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Long-term tillage effects on the distribution of P fractions of German loess soils

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Different tillage systems may affect P dynamics in soils due to differently distributed plant residues, different aggregate dynamics and erosion losses. Objectives were to investigate the effect of tillage on the availability of P in a long-term field trial initiated from 1990 to 1997. Four research sites located in eastern and southern Germany were established with a crop rotation consisting of two times winter wheat followed by sugar beet. The two treatments were no-till (NT), i.e. without cultivation, and conventional tillage (CT) down to 25-30 cm on loess soils. Soil P was divided into pools of different stabilities by a sequential extraction method and total P (Pt) was extracted by digesting the extracts of the fractionation to calculate organic P (Po). The Pt content (792 mg kg-1 soil) in the topsoil of the plots with NT was 15% higher than the content of Pt in the CT plots, while with increasing depth the Pt concentration decreased more under NT than under CT. This was also true for the other P fractions. The higher P contents in the topsoil of NT resulted presumably from the shallower incorporation of harvest residues compared to CT, whereas estimated soil losses and thus also P losses due to water erosion were only small for all four sites and treatments. Contents of oxalate extractable iron and organic carbon were positively related to the labile inorganic P (Pi) fractions, while there was a high correlation of the stable fractions with the clay contents and pH. Overall, the regression analyses indicated that labile P contents were controlled by the contents of organic C, while stable P contents depended on the contents of clay, oxalate-extractable Fe and Al, which suggested that the mineralization of organic matter provided available P. Overall, the tillage treatments had only little (and generally insignificant) effect on the total P content with a slightly increased soil P content under NT compared to CT mainly due to an increase in the content of labile P in the topsoil.