Soil Phosphorus Pools and Sorption Capacity in Long-term Organic and Conventional Management Systems.

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Background: Widespread phosphorus shortages have been reported in organically managed soils across Canada, although yields often do not reflect deficiencies. Considering that more than 80% of soil P may be unavailable for plant uptake, the current soil test phosphorus may be inaccurately assessing available P in organic systems.

Project Overview: The objective of the current study is to examine differences in soil P pools and P sorption capacity in a long-term forage-grain rotation (flax-alfalfa-alfalfa-wheat) and compare between organic, manure-amended (once only) organic, conventional and restored native prairie management. In May 2011, soil samples (0-15 cm; n=20) were collected from the wheat phase of the Glenlea Long Term Crop Rotation and Management research plots at Glenlea, MB. After 20 years the P sorption, or retention, ability of the soil under organic management is higher than conventional but less than the prairie (Figure 1), although these differences were not significant ($p<0.05$). Sequential Hedley P fractionation revealed significantly lower concentrations of both labile and moderately labile P fractions in the organic treatments compared to the prairie and often conventional systems (Figure 2). This was especially true for inorganic (Pi) compared to organic (Po) fractions. These fractions have been operationally defined with decreasing availability for plant uptake as: (1) Resin P-Pi, exchangeable with solution; (2) 0.5 M $NaHCO_3$ P_i and P_o, sorbed on soil minerals and some microbial P; (3) 0.1 M NaOH-P_i, P_o, associated with Fe and Al oxyhydroxides; (4) 0.1 M NaOH after ultrasonification-P_i, P_o, removing P at internal surfaces of aggregates; (5) 1 M HCl-Pi apatite mineral and some occluded P.

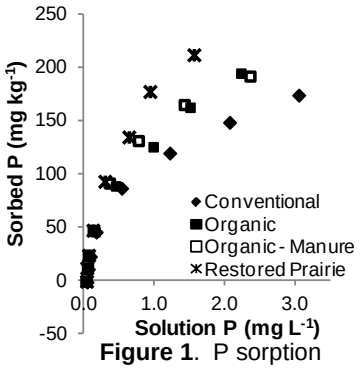

Figure 1. P sorption

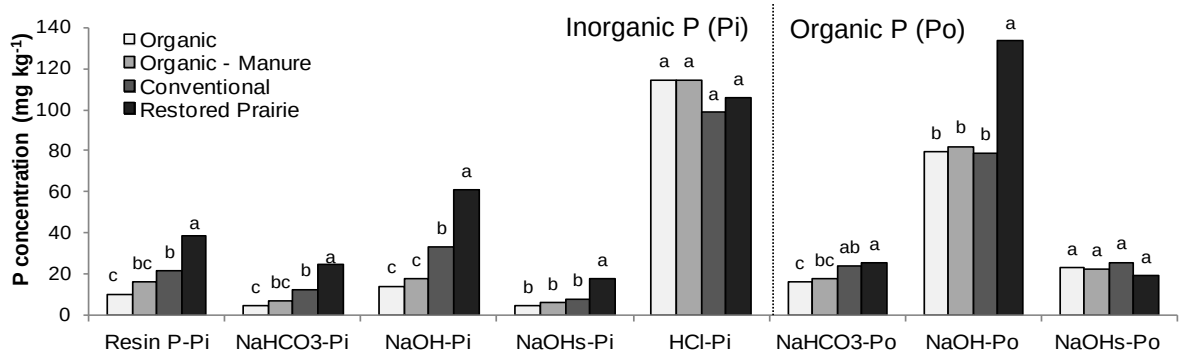

Figure 2. Phosphorus concentration from sequential extraction. Values are treatment means (n=3) with same letters within fractions representing no significant difference at $p<0.05$ as determined by Tukey's test.

Conclusion: Replacement of P in long-term organic systems is essential for maintaining yields, considering both labile and moderately labile P pools may be depleted, especially where hay is removed as in this rotation sequence. The one time manure application does not appear to have achieved this and a second application was added in autumn 2011.

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