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Over Winter Changes for Soil P Fractions as Affected by Tillage and P Fertilization in Eastern Canada

Yichao SHI[1], Noura ZIADI[1]*, Aimé J. Messiga[2] and Roger LALANDE[1]

[1]Soils and Crops Research and Development Centre, Agriculture and Agri-Food Canada, Quebec (QC), Canada
[2]Centre de Recherche sur les Grains Inc (CÉROM). Saint-Mathieu-de-Beloeil, QC, Canada

noura.ziadi@agr.gc.ca

Introduction

- Phosphorus (P) fractionation schemes have been widely used to characterize changes in inorganic and organic P fractions as affected by cultivation, land use and management, and P loss (Shi et al. 2013).
- Soil P fractions under different tillage systems and P applications could be affected also by seasonal and environmental conditions.
- Few studies assess how changes in soil P fractions over the winter are affected by agricultural management practices (tillage and P fertilization) for arable soils in cold climatic regions, despite their extended periods of cold and heavy snow cover.

Objective

- To determine changes in soil total P and associated P fractions over winter (from fall to spring) during two time periods (2001–2002 and 2007–2008).
- to determine the effects of tillage management practices and P fertilization on these changes.

Materials and Methods

Site description

- The study was conducted in a long-term maize-soybean rotation experiment established since 1992 on a clay loam soil (clayey, mixed, mesic Typic Humaquept) in Quebec, Canada.

Experimental design

- 2 tillage systems: moldboard plow (MP) and no till (NT) and 9 fertilization applications including 3 N rates (0, 80 and 160 kg N ha^{-1}) and 3 P rates (0, 17.5, 35 kg P ha^{-1}) were used in a split plot with 4 replications.
- Fertilizer were applied only in corn phase.
- P was applied at planting as 0-46-0.

Soil sampling and measurements

- Soil samples (0-15 cm) were collected the experimental plots under MP and NT receiving 0, 17.5 and 35 kg P ha^{-1} and 160 kg N ha^{-1} on fall 2001, spring 2002, fall 2007, and spring 2008 (Fertilization treatments were referred as P0, P17.5, and P35).
- Phosphorus fractions were determined using a modified Hedley sequential fractionation procedure (Tissen and Moir, 2008).
- Soil P fractions were assessed over periods 1 (spring 2002 subtracted from fall 2001) and 2 (spring 2008 subtracted from fall 2007).

Results and Discussion

Changes over winter

- Total P in the 0–15-cm layer decreased between fall and spring for both periods (Fig.1) indicating a potential P losses from the surface layer.
- Changes for all soil P fractions differed between the two periods, indicating the possible effect of environmental conditions (Fig. 1).
- The increasing trend of resin-P, NaOH-Pi, and NaOH-Po in period 1, and NaOH-Pi in period 2, indicates that these fractions could be the sink of soil P involved in the soil P mineralization /immobilization process over winter. (Fig.1)

Effects of tillage and P fertilization

- Compared with MP, NT significantly increased positive changes in resin-P and NaOH-Pi, and decreased the negative change for total P in period 1.Tillage had no significant effect on all soil P fractions during period 2 (Fig.2).
- P fertilization had a positive effect on changes for soil Pi fractions, as reported in Shi et al. (2013); and also for NaOH-Po over the two periods, which indicates that residual fertilizer P contributes to soil P cycling during winter (Fig.2).

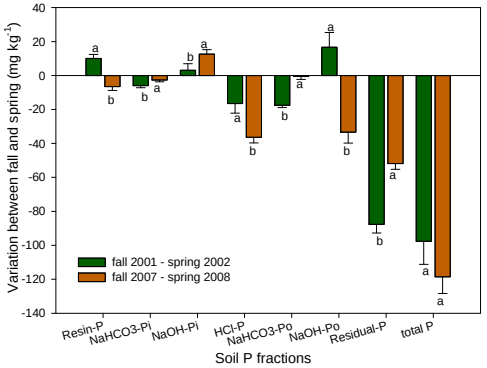

Fig.1 Soil P fraction changes between fall and spring in period 1 (fall 2001 - spring 2002) and period 2 (fall 2007 - spring 2008). Means followed by different letters between the two periods for each fraction are significantly different at $P < 0.05$.

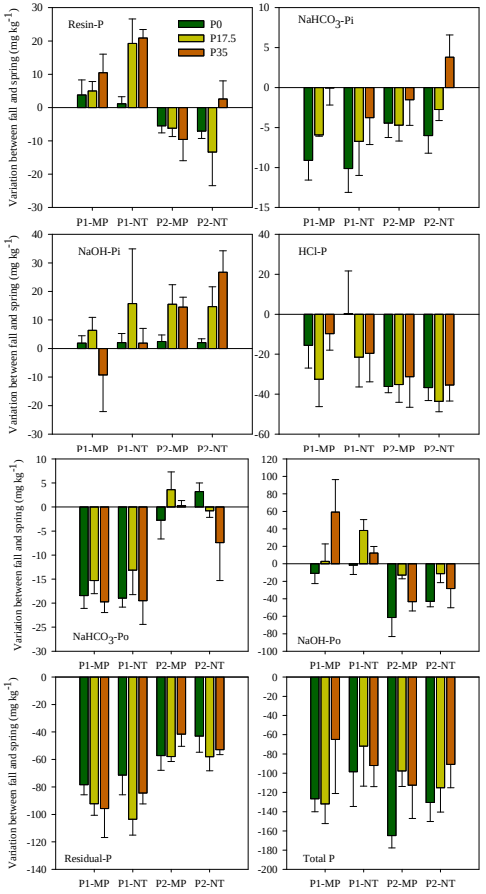

Fig.2 Variation of soil P fractions between fall and spring in period 1(P1, fall 2001-spring 2002), and period 2 (P2, fall 2007-spring 2008) under different tillage and P fertilization.

Conclusion

We conclude that NT combined with P fertilization might affect soil P transformation over winter, and that these effects were largely influenced by environmental conditions.

References

Shi et al.2013. Soil Sci. Soc. Am. J. 77:1402–1412.

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