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Effect of biochar on nitrate and ammonium retention in paddy soil columns

Mannapperuma S.R., Kumareswaran K. and Wijetunga S.*
Department of Agricultural Engineering, Faculty of Agriculture, University of Ruhuna, Matara, Sri Lanka.

Paddy cultivation occupies a prominent place in the agriculture sector in Asia, which relies on the intense use of nitrogen fertilizers. Excessive use of nitrogen fertilizers in agriculture over years results in several ecological disorders principally nitrogen leaching, eutrophication, and global warming. Nitrogen leaching has been a potential source of water pollution both surface and groundwater further, remains a major constraint in nutrient utilization. This study intended to assess the effect of biochar, a potential organic soil amendment on nitrate and ammonium ion retention on paddy lands; with the objectives of determining the nitrogen loss by leaching in paddy soils at different biochar levels under constant nitrogen fertilizer application. The soil samples (n = 16) were taken at six sampling locations at two depth levels (0-20cm and 20-40cm) from paddy fields in the Mapalana area and biochar prepared from discarded cinnamon sticks following traditional method were used to fill the soil columns for treatment after appropriate preparation. Three laboratory experiments were conducted with one control. A constant urea level of 0.405 g was applied separately to the three different soil columns in 01%, 2.5%, and 5% (W/W) biochar mixed with soil. The $NH4^+$-N and NO_3^--N concentrations were measured using ultraviolet and visible spectrophotometer. When the biochar content increased from 1% to 2.5%, a significant reduction of NH_4^+ and NO_3^- in leachate from 0.7 mg/l to 0.1 mg/l and 200 mg/l to 100 mg/l were shown respectively demonstrating minimum ammonium and nitrate ion levels in leachate during the 2.5% biochar level. However, no significant changes were recorded in nitrogen retention for 2.5% and 5% biochar levels. Thus, the study concludes 2.5% is optimum biochar level to enhance nitrogen retention in soil and reduce nitrate and ammonium leachate in the soil under recommended urea application rate for paddy.

Keywords: Ammonium leachate, Biochar, Nitrate leachate, Nitrogen retention, Soil amendment

*Corresponding author: swije@ageng.ruh.ac.lk