The Study in the Model Experiment of the Effect of Biochar Introduction on the Intensity of Substrate-induced Respiration of Soils

K.G. Ginivatullin. E.V. Smirnova, R.V. Okunev, A.A. Valeeva, S.S. Ryazanov, I.A. Guseva
Kazan Federal University, Kazan, Russia

The introduction of biochar to soils allows, in the opinion of most authors, to solve in the future the most important problems of our time: long-term improvement of soil fertility, waste utilization, and most importantly, the need for sequestration of atmospheric carbon. The possibilities of solving the latter problem began to be questioned to some degree in connection with the finding of a positive priming effect - increase in soil respiration (SR) due to the decomposition of soil organic matter (SOM) during the introduction of biochar. However there are research works in which a negative priming effect is detected or there is no significant effect on the SR. The discussion is also a question of the mechanisms of the effect of biochar on $C0_2$ emissions from soils.

In research works (Major et. al. 2010, Maestrini et. al. 2015) is expressed the opinion that the positive effect of biochars on SR is observed only in a short time due to the available of biochar OM. In the future the biochar can be considered as part of the SOM pool that resistant to oxidation. The aim of work: the assessment of the effect of the duration of soil-biochar mixtures incubation on the directivity, the intensity of substrate-induced respiration (SID) and evaluation of affecting factors.

For experiments used 10 biochar samples that prepared from various wood and grassy materials in different pyrolysis modes (400°C and in the range of 400-600°C). This biochars were characterized by 28 indicators including the content of organic carbon and nitrogen, the oxidability of biochar OM, ash content, pH, and the composition of acetate and water extracts. Model soil:biochar mixtures (20:1) were incubated at the optimum humidity and temperature. The SID value was determined after 3, 95 and 187 days of incubation. It was shown that the effect of incubation duration of 3 days operates in different directions, is observed a both decrease and increase in SID intensity and the direction of influence depends on the plant material. The incubation for 95 days leads to an increase in SID in all variants compared to the control. With further incubation (187 days) for some variants, there is a decrease in intensity, for some, on the contrary, an increase but for all variants the LED remains higher than in the control.

Regression analysis was used to evaluate the biochar properties affecting the intensity of SID. Since the data set refers to high-dimensional with a high degree of cross-correlation variables to evaluate relationships used ridge LASSO regression as well as multiple linear regression with step by step inclusion of variables. The inclusion of variables was carried out using the AIC criterion. At each stage of adding variables the VIF analysis was performed to diagnose the multicollinearity problem. It was revealed that the best results are obtained by the use of LASSO regression. The result of application of LASSO regression showed that during the short-term incubation a positively affects on SID the content of oxidized OM, pH_Hro and negatively - the content of acetatsoluble sodium. During incubation of 95 days has a positive effect on the SID is the content of oxidizable OM, during 187 days - ash content. From the work it can be concluded that the duration of incubation of the soil:biochar mixture affects on SID in different directions and depends on its various properties.

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Biogeosystem Technique - Design of a Dispersed Soil System, Intra-soil Moistening, Intra-soil Waste Recycling - Priority Conditions for the Humic Substances Synthesis and Stability

уя1йгу P. Kalinichenko[12]. Vladimir G. Sister[3], Andrei N. Tsedilin[3], Dmitry A. Makarenkov[3,4], Vyacheslav I. Nazarov[3]
institute of Soil Fertility of South Russia, Rostov region, Russia, kalinitch@mail.ru
[2]Russian Scientific Research Institute of Phytopathology, Moscow region, Russia
[3]Moscow Polytechnic University, Moscow, Russia
[4]National Research Centre "Kurchatov Institute" - Irea, Moscow, Russia

The significant role of humic substances in the provision of stable and high soil agronomic properties assumes the creation of prerequisites eliminating the climatic and anthropogenic stress of interaction in the system "environment - soil - organisms and biocosic matter of soil - technical means and technologies of agronomy, land reclamation, waste utilization".

The use of obsolete imitation principles of land use management leads to destruction of urban and agroecosystems, intensifies conflict between biosphere and humanity, increases a probability of modern biosphere evolution degradation scenario. The demand for new development vector is urgent in the world. It was proposed to develop nature-friendly technologies as a strategic reference point. The message is promising, but it assumes a creative approach to its comprehension and application, because "nature-similar" does not mean simple resemblance or copying - "nature-like", but requires a much broader comprehension of the world development, especially given its current impasse in all directions.

Most modern technologies are built on unqualified imitation of natural phenomena, therefore they are not "nature-similar", and the continuation of their application causes degradation of natural and anthropogenic biogeosystems, aggravates "ecosphere - technology" conflict. In aspect of humic substances this means a deterioration of of humic substances synthesis and stability in soil conditions, and soil fertility decrease.

In order to overcome the "ecosphere - technology" conflict, **Biogeosystem Technique** - the algorithm and technologies for controlling biogeochemical cycle in the gaseous, liquid, solid phase is proposed to create a biogeosystem with transcendental properties - not direct analogies with nature, but the search for a niche that nature has left for continuation of her intents. The approach allows, without contradiction to nature, to create a soil with highly disperse illuvial horizon; reduce the rate of fresh water consumption for bioproduction; Increase the productivity of environmentally safe recycling in disperse soil system. Biogeosystem Technique, in comparison to natural conditions and known standard imitation technologies, makes it possible to activate the biosphere process, have the priority conditions for humic substances synthesis and stability, healthy soil, increased soil biological production, save environment, resources and food at high production results, long-term economic benefits in a unified technological cycle.

The technical solutions and technologies of Biogeosystem Technique are developed that have no direct analogues in the world:

- milling processing of the soil inner layer of 20-50 cm allows to improve the conditions for humic substances synthesis and stability, increase the soil fertility by 30-80 % to the period up to 40 years, increase the profitability of farming technology by 2-3 times;

- recycling of industrial (including food waste) and domestic waste in the dispersed soil system in an amount up to 500 t/ha during milling the inner sojl layer of 20-50 cm to stimulate the saprophyte activity and humic substances synthesis and stability;