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Coffee Husk Biochar Application Improved Soil Chemical Properties and Yield of Soybean Grown in a Tropical Nitisol, Ethiopia

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Abstract

Low levels of soil fertility and soil acidity are among the major bottlenecks to enhance agricultural productivity in the humid tropics. Soil management systems that enhance soil fertility and biological cycling of nutrients is crucial to sustain soil productivity. This study was, therefore, conducted to determine the effects of coffee husk biochar (here after biochar), *rhizobium* inoculation and P fertiliser application on Arbuscular mycorhyzal fungi (AMF) root colonisation, yield, P uptake and N_2 fixation of soybean grown on tropical Nitisol of Jimma, southwest Ethiopia. The experiment consisted of two levels of *rhizobium* inoculation (with and without), phosphorous (P) application (0 and 20 kg ha^{-1}) and four levels of biochar (0, 6, 12 and 36 t ha^{-1}) in a 2 × 2 × 4 factorial design with 3 replications. The experiment was conducted under lath house conditions in 2015. ANOVA showed that integrated application of biochar and P fertiliser significantly improved soil chemical properties, P uptake and seed yield, with a seed yield increment of more than two-fold and highest total P uptake (4.5 g plant^{-1}) with inoculation, 20 kg P and 36 t biochar compared to the yield from the control (without inoculation, P and biochar). However, the highest AMF root colonisation (80 %) was obtained at 36 t biochar without P and declined with 20 kg P application. The highest total N content (4.2 g plant^{-1}) and N_2-fixed (4.6 g plant^{-1}) was obtained with inoculation, 20 kg P and 36 t biochar. However, the highest %N derived from the atmosphere (%Ndfa) (>98 %) did not significantly vary between 12 and 36 t biochar treatments at each level of inoculation and P addition. The improved soil chemical properties, seed yield, P uptake and N_2-fixation through combined use of biochar and P fertiliser suggests the importance of integrated use of biochar with P fertiliser to ensure that soybean crops are adequately supplied with P for nodulation and N_2-fixation in tropical acid soils for sustainable soybean production in the long term.

Keywords: Acid soil, AMF, biochar, N fixation, soybean

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