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The Effect of Biochar on Soil Organic Carbon and Crop Yield in East Asian Paddy Fields: A Meta-Analysis

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[Introduction]

As part of the response to climate change, efforts are being made in agriculture to encourage improving soil health and soil organic carbon (SOC) sequestration. Biochar has been considered a potential means to increase soil organic carbon and crop yields. However, the effects of biochar application on crop production appear variable among many case studies. The efficacy of biochar as a carbon sequestration agent for climate change mitigation remains part of uncertain. Therefore, this study aims to comprehensively and quantitatively understand biochar's effects on SOC storage and crop production at the regional level.

[Materials and Methods]

We performed a meta-analysis of 42 published papers with 82 (SOC) and 196 (crop production) paired comparisons to obtain a central tendency of SOC storage and crop production in response to biochar application in East Asia. Various data were categorized to evaluate the effectiveness of potential factors affecting SOC storage and crop production. Categorization was divided into experimental conditions, biochar characteristics, and soil properties.

[Results and Discussion]

SOC storage increased by approximately 40.5% from 17.7 ± 1.0 Mg/ha to 24.3 ± 1.2 Mg/ha (95 % CI = 38.5%, 42.5%, $p < .000$), and crop yields also increased significantly by 16.2% from 9.9 ± 0.9 Mg/ha to 11.4 ± 1.0 Mg/ha (95 % CI = 15.2%, 17.2%, $p < .000$). In rice paddies in East Asia, biochar application has the effect of improving SOC content and crop yields. This suggests that biochar can be an effective improvement to increase SOC content and crop yields. These results are expected to be used as basic data for predicting SOC content and crop production by applying biochar in East Asian paddy fields in the future.

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