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).

