How soil erosion affects soil quality and corn yield in the Mollisol region of Northeast China

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Abstract

A better understanding of how soil erosion affects soil quality and crop yield is important for controlling soil erosion and sustaining crop yield in Mollisol region. The objectives of this study were: 1) to estimate erosion rate, 2) to identify the key indicators of soil quality, and 3) to analyze how soil erosion affects soil quality and corn yield in the typical Mollisol region of Northeast China. Soil samples were collected based on a 100 ×100 grid cell in an agricultural catchment in Bin County, Heilongjiang province. The ^{137}Cs tracer technique was used to estimate erosion rate and soil quality index (SQI) was used to characterize soil quality. The results showed that at the slope scale, erosion rate increased from the summit to the shoulder and back slopes, and decreased at the foot-slope, while deposition occurred at the toe of slope. At the catchment scale, soil erosion intensity decreased from upstream to downstream. Based on correlation analysis, sensitivity analysis and principal component analysis, we selected 7 key soil feature indicators for soil quality evaluation. They included mean weight diameter (MWD) of soil water-stable aggregate, soil bulk density (BD), soil organic matter (SOM), total nitrogen (TN), available phosphorus (AP), invertase, and soil microbial biomass carbon (MBC). The distribution of SQI in the catchment was corresponding to the distribution of soil erosion rate. The soil quality indexes had very significant negative correlation with soil erosion rate. The soil erosion was the key driving force to affect soil quality. The corn yield in erosion areas was significantly lower than that in the deposition areas of the catchment, and corn yield had a highly significant positive correlation with soil quality. Finaly, the distribution of corn yield had negative response to erosion rate in catchment.

Keywords

Soil erosion; Corn yield; Soil quality index; ^{137}Cs tracer technique; Mollisol region