GREEN & GROWTH

BIOCHAR 100% HEMP

AGRICULTURAL USE

PRODUCT DESCRIPTION

Biochar 100% coming from the pyrolysis of industrial hemp plants. 100% natural, non-toxic and sustainable product. Highly recommended for soil and environmental engineering purposes.

PRODUCT CHARACTERISTICS

PROCESSING

Green & Growth® Biochar 100% Hemp is obtained by the pyrolysis of biomass from cultivars of controlled molecular composition at an ideal temperature of more than 500°C in a furnace with gas recombustion technology, making the process more respectful by avoiding the emission of gases and smoke.

FORM OF SUPPLY

Green & Growth® Biochar 100% Hemp is supplied in 1L hermetic bags.

ANALYTICAL PROFILE

PARAMETER	TYPICAL VALUE
Feedstock :	100% Industrial hemp biomass from controlled cultivars
Pyrolysis temperature :	>500°C, > 3 min
Particle size :	Up to 5 mm
pH :	8-9.5
Electrical conductivity :	<1 mS/cm
Bulk density (DM) :	0.06-0.1 gr/cm3 as manufactured
Moisture :	8-10% as supplied
Fixed carbon :	>70%
Ash 550°C :	<10%

SOIL AND ENVIRONMENTAL BENEFITS

Biochar quality is directly related to the type of starting biomass and the conditions for its production (temperature, residence time, etc.). Not all biochars are produced at suitable conditions for generating agricultural benefits.

Green & Growth® Biochar 100% Hemp retains the unique technical and environmental benefits of its source material, the industrial hemp, and gains additional unique benefits and applications through an specific high-temperature pyrolysis method.

Benefits coming from its source material: Industrial hemp

- Respectful plant raw material, hemp, with sustainable crop management and environmental benefits. Improves soil structure and fertility for other food crops in rotation.
- Hemp remediates soil by removing contaminants like heavy metals or pesticide residues.
- Hemp is very resistant to extreme climates, diseases, and pests, requiring minimal amounts of phytosanitary products.
- Hemp has an outstanding growth and photosynthetic rate, implying an also outstanding CO2 capture capacity. Its use reduces the carbon footprint of any final product.
- Hemp is one of the richest sources of cellulose in nature, which leads to a high content of fixed organic carbon after pyrolysis, implying a higher stability and refractoriness.
- Hemp cellulose yield and cellulose characteristics, structure and applications, outperform wood, helping prevent deforestation.

Benefits coming from the conditions used during its transformation: Green & Growth® Biochar 100% Hemp

- The unique molecular arrangement of hemp cellulose microfibrils results in biochar particular properties after pyrolysis: great porosity, very low density and very high durability.
- Its special low density and porosity heals the soil structure, improving drainage and recovering a beneficial bulk density in the soil.
- Its porous structure is crucial for agriculture and gardening, since allows the establishment of beneficial microbiota communities in the soil.
- Biochar establishes a complex organic-mineral relationship between plant roots, microorganisms, and the rest of the organic matter and soil nutrients. It improves natural fertility, by retaining water and nutrients through adsorption, preventing leaching, strengthening against pests and diseases, and reducing soil irrigation and fertilization needs.

SOIL AND ENVIRONMENTAL ENGINEERING MOST COMMON USES

Soil amendment, soil remediator, soil restructuring or soil enhancer	To recover and make the most from the agricultural land, gaining crop productivity and crop health whereas minimizing the use of agrochemicals.
Great immobilizer of soil contaminants	To avoid crop affectation and the spreading of the contaminants to nearby areas or aquifers.
Atmospheric CO2 capture tool, carbon sink	When added to soil it is recognized as a tool for combating climate change by the FAO. A method for sequestering atmospheric carbon, recarbonizing, recovering, and preparing soils for extreme weather.

APPLICATION INSTRUCTIONS

OVERVIEW

Amending soil with Green & Growth® Biochar 100% Hemp, even at a low rate of 0.1% (dry weight), enhances seasonal crop productivity by promoting natural water and nutrient retention, increasing nutrient bioavailability for plants, and enhancing overall crop resistance since the soil is alive, healthy, and well-structured.

As a standard dose, you can apply 2-5% (v/v) of biochar to the soil, which will surely benefit your plants. But to achieve long-term soil health improvements, it is recommended to apply biochar following basic guidelines to calculate the most suitable dosage for your specific soil type and crop.

The dosage is directly influenced by soil pH and type. In this guide, we provide simple methods for you to determine soil pH and soil type from the comfort of your home, helping you determine the most appropriate Green & Growth® Biochar 100% Hemp dosage.

Correctly applied biochar can improve the properties of all soil types.

INSTRUCTIONS FOR PH MEASUREMENT WITH PH TEST STRIPS

pH is one of the most critical variables in agricultural soils since it directly impacts the absorption of nutrients by plants. Generally, the optimal pH range for these soils should fall between 6.5 and 7.0 to achieve the highest yields and productivity. This range is where nutrient assimilation is most efficient, making it suitable for the majority of plant species.

While some plants can tolerate more acidic or alkaline conditions, they generally thrive within this pH range. The pH of biochar tends to become more alkaline as the production temperature increases, which is closely linked to its quality and stability. Knowing the pH of the soil you are amending with biochar is essential to apply the correct dosage and improve soil properties effectively.

Materials needed:

- Clear container with a lid (you can reuse a water or food preservation bottle).
- Water (distilled or, if unavailable, weakly mineralized bottled water).
- A handful of soil from the area you want to analyze.

Procedure:

1. Take a representative soil sample for analysis, avoiding stones, gravel, plant debris, surface dirt, transit or border areas. If you suspect that the soil is not uniform, take samples from different areas.

2. Use as many clean containers as samples you want to analyze. Mix equal volumes of soil and water (1:1).

3. Secure the lid and shake the container until the soil and water are well mixed.

4. Allow the sample to rest until solid particles settle and a clear layer of water appears on the surface. If you find it more convenient, you can filter the sample using a filter paper (such as a coffee filter) to expedite the process. Testing with turbid water could complicate the interpretation of the test by tinting the strip brown.

5. Take a piece of pH strip, being careful not to touch anything else, and insert one end (approximately 1 cm) for 1 second into the clear water layer at the top of the container. The pH strip can become unusable when it reacts with the pH of other objects, such as our fingers or any other surface. You can use tweezers to handle the strips if it's more convenient.

6. In about 30 seconds, a color will appear at the end of the strip. The resulting pH value should be interpreted by direct comparison with the color legend provided.

INSTRUCTIONS FOR THE ESTIMATION OF THE SOIL TYPE

This test is designed to help you easily determine your soil type. There are three primary soil types, each characterized by a different composition of particles in terms of size and texture: sand, silt, and clay.

In simple terms, sand consists of larger particles with a rough texture, silt is composed of medium to small-sized particles with a smooth, floury texture, and clay comprises the smallest particles with a sticky texture.

Determining the proportion of each of these particles will allow you to identify your soil's composition, or in other words, your soil type. This knowledge will help you gain insights into its structure, fertility, and physical-chemical properties, such as drainage capacity and leaching probability.

Materials needed:

- Clear container with a lid (you can reuse a water or food preservation bottle).
- Water (tap or bottled).
- A handful of soil from the area you want to analyse.

Procedure:

1. Collect a representative soil sample for analysis, avoiding stones, gravel, surface debris, and transit or border areas. If the terrain or plot is extensive, consider taking multiple samples to ensure the soil's composition is uniform across its entire surface.

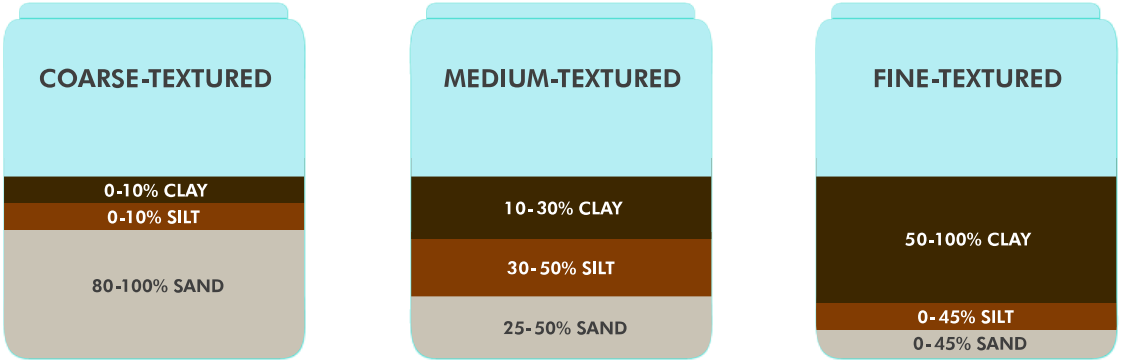
2. Use as many containers as the number of samples you wish to analyze. Fill one-third of the container with the soil sample and the remaining two-thirds with water. Leave some space between the lid and the water level to facilitate more effective shaking.

3. Secure the lid tightly and shake the container vigorously during some minutes until the particles are thoroughly mixed.

4. Allow the sample to sit undisturbed for a minimum of 48 hours. Over time, different layers will form. Initially, a bottom layer will develop with the heaviest particles, such as gravel and sand. Subsequently, silty particles will settle in a middle layer, and finally, clay particles will settle in the topmost layer.

5. When the water becomes clear or nearly clear, it indicates that the last clay particles have settled. At this point, use a ruler to measure the height of each layer and estimate the percentage of each layer in relation to the total height of the three layers.

6. You can determine your soil type based on the following classification scheme:



Curiosity: On the water's surface, you will find floating fragments of organic matter, which can provide you with an indication of the quantity of organic nutrients present in the soil.

GREEN & GROWTH® BIOCHAR 100% HEMP DOSAGE DETERMINATION

Once the pH and composition type of the soil to amend are known, the following table will guide you in determining the most appropriate biochar dosage. The dosages are given in % dry weight.

You can estimate the dosages also in % volume, but it will be much more accurate if calculated on a dry weight basis.

SOIL TYPE	PH VALUE			
	ACID pH <6	NEUTRAL pH 6-7	ALKALINE 7< pH <7,6	VERY ALKALINE pH >7,6
Coarse-textured	10 – 20 %	5 – 10 %	2 – 5 % pH control is recommended for not surpassing pH 7,5	< 2% Combine with sulfur compounds and/or manure (*)
Medium-textured Fine-textured	10 – 15 %			

(*) Biochar obtained at high temperatures is very stable, has a higher percentage of organic carbon, and becomes more alkaline in pH. Therefore, in soils that are already highly alkaline, it is recommended to combine the biochar with sulfur compounds or manure to avoid further increasing its alkalinity.

The dosage estimates are based on the principle that the most beneficial and productive soils for the vast majority of crops are those that maintain a pH below 7.5 and an electrical conductivity (EC) below 2.7 dS m−1 (in a 1:1 soil/water slurry).

After applications, it is advisable to re-measure pH and EC to ensure that the values are within suitable ranges. Soil amendment with biochar yields the most remarkable benefits in acidic, coarse-textured, highly leached soils.

The application can be done at one time or cumulatively, until the desired dosage is achieved. If the intended dosage is high and you wish to apply it all at once, it is advisable to pre-activate the biochar, for which some recommendations are provided below.

BIOCHAR ACTIVATION

Biochar is composed almost entirely by non-reactive carbon and in its fresh raw state it is not activated. It means that it has no microbiota living inside its porous structure, and has still no nutrients adsorbed. When applied to the soil, it will mature over seasons, its surface will be colonized by living organism and organic acids, minerals and other soil particles will adsorbed to its surface. In this state biochar gains all its functionality and beneficial qualities permanently.

If the quantity of biochar to be added in a single application is big, it can create a temporary nitrogen tie-up, so mix it with compost or apply it in combination with organic or chemical fertilizers is advisable to avoid diminish or delay crop productivity at the beginning.

While biochar activation takes some seasons in the soil, it takes just weeks in a compost environment. When combined in compost piles at an early stage, relatively small amounts of biochar can significantly reduce N-loss during composting and help to support thriving microbial communities.

A useful method to activate biochar is mixing biochar:compost in 4:1 proportion, and let it mature two weeks before application in soil. Then, apply it respecting the biochar proportion recommended in the above dosage table.

FORM OF APPLICATION

To maximize the soil health benefits while minimizing the erosion risk, biochar amendment should be implemented through broadcasting the granular biochar in moistened conditions, or in combination with compost, to soil or cropland under low-wind weather, followed by thorough and uniform incorporation, at least, into the 0–15 cm soil layer.

For established crops or trees, the closer to the roots and the deeper the application of biochar, the more beneficial it will be, taking care not to damage them.

INSTRUCTIONS FOR DETERMINATION OF THE DRY BULK DENSITY OF A GIVEN SOIL SAMPLE

Bulk density measures the weight of soil in a given volume. It indicates the degree to which the soil is compacted, which affects root growth and water infiltration.

Materials needed:

Hollow cylinder made of metal or another hard material, ideally with a height equal to the height of the soil layer you want to analyse, hammer, shovel, scale, oven, ruler, calculator.

Method:

1. Take the cylinder, place it on the clean soil to be analysed, free of vegetation and dirt, and start hammering it into the soil until it penetrates and reaches the same level.

2. With the help of a shovel, remove all the soil from around the cylinder until you can carefully extract it without altering or compressing the soil sample inside. Remove any excess soil to match the sample exactly to the inner volume of the cylinder.

3. Recover the soil sample from inside the cylinder and dry it at 105°C in the oven. You can weigh the sample every half hour, and when it stops losing weight, you can consider it to have lost all its moisture.

4. Weight the dry soil sample on the scale and record the result in grams.

5. Calculate the volume of the cylinder used to take the soil sample. To do this, measure its inner diameter and height in centimetres.

   Using the following formulas, you can calculate the volume of the cylinder:

   radio=diameter/2
   Volume (cm3) = 3.1416 * radio * radio * height

6. Once you have the data of weight (gr) and volume (cm3), you can express the bulk density of the dry soil sample according to the following expression:

   Dry bulk density = weight of the dry soil sample (g) / volume of the cylinder (cm3)

SAFETY INSTRUCTIONS

Biochar is considered a safe product; however, when it possesses low levels of humidity, it may release small particles during handling that could potentially cause irritation to the respiratory tract. To mitigate this risk, it is advisable to lightly moisten biochar before handling and take precautions to avoid inhalation. Using an appropriate mask is also recommended.

Furthermore, biochar has the potential to self-ignite when exposed in large volumes to significant heat or to an ignition source.

Additionally, burning biochar can result in the emission of hazardous carbon monoxide (CO). Therefore, it is crucial to refrain from burning biochar in enclosed environments to prevent the accumulation of harmful gases.