Soil organic matter and ammonium affect potassium retention in soil microaggregates under long-term fertilization

Mingjun Chen¹, Xiaoqin Chen², Shahbaz Muhammad³, Tida Ge⁴, Huoyan Wang⁵, Shu Wang¹, and Wenzhao Zhang⁶

¹Southwest Forestry University

²Institute of Soil Science Chinese Academy of Sciences

³Centre for Environmental and Climate Science

⁴Institute of Subtropical Agriculture, The Chinese Academy of Sciences

⁵Institute of Soil Science, Chinese Academy of Sciences

⁶Institute of Subtropical Agriculture Chinese Academy of Sciences

September 25, 2021

Abstract

The adsorption and fixation of potassium in agricultural soils are important as they influence K availability for crops. Soil organic matter (SOM) and ammonium (NH₄⁺) exist in soils and play indispensable roles in soil fertility and crop yield; however, the effects of SOM and NH₄⁺ on K retention in soil aggregate remains unclear. This study aimed to evaluate the effects of SOM and NH₄⁺ on K adsorption and fixation in soil microaggregates (<0.25 mm). Soil microaggregates were extracted from three long-term fertilization treatments under rice-wheat rotations: no fertilizer (CK), fertilized with inorganic NPK (NPK), and inorganic NPK fertilizers combined with straw return (NPKS). Long-term fertilization, particularly the application of inorganic NPK combined with straw return, significantly improved the SOM content in microaggregates. Both NPK and NPKS treatments increased K adsorption but decreased K fixation, and SOM oxidation of microaggregates reduced K adsorption but increased K fixation in all treatments, indicating the positive and inhibitory effects of SOM on K adsorption and fixation, respectively. NH₄⁺ significantly inhibited K adsorption and fixation, and this inhibitory effect was more significant in microaggregates with a higher SOM content. Although NH₄⁺ reduced the positive effect of SOM on K adsorption, it enhanced the inhibitory effect of SOM on K fixation. Conclusively, long-term fertilization increases K adsorption but reduces K fixation by improving SOM content, where NH₄⁺ enhances SOM inhibited K retention in soil microaggregates, which is considered to improve K availability in soils amended with K fertilizers. Keywords: soil organic matter, NH₄⁺, K, adsorption, fixation

Hosted file

manuscript.doc available at <https://authorea.com/users/436116/articles/538670-soil-organic-matter-and-ammonium-affect-potassium-retention-in-soil-microaggregates-under-long-term-fertilization>