Soil P status under conventional and no-tillage systems in a long-term corn-soybean rotation conducted in eastern Canada

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Agricultural management including tillage system and fertilization may influence soil P status and dynamics. Phosphorus has been found to accumulate in the surface soil layer in long-term and fertilized agricultural systems under no till (NT) management (Selles et al., 1997; Messiga et al., 2010). We investigated the effect of tillage system (NT versus conventional tillage (CT)) and P fertilization on soil P status. The study was conducted on a clay loam soil in a long term experimental site with corn (*Zea mays* L.) -soybean (*Glycine max* L. (Merr.)) rotation established since 1992 in Quebec, Canada. Soils were sampled (0–15 cm and 15–30 cm) during fall 2007, 2008 and 2009 in plots that received 0, 17.5 and 35 kg P ha^{-1} and 160 kg N ha^{-1} every 2 yr since 1992. Soil was characterized for different parameters including: total C and N, pH, Mehlich 3 extractable nutrients (K, Ca, Mg, Fe, Al, etc.). Soil P status was determined by Mehlich-3 (P_{M3}) and water extraction (P_w). Soil P fractionation and soil biomass P and C were also performed on soil sampled in fall 2008 and fall 2009, respectively. The pH of the plough layer was slightly acidic in both tillage management systems (6.3-6.5) and did not vary from 1992, when the experiment was established. Total C was 2.3% in CT and 2.5% in NT while no difference was observed between the two systems for the total N (0.2%) indicating a limited effect of NT on soil organic matter content. The P_w concentration was in averaged 6.2 mg P kg^{-1} in NT and 5.2 mg P kg^{-1} in CT. In fall 2007, the P_{M3} concentration of the plough layer in NT was 36.9 mg kg^{-1} and 27.1 mg kg^{-1} in CT showing a trend of lower P_{M3} concentration in CT than NT. Soil P_w and P_{M3} varied significantly with tillage, P fertilization and season. In both NT and CT, the P_w and P_{M3}, increased with increasing fertilization rate, but the rate of increase was greater in the NT than CT. Total soil P was higher by 20% under NT compared to CT as reported by other studies (Selles et al., 1997). The P/Al saturation index was 0.03 under CT and 0.04 under NT. Soil biomass P increased with P rates only in the 0-15 cm layer under NT. This study indicated that there is an accumulation of soil P (inorganic and organic) under NT system with low potential environmental problems, considering the critical P_w value of 9.7 mg P kg^{-1} and the $(P/Al)_{M3}$ saturation rate of 0.05 (Pellerin et al., 2006).

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