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Impact of Biochar on water quality in cotton production system in the Mississippi Delta

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Abstract

Excessive use of synthetic fertilizers and prevalent practices of conventional tillage pose a threat to the quality of subsurface water and nearby water sources due to nutrient leaching. Biochar application have a potential to decrease nutrient leaching and improve soil health and crop productivity. A field experiment was conducted from 2019 to 2022 to evaluate the effects of biochar application rates on subsurface water quality in a rainfed continuous cotton production system in the subhumid region climate of Mississippi Delta. The study was designed as completely randomized with four replications. Biochar was applied before planting cotton at rates of 0, 10, 20, and 40 Mg ha⁻¹. A total of 32 suction cup lysimeters were installed at 46 and 81 cm soil depths for collecting soil solution samples and monitoring nutrient leaching. Soil solution samples were collected weekly or biweekly after every significant rainfall event (>12.7 mm). Soil solution samples were analyzed for pH, electrical conductivity, anion concentrations (NO₂-N, NO₃-N, Cl⁻, PO₄-P, and SO₄-S) using Dionex Integrion High-Pressure Ion Chromatograph, ammoniacal nitrogen (NH₄-N) using Quikchem 8500 flow injection system on and cations (Ca, Mg, Na, Fe and K) using Inductively coupled plasma emission spectrometry (ICP-AES). A total of 42 sampling events were conducted, 28 during the fallow season and 14 during the cotton season. The data were analyzed separately for each season using the



GLIMMIX procedure in SAS software (9.4v). The results showed that increasing the biochar application rate led to a reduction in chloride, nitrate, and phosphate losses. However, during the fallow season, there was an increase in sulphate leaching losses at higher biochar application rates. During the cotton season, there were no significant changes observed, except for a slight increase in sulphate leaching losses at higher biochar application rates.