Effects of straw return depth on soil organic carbon, nitrogen content, and soil enzyme activity of spring maize field

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Abstract: 【**Objective**】In order to evaluate the effect of straw return depth on soil physicochemical properties, enzyme activity, and explore the relationship between them under different straw return depths. 【**Method**】A field micro-plots experiment was conducted for 3-year (2016—2018) in northeast China, and totally six treatments were set as following, straw incorporation with rotary tillage for 10 cm (S1D1), 20 cm (S1D2) and 30 cm (S1D3) of soil depth, and straw removal with rotary tillage in the same soil depth (S2D1, S2D2 and S2D3), respectively. Individual and interaction effects on physical and chemical properties of soil and enzyme activity of spring maize field were determined in this study.【**Result**】Soil organic carbon (SOC) was significantly affected by rotary tillage depth (D) and its interaction with straw (S) treatment ($P<0.05$). SOC contents under S1D1 and S1D2 were 1.2%-16.0% higher than those under S1D3 treatment at 0-20 cm soil layer, and the highest SOC content at 20-40 cm soil layer was observed in S2D3 treatment. Soil nitrate (NO_3^--N) and ammonium (NH_4^+-N) contents and invertase and catalase activities were significantly influenced by straw and rotary tillage depth treatments and their interactions ($P<0.05$). Across 0-40 cm soil layer, S1 treatment increased soil NO_3^--N contents under D1 and D2 conditions by an average of 46.9% and 34.9%, respectively, but lowered soil NH_4^+-N contents by an average of 31.6% and 4.4%, respectively, compared to S2 treatment. Among treatments of rotary tillage depth, S1 treatment enhanced soil invertase and urease activities at 0-20 cm layer and decreased catalase activity at 20-30 cm layer, compared to S2 treatment. Correlation analysis revealed that SOC, soil TN, NO_3^--N and NH_4^+-N content, and invertase activity were significantly positive correlated. Both SOC and TN were highly negatively correlated with soil pH and SWC. Principal component analysis (PCA) suggested that SOC, TN content and enzymes activity were more obviously affected by S1D2 treatment in 0-40 cm and 0-20 cm soil layer, respectively, compared to S1D1 treatment. 【**Conclusion**】Soil nutrients level and enzymes activity in 0-40 cm layer were improved by S1D2 treatment, and might be considered as a suitable straw incorporation method for improving soil fertility in maize field within study area.

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