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The effect of soil erosion depth on maize yields, evidence based on a long-term field simulation experiment

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Despite soil erosion has a strong impact on crop yield, whether soil erosion depth leads to abrupt or gradual crop yield changes is not well understood. To investigate how crop yields respond to soil erosion depth, we conducted a simulated erosion experiment by adopting the cut-and-fill method from 2012 to 2018 in a typical mountain area in the southeastern China. A completely randomized design with five soil erosion depth (5, 10, 20, 30 and 40 cm soil cut) and a control (0 cm soil cut) were used. Each treatment had three replicates. Maize was planted in these simulated erosion plots and maize yields were monitored from 2012 to 2018. Our results showed that the maize yield decreased with erosion depth and with decreasing remaining A_p horizon depth. Inconsistent with earlier studies, maize yield exhibited a quadratic function rather than linear response to increase in soil erosion depth and decrease in remaining A_p horizon depth. Soil erosion depth led to abrupt changes in maize yield. Compared with control, maize yield did not decrease significantly at 5 cm erosion depth or 25 cm remaining A horizon depth, but its reduction rate per 1cm of soil loss (3.36%) increased sharply at 10 cm erosion depth or 20 cm remaining A_p horizon. When remaining A_p horizon left 10 cm, maize yield demonstrated the lowest, which may be irreversible via application of chemical fertilization. Considering high heterogeneity of A_p horizon in the mountain area, soil erosion-crop yield relationship could be expressed well by remaining A_p horizon. We also found remaining A_p depth had a significant direct and indirect (via reduced SOM, soil available water, AP and AK contents) negative effect on maize yield. These results could be useful in identifying allowable soil-loss thickness and highlight the importance of soil nutrient monitoring in different soil erosion levels in designing a fertilization scheme aimed at ensuring food security.