# BIOCHAR ACTIVATED BY NUTRIENT- AND MICROORGANISMS-ENRICHED LIQUIDS AS A SOIL AMENDMENT

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Key Words: Biochar, Activation, Dehydrogenase activity, amoA gene (Ammonium Monooxygenase).

Biochar is very stable in nature and lasts for thousands of years. Biochar addition to soil positively affects the ecosystem, such as soil fertility and biological activity. Adding biochar to soil do not always increases soil activity. Studies have shown that biochar may also have a negative impact on soil microflora. Although biochar provides nutrients and mineralizable carbon to soil microorganism, due to its strong adsorption power, it pulls out soil nutrients away from the soil and may show a negative effect on soil microflora and rhizosphere. Modification of biochar is important to avoid its adverse effects. Physical and chemical modifications are a common method for the activation of biochar. Chemical modification has more advantage than a physical modification in term of porosity, greater surface area, less aromatic compound, and more oxygen-containing group. Chemical modification of biochar requires the use of strong chemicals which increase the risk to environment pollution. In the modern time with the increasing pollution, there is a demand for a low-cost green method to activate biochar, beneficial to the farmers and the environment. Uncommon biological activation of biochar fits in all the above aspects.

The specific aim of this study is to develop a low-cost and more environment-friendly method for activation of biochar. For the study, biochar prepared from plant residues was used for activation. Two weeks bathing of biochar was done in liquid enriched with nutrients and beneficial microorganisms. 15 gram of biochar was taken in a sealed polyurethane bag and dipped in each beaker containing nutrients enriched activation liquid and also in a beaker containing distilled water as a control. The variants of the experiment according to a type of used liquid were: [1] Distilled water (non-activated), [2] Medium M9, [3] M9 + Rewital Biogen Pro+ (commercial concentrate of helper soil and plant microorganisms). The activation liquid variant [2] Medium M9, contains dextrose as carbon source, Ammonium chloride (nitrogen), phosphate (phosphorus), sulfur, potassium, and magnesium. The activation liquid of variant [3] was prepared by inoculating medium M9 with Rewital Biogen Pro+ and incubated for three days at room temperature and under intense exposure to air. The activation liquids in a 500-ml bottle were aerated for 14 days at room temperature. Values of pH and glucose concentration were measured at the beginning and the end of the activation.

Activated biochar was tested as a soil amendment for its beneficial microbial enrichment in a pot plant growth experiment with lettuce (Lactuca sativa) seedlings. Activated biochar of all three variants was amended to the soil, negative control without biochar amendment was also prepared, sowed with lettuce seeds and grown under white light (20 000 lux) in phytotron (a 12 h photoperiod, temperature 18/22 °C (night/day), relative humidity 70%). After 42-days growth, the plants were harvested, the biomass of plants from all variants compared, and the biological parameters of soil at the beginning and the end of the experiment compared. Biological parameter compared were microbial biomass carbon (MBC), soil dehydrogenase activity (DHA) and soil microbial community abundance was determined by 16S rDNA (bacteria) and 18S rDNA (fungi), amoA gene (ammonium monooxygenase), nxr gene (nitrite oxidoreductase) and nirS gene (nitrite reductase).

From the overall result, it can be concluded that the number of bacteria, fungi, and values of microbial carbon and dehydrogenase activity in soil samples of all variants were comparable. The biomass of harvested lettuce seedlings does not show a significant difference. However, a significant increase (more than 2-fold) in the amoA gene were found for soil samples treated with variant [3] .

Acknowledgments: The work was supported by the project of Technology Agency of the Czech Republic TH03030319: „Promoting the functional diversity of soil organisms by applying classical and modified stable organic matter while preserving the soil's production properties.