EGU23-9066, updated on 01 Jun 2023
https://doi.org/10.5194/egusphere-egu23-9066
EGU General Assembly 2023

Granulated biochar-based NPK fertilizer and its impact on nutrient leaching, plant growth and soil-borne N_2O emissions

Jannis Grafmüller[1,2,3], Daniel Kray[1], Claudia Kammann[4], Marie E. Mühe[3,5], Hans-Peter Schmidt[2], and Nikolas Hagemann[2,6]

[1]Institute of Process Engineering and Institute for Sustainable Energy Systems, Offenburg University of Applied Sciences, Germany (jannis.grafmueller@hs-offenburg.de)

[2]Ithaka Institute, Arbaz (Switzerland) and Goldbach (Germany)

[3]Plant Biogeochemistry, Tübingen University, Tübingen, Germany

[4]Department of Applied Ecology, Hochschule Geisenheim University, Geisenheim, Germany

[5]Department of Environmental Microbiology, Helmholtz Centre for Environmental Research - UFZ, Leipzig, Germany

[6]Environmental Analytics, Agroscope, Zurich, Switzerland

Biochar amendments to fertilized soils are an important step towards more resource-efficient practices in agriculture by limiting the amounts of nutrients being leached to water bodies or transformed to the potent greenhouse gas (GHG) nitrous oxide (N_2O). Biochar was often amended to the soil separately to the fertilizer application. Alternatively, biochar and nutrient bearing salts or minerals can be blended and aggregated, e.g., granulated prior to soil application. However, the impact of this practice on biochar effects on nutrient availability, leachability and soil-borne N_2O emissions is so far largely unexplored. Here, we present data on the effects of a granulated, biochar-blended mineral NPK fertilizer applied to a sandy soil in two different greenhouse pot trials on white cabbage and spinach, respectively. In the white cabbage (*Brassica oleracea convar. Capitata var. Alba*) experiment, the biochar blended NPK fertilizer reduced nitrogen leaching by 30 to 45% compared to the pure NPK fertilized control following two simulated heavy precipitation events. Results in a similar range were obtained when pure, milled biochar was homogeneously mixed with pure NPK fertilizer in the soil as a further control. The reduced nutrient loss in biochar-amended pots may have contributed to increases in cabbage head biomass of 14% for the granulated biochar NPK fertilizer and 34% for the loose mix of milled biochar with pure NPK fertilizer, when compared to the NPK fertilizer control without biochar. In the spinach (*Spinacia oleracea,* no precipitation events) experiment, the biochar-blended granulated fertilizer increased the marketable fresh spinach yields by 5% while the mixture of milled biochar and pure NPK fertilizer in the soil increased yields by 13% compared to the control without biochar, respectively. The analyses of GHG emissions that were measured during this experiment allows to comprehend whether these yield increases were also caused by a lower volatilization of fertilized nitrogen as N_2O-N. With these two experiments, we provide insights on how biochar-blended fertilizers interact with plants and the soil system and how biochar could be used in agricultural practices to increase nutrient use efficiencies, i.e., the environmental costs per unit of yield produced, by reducing the undesired loss of nutrients from soil in combination with

yield increase.