Nitrate and Phosphate Desorbed from Anionic Exchange Membranes Over Winter as Affected by Tillage and Fertilization

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Introduction

- Projected global warming may result in large variations in climatic conditions including soil temperatures and the number of soil freezing and thawing cycles during winter in cool temperate and high-latitude regions.
- Determining how agricultural management practices affect changes of soil N and P over winter could further our understanding of soil N and P cycle.
- Anionic exchange membranes (AEMs) have been successfully used to estimate the availability of soil N and P in farming systems (Ziadi et al. 1999; 2001).

Objective

- To assess the effects of tillage systems, mineral N and P fertilization on NO_3^- and PO_4^- accumulation on AEMs (AEM-N and AEM-P, respectively) over winter.

Materials and Methods

Site description

- The study was conducted in a long-term corn-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 plough (MP) and no till (NT) and 9 fertilization applications including 3 N rates (0, 80 and 160 kg N ha^{-1}) (N0, N80, N160) and 3 P rates (0, 17.5 and 35 kg P ha^{-1}) (P0, P17.5, P35) were used in a split plot with 4 replications.
- Fertilizer were applied only in corn phase.

The AEMs set-up and measurements

- 288 AEMs were prepared as described by Ziadi et al. (1999) and buried in the surface layer (0–15 cm) in all plots after harvest (mid. Nov.) for four consecutive years (2009-2012).
- The AEMs were collected in the following spring (mid. April) and treated as described by Ziadi et al. (1999).
- AEM-N and AEM-P concentrations were determined based on Ziadi et al. (1999, 2001).

Results and discussion

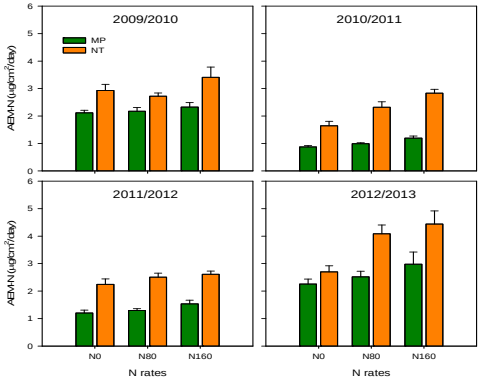

Figure 1. Effects of tillage and N fertilization on AEM-N accumulated over winters of 2009/2010, 2010/2011, 2011/2012, and 2012/2013.

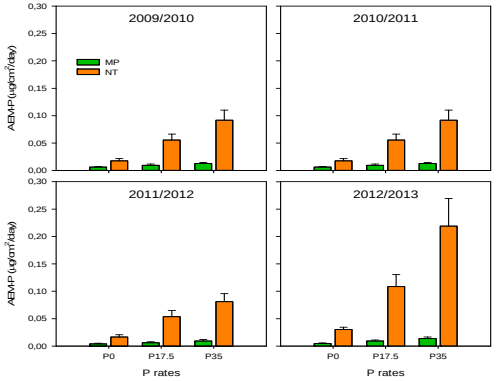

Figure 2. Effects of tillage and P fertilization on AEM-P accumulated over winters of 2009/2010, 2010/2011, 2011/2012 and 2012/2013.

Effect of tillage

- AEM-N and AEM-P were significantly greater under NT than MP across all fertilization treatments and years (Figs. 1 and 2), as previously reported in Messiga et al. (2012).

Effect of N fertilizaiton

- AEM-N was significantly increased with the increasing N application in three winters, except in 2009/2010 (Fig. 1).
- The interaction of N fertilization and tillage was also observed on AEM-P in winters of 2010/2011 and 2011/2012 (Fig. 3). The AEM-P was greater without than with N applied only under NT but not under MP.

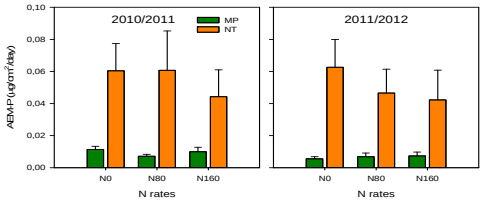

Figure 3. Effects of tillage and N fertilization on AEM-P accumulated over winters of 2010/2011 and 2011/2012.

Effect of P fertilizaiton

- P fertilization had no effect on AEM-N, but affected AEM-P in all four winters (Fig. 2). The AEM-P increased by increasing P application, as reported in Shi et al. (2013) for resin-P.

Variations among years

- AEM-N was greatest in winter of 2012/2013, and lowest in winters of 2010/2011 and 2011/2012, maybe due to the variation of environmental conditions (Fig. 4).
- AEM-P was greater in winters of 2010/2011 and 2012/2013 than in other two winters, maybe due to the addition of fertilization in the former growing season (Fig. 4).

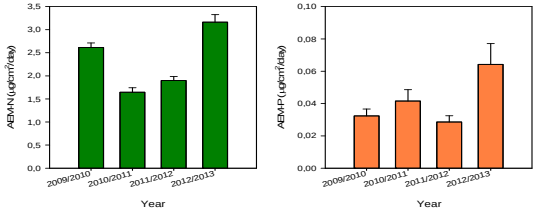

Figure 4. Variation of AEM-N and AEM-P accumulated over winter among years.

Conclusion

We conclude that tillage and fertilization affect soil N and P availability over winters, and that these effects were more evident under NT combined with fertilization.

References

***Messiga et al.* 2012**. Field Crop. Res. 133:10–22. ***Shi et al.* 2013**. Soil Sci. Soc. Am. J. 77:1402–1412. ***Ziadi et al.* 1999**. Can. J. Soil Sci. 79: 281–294. ***Ziadi et al.* 2001**. Can. J. Soil Sci. 82: 167–174.

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