from?**

Biochar can be made from many different types of biomasses, such as

- wood residues
- compost waste
- agricultural residues, and
- forest wastes.

To meet regulatory requirements and avoid toxicity in the biochar, the feedstock needs to come from clean source material and not have any contaminants such as plastics, PCBs, wood preservatives. Biochars must comply with the Canadian Food Inspection Agency (CFIA) Fertilizer Division requirements. Biochars may be screened after production to optimize the size and shape for different applications. For example, screened biochar to a medium size about the that of rice grains are best suited for greenhouses and are easier and provide more aeration in most soil applications.

6. **How is biochar made?**

Biochar is made by heating organic matter (biomass) in an oxygen deprived environment such that combustion does not occur. This process is known as “pyrolysis.” During pyrolysis, heat in the absence of oxygen drives off gases from the biomass, leaving behind a porous material that is rich in carbon and highly resistant to decay. Beware of common charcoal and includes toxic materials harmful to plants to make a fuel for combustion purposes. Biochar is made from clean woody materials and typically produced at temperatures in the range of 500 to 700 degrees Celsius. At higher temperatures, such as from gasification conditions, the biochar may contain contaminants such as furans, dioxins (from chlorine salt), and PAHs (polyaromatic hydrocarbons). Ensuring the quality of the source materials and controlling the process conditions is the responsibility of the biochar producer to comply with biochar standards. Look for OMRI, CSI, or similar certification to comply with Canadian CFIA regulations.

7. **Does making biochar require the use of fossil fuels?**

No, but a small amount of natural gas or liquid fuel may be used to initiate the pyrolysis heating process, but after that, the pyrolysis process is self-sufficient, and the associated pyrolysis gas produced is typically used to sustain the process.

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8. **How does the biochar process supply alternative energy?**
   Once the biochar-making process has been initiated, it generates a high-energy content gas (synthetic gas, or wood gas) that is typically used to heat the process, and any additional pyrolysis gas can be treated to heat buildings, greenhouses, or to run electrical generators. Therefore, the biochar-making process is a potential source of alternative energy to offset the burning of fossil carbons. The produced gases are also rich in organic compounds and can be condensed and used as a fuel and the associated water vapours can be condensed into wood vinegar which is useful as a soil amendment or to condition the raw biochar.

9. **How was biochar re-discovered?**
   Biochar was recently "re-discovered" through studies of ancient civilizations that lived in the Amazon rain forests of Brazil. Soil scientists were amazed by the fertile soils that occur in some regions of South America. In these locations the existence of very dark nutrient-rich soils contrasted with the lighter less rich surrounding soils. It turns out that the people of these ancient civilizations amended the darker fertile soils with biochar generated from their cookstoves.

   Although there are no written and oral accounts, we believe that Amazonians discovered and produced biochar through observing plants growing better where wood charcoal was left on the ground. We expect that:
   - Amazonians cooked food with very inefficient wood stoves that left charcoal behind after the cooking sessions. They then spread this charcoal onto compost piles before using this material as a fertilizer for their crops, or
   - Amazonians realized the benefits of adding large quantities of carbon to their soil and intentionally built earthen kilns in the form of mounds to produce what we now call biochar. They harvested trees from the forest to produce this biochar and increased the productivity of their poorer soils for planting maize. Biochar then formed what we know as Terra Preta soils.

10. **What is Terra Preta?**
    The Amazonian dark soils of South America are locally referred to as "Terra Preta" or dark earth, when translated directly from Portuguese. These soils have been fertile for an exceptionally long time (over two thousand years).

    More information about Terra Preta soils is available here:
    https://en.wikipedia.org/wiki/Terra_preta

11. Are there any concerns about the use of biochar?

Cutting down trees solely for the purpose of making biochar does not make sense as the trees absorb carbon dioxide from the air and are essential to reduce the impacts of man-made climate change contributing to global warming. Instead, biochar is typically made from forest industry residuals in an "environmentally sustainable" manner after the lumber and other related products such as plywood, oriented strand board have been produced. Converting the residuals from sawmills and the forest is an environmentally sustainable practice that we think should be encouraged.

The production of biochar from waste wood including unused forest residuals is a sustainable and beneficial practice that should be promoted because of its net carbon sequestration potential. The sustainability of Canada's forest industry depends on its continued commitment to the environment, and regulations which require reforestation. The full utilization of the forestry residuals enhances the commitment to the environment and ensures the future of the forest industry for generations to come.

Biochar from clean woody materials does not contribute to animal related pathogens in soils. Forestry residuals do not have animal pathogens, and any pathogens that could be in the woody feedstock are destroyed in the high temperature pyrolytic process to produce biochar. However, biochar could become contaminated with a pathogen after its production if it mixed with infected materials.

At higher temperatures, such as from gasification conditions above 1,000 degrees Celsius, biochar may contain contaminants such as furans, dioxins (from chlorine salt), and PAHs (polyaromatic hydrocarbons). Ensuring the quality of the source materials and controlling the process conditions is the responsibility of the biochar producer to comply with biochar standards. Look for OMRI, CSI, or similar certification to comply with Canadian CFIA regulations.

12. What is the "State of the Art" of biochar today?

A great deal of research has concluded that biochar enhances a wide variety of soils for plant growth, health, and nutrition. Continuing research is helping us better understand how we can benefit in aspects related to:

- Social elements
- Economics
- Engineering (production processes)
- Soil science and agronomics
- Land use and land use change management
- Climate change mitigation by storage of carbon in soils

Research is ongoing and soil-related research is focusing on biochar applications as a method of "carrying" beneficial microorganisms (such as nitrogen fixing bacteria) to the soil. Recent

understanding of how biochar benefits plants point to using biochar as a co-composting ingredient. Co-composting generates plant-available nutrients that coat the surfaces of the biochar. Given biochar's adsorptive ability, agronomists are finding new ways to "charge" the biochar to carry nutrients to the soil in a way that slowly releases them for plant use.

Biochar Today is a reliable source of research and related news information on the internet and social media. Check out their website at https://biochartoday.com/

13. **How does biochar benefit the environment?**
    Biochar carbon is very long-lived in soils; as such, it is an excellent way to withdraw CO_2 from the atmosphere. The biochar production process captures and sequesters carbon that is stored in plant tissues during photosynthesis and would otherwise return to the environment via natural carbon cycling. Through thermal conversion (pyrolysis), carbon in plant tissue is converted to biochar. This process results in about half of the carbon that the trees capture from the atmosphere being sequestered when applied to soils while the other half of the stored plant carbon is released back to the atmosphere.

    To learn more about how biochar helps address sustainability and climate change concerns, please visit the International Biochar Initiative website at https://biochar-international.org/sustainability-climate-change/

14. **Can biochar be used as a livestock feed additive?**
    Recent studies have demonstrated that high surface area produced biochar can be an alternative for activated carbon used as a feed additive to ruminant animals such as cows and calves. More research trials are needed to optimize its many health benefits.

15. **Does the use of biochar as a "carbon sink" qualify for carbon credits and offsets?**
    There is a proliferation of carbon credit platforms that are available for producers that are helping reduce biochar costs and support the worldwide adoption of biochar to improve our soils while reducing the man-made impacts of climate change.

    Jurisdictions in Canada, the US, EU, UK and around the world are developing formal "carbon offset protocols" to enable using biochar as a registered, monitored, and monetized carbon offset.

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16. Is biochar a "fad"?

No. Biochar is a scientifically proven soil amendment that enhances the soil structure, adds carbon to the soil, promotes healthy microorganisms, and is safe for all soils.

Have more questions? Please ask us through our website at: www.charterra.ca/contact

April 22, 2024
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