Groß-Gerau (Germany)

EXPERIMENT GOALS

The following hypotheses have been tested, biochar amendments (compared to control sites) can: i) improve soil hydraulic properties, and hold and deliver more water to crops, thereby increase the crop production, ii) enhance nitrogen use efficiency and crop growth, and iii) will only initially increase soil respiration due to the release of small amounts of labile carbon, but thereafter be unchanged, d, confirming biochar's overall low SOC-priming ng potential and high recalcitrance in soil.

4-year experiment

Site description

A field experiment was conducted at the experimental station of Justus-Liebig University Giessen, Germany. The research area is at Gross-Gerau, 49°45’ N and 8°29’ E, 90–145 m above sea level. The climate of the area is characterized as the warm-temperate climate with average (56 years) temperature of 9.8 °C and annual precipitation of 600 mm. The soil was formed from river (Rhine) sand deposits and it is characterized as silty sand (particle size, sand 2.0–0.5, silt 0.05–0.002 and clay <0.002 mm) having sand, silt and clay as 85.2, 9.6 and 5.2% respectively. Four major and two cover crops were grown in consecutive growing seasons from 2012 to 2015 in the following sequence: maize (Zea maize L.), winter wheat (Triticum aestivum L.), peas (Pisum sativum L.), summer barley (Hordeum vulgare L.), peas (Pisum sativum L.) and again maize.

Biochar and its application in the field

The feedstock for the biochar production was comprised of wood chip sieving (needles, bark, twig pieces and small wood chips) of Norway spruce (Picea abies L., 70%), and a deciduous tree European Beech (Fagus sylvatica L., 30%); needles roughly contributed 30% to the total feedstock. Biochar was produced at 550–600 °C (Pyreg GmbH, Dörth, Germany). The moisture rich (256%) biochar was thoroughly mixed before field application. The field experiment was established in April 2012 and initiated with a single application of biochar to the experimental plots. The experiment was laid out in a randomized complete block design with two factors (BC, 0, 15 and 30 Mg/ha; watering regime, rainfed or irrigated) in split plot arrangement. The biochar was applied at 0, 15 and 30 Mg/ha (on dry weight basis) and spread manually with hand spreader in the respective plots.

Measured parameters

Field conditions: rainfall
Soil analysis and interactions with biochar: soil analysis at T0, periodic soil analysis, N, NH_4^+, NO_3^-, soil moisture
Carbon dynamics: soil respiration
Production data: straw and grain N concentration, N uptake
Plant-soil dynamics and interactions: Plant biomass nutrient analysis (K, Mg, N, P, Ca, Na, Fe, Cu, Zn)

Key features

- Biochar induced Mn deficiency in the first months and in subsequent years limitations in the N uptake even in the presence of available N (NO_3^-).
- At least the selected biochar may need longer (>10 years) residence time in soil to produce beneficial effects on crop growth and yield.
- Soil moisture improvement due to biochar addition was mainly attributed to changes in soil bulk density (SBD) and WHC due to porous structure with high adsorption capacity of biochar particles.

Planned activities or potential experimental activities

Compare the effects of BC on crop yields, mineral nitrogen (NO_3^- and NH_4^+) dynamics, soil moisture and initial soil CO_2 efflux.

PRESENTATION OF THE WORKING GROUP

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Bibliography and publications of the experiment, online information material, websites

Haider, Ghulam, Diedrich Steffens, Gerald Moser, Christoph Müller, and Claudia I. Kammann. 2017. 'Biochar Reduced Nitrate Leaching and Improved Soil Moisture Content without Yield Improvements in a Four-Year Field Study'. Agriculture, Ecosystems & Environment 237 (January): 80–94. https://doi.org/10.1016/j.agee.2016.12.019.

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