

Gartow (Germany)

EXPERIMENT GOALS

Substitution of mineral fertilizers with biochar from anaerobic digestion plants to improve soil fertility properties such as aggregation and organic matter (OM) content under temperate field conditions.

4-year experiment



SITE DESCRIPTION

The field experiment was established in May 2012 in northwestern Germany (53°01'09.26" N and 11°29'50.04" E, 19 m asl) on a sandy Cambisol. The site has a temperate climate with an average temperature of 8.8°C and annual precipitation of 575 mm. Texture analysis revealed 94% sand, 4% silt, and 2% clay for the soil under study. The crop rotation during the experiment included silage maize, winter rye, a multi-species cover crop mix, blue lupine, and rapeseed.

BIOCHAR AND ITS APPLICATION IN THE FIELD

The biochar was produced from green cuttings in a Pyreg reactor at around 650°C (Doerth, Germany, www.pyreg.de). Treatments included fertilization with mineral fertilizer or biogas digestate, with or without the addition of 3 or 40 Mg biochar ha⁻¹ produced at around 650 °C. Ten experimental treatments was replicated five times, creating a total of 50 plots 72 m₂ each, arranged in a row-column design so that each treatment was present in each row and each column. Six treatments, were analyzed in the present experiment, including two fertilizer treatments [mineral fertilizer (**M**) or biogas digestate (**D**)] applied without biochar (**B0**), with 3 Mg biochar ha⁻¹ (**B3**), or with 40 Mg biochar ha⁻¹ (**B40**).

Measured parameters

Soil analysis and interactions with biochar: soil analysis at T0, periodic soil analysis, pH, CEC, Cmic, bulk density, SOC, POM

Biochar dynamics and matrices: degradation of biochar, soil carbon contribution

Key features

- Application of 40 Mg biochar ha⁻¹ did not consistently improve CEC and WHC four years after application to a sandy soil, which could be a result of the high pyrolysis temperature and coarseness of the biochar.
- Biochar did improve soil structure by significantly increasing the yield of small macroaggregates (2–0.25 mm) even at a low application of 3 Mg ha⁻¹.
- High temperature biochar applied to a sandy soil under temperate climatic conditions is primarily recommended to increase SOC content, which could help mitigate climate change if this C remains sequestered in the long-term.

Planned activities or potential experimental activities

Analyze the effects of biochar and biogas digestate versus mineral fertilizer on soil aggregation and OM dynamics under temperate field conditions.

PRESENTATION OF THE WORKING GROUP

The German Federal Ministry of Education and Research (BMBF) supported the study within the Clima-Carbo project (No. 01LY1110B)

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

Greenberg, Isabel, Michael Kaiser, Steven Polifka, Katja Wiedner, Bruno Glaser, and Bernard Ludwig. 2019. 'The Effect of Biochar with Biogas Digestate or Mineral Fertilizer on Fertility, Aggregation and Organic Carbon Content of a Sandy Soil: Results of a Temperate Field Experiment'. *Journal of Plant Nutrition and Soil Science* 182 (5): 824–35.
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