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Influence of Applied Inorganic and Organic Nitrogen Fertilizers on Nitrogen Forms in Biochar-Treated Soil

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Abstract : Biochar application to calcareous soils could potentially influence the nitrogen dynamics that affect the bioavailability of plants. This study was carried out to investigate the effect of incubation periods on the changes of nitrogen levels (total nitrogen TN and exchangeable ammonium NH_4^+ and nitrate NO_3^-) in biochar-treated calcareous soil. The incubation course was extended to 144 days at 30 ± 3 ℃ and at 50% of soil water holding capacity (WHC). Two types of biochars were obtained by pyrolysis at 500 ℃ from rice husk (RHB) and sugarcane bagasse (SCBB). The experiment was planned in a factorial experimental design with three factors (6 periods '24 days for each period' × 3 biochar types 'un-amended, RHB and SCBB' × 3 nitrogen fertilizers 'control, ammonium nitrate; AN and animal manure; AM') in a completely randomized design. The results obtained showed that the highest level of TN was found in the first 24 days of the incubation period in all treatments. However, the amount of TN was decreased with proceeding incubation period up to 144 days and reached to the lowest level at the end of incubation with values of change rate was 17.5, 16.6, and 14.6 g kg^{-1} day^{-1} for the un-amended, RHB and SCBB treated soil, respectively. The values of change rate in biochar-soils treated with nitrogen fertilizers were decreased gradually through the whole incubation time from 127.22 to 12.45 g kg^{-1} day^{-1} and from 65.00 to 13.43 g kg^{-1} day^{-1} for AN and AM respectively, in the case of RHB-soil. While in SCBB-soil, these values were decreased from 70.83 to 12.13 g kg^{-1} day^{-1} and from 59.17 to 11.48 g kg^{-1} day^{-1} for AN and AM treatments, respectively. The lowest concentration of exchangeable NH_4^+ was generally found through the period from 24-48 days of incubation. However, the addition of nitrogen fertilizers, enhanced NH_4^+ production through incubation periods. In the case of RHB-soil, the value of change rate in NH_4^+ level in the first 24 days of incubation was 0.43 mg kg^{-1} day^{-1} and with the addition of AN and AM this value increased to 1.54 and 4.38 mg kg^{-1} day^{-1}, respectively. In the case of SCBB-soil, the value of change rate in NH_4^+ level was 0.29 mg kg^{-1} day^{-1} which increased to 1.04 mg kg^{-1} day^{-1} at the end of incubation, and due to the addition of AN and AM this value increased to 2.78 and 1.90 mg kg^{-1} day^{-1} in the first 24 days of incubation period, respectively. However, as compared to the control treatment, the lowest rate of change in NH_4^+ level was found at the end of incubation. On the other hand, incubation of all biochars-amended soil and treated with AN and AM decreased the concentration levels of NO_3^-, especially through the first 24-72 days of incubation period. As a result, the values of change rate in NO_3^- concentrations in all treatments were almost negative.

Keywords : ammonium nitrate, animal manure, biochar, rice husk, sugarcane bagasse
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