

Phosphorus under long-term and short-term no-till in a wheat-pea rotation with five P fertilization rates

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Conservation tillage has become a common practice in the Canadian prairies, to minimize wind and water erosion, conserve moisture and sequester organic carbon. However, little is known about the fate of applied fertilizers with long-term no-till, particularly phosphorus (P), which is relatively immobile and can stratify without mixing from tillage. This study examined the forms and concentrations of soil P under long-term (> 28 years) and short-term (8 years) no-till, using duplicate plots of a wheat-pea rotation. Seed-placed monoammonium phosphate was added at rates of 0, 11.2, 20.4, 33.6 and 44.8 kg P₂O₅ ha⁻¹ added every year to the same plots. Soils were sampled each fall at 0-7.5, 7.7-15 and 15-30 cm depths, beginning in 2008. Preliminary results on soils sampled in 2009 indicate that total P was significantly higher under short-term no-till, while total inorganic P and bicarbonate-extractable (Olsen) P were significantly higher under long-term no-till in the top two depths. There were no significant differences with crop or fertilizer rate, but there was a significant interaction with length in no-till and fertilizer rate for total P and Olsen P, which were highest in long-term no-till receiving higher rates of fertilizer than short-term or long-term no-till receiving lower rates of fertilizer. Total organic P was generally high in these soils, averaging 60% at the surface and 40% at 15-30 cm depth, with no significant differences with length of no-till. Phosphorus-31 NMR showed a range of P forms at all depths, including phytate, DNA, phospholipids, orthophosphate and pyrophosphate. Orthophosphate was highest in the surface of soils receiving higher P fertilization, and was comparable at lower depths regardless of fertilization rate. These results suggest that P fertilizer can accumulate in the surface of soils under no-till, especially sites under long-term no-till receiving high rates of P fertilizers.