IMPACT OF TILLAGE AND CROP RESIDUES RESTITUTION ON PHOSPHORUS DISTRIBUTION WITHIN TOPSOIL IN LOAMY SOILS OF WALLONIA (BELGIUM)

Barbieux S.[1] (*sophie.barbieux@ulg.ac.be*), Bodson B.[1], Renneson M.[1], Cobert F.[1], Colinet G.[1]

[1] Université de Liège, Gembloux Agro-Bio Tech. Unité Systèmes Sol-Eau, 2 passage des déportés. B-5030 Gembloux (Belgium)

World reserves of mineral phosphorus (P) are limited and non-renewable at human scale. The disappearance of phosphate rock of high quality is expected in the coming decades (Cordell et al., 2009). Recently Renneson et al. (2013) showed that the reserves of total phosphorus in soils of Wallonia (Ptot) were high (904 mg P/kg on average in the topsoil). However only a small part of Ptot is available for plant nutrition (9% of Ptot - 71.6 mg P/kg) due to a high soil P sorption capacity (Renneson et al., 2013). There is an imperative need to re-mobilize phosphorus already present in soil without further increasing P inputs. To achieve this, a better exploration and an improved use of soil resources in agroecosystems are required (Cassman, 1999). In that context, this research studied the influence of tillage and crop residues restitution on P distribution within topsoil.

The experiment has taken place since autumn 2008 in Gembloux (Wallonia) where soils are representative of the most widespread cultivated soils of Belgium (WRB: Luvisol). Field is divided into 16 plots distributed over 4 modalities: Tillage (ploughing within 25 cm depth) without residues restitution (T OUT); Tillage with residues incorporation (T IN); No-tillage without residues (NT OUT); and No-tillage with residues (NT IN). No P fertilizers were added since 2008. Samples were taken from all plots at 30 cm depth with a tubular auger twice a year (autumn and spring) since autumn 2011. Samples were divided into three parts: 0-10, 10-20 and 20-30 cm. They were sieved at 8mm for water-soluble extractions, then dried and sieved at 2mm for other analyses. Phosphorus, calcium and magnesium contents were obtained using water extraction (P_w, Ca_w and Mg_w) and ammonium acetate-EDTA extraction (P_{NH4}, Ca_{NH4}, Mg_{NH4}).

The results show that tillage treatments mainly influence the spatial distribution of P_w within soil profile. Under NT practices, a higher Pw content occurred at the soil surface and decreased with depth while it was quite homogenous under till soil. Ca_w and Mg_w presented higher contents in soil surface regardless tillage treatments. Pw content was significantly higher under NT IN than NT OUT from spring 2013 proving an effect of crop residues restitution. Actually the crop residues left on field decomposed and constitute a source of P (Ulén, 1997). However no significant increase under T IN could be observed compared to T OUT. Results also revealed a negative correlation between P_{NH4} and Ca_{NH4} as well as between P_w and Mg_w. The latter information coincides with observations of Genot et al. (2012). They showed that the Mg content in Walloon soils was increasing and suspected

risks of P immobilization. Further researches are planned about the effect of Mg fertilization on soil P dynamics.

References

Cassman, K.G. (1999). Ecological intensification of cereal production systems: Yield potential, soil quality, and precision agriculture. Proc. Natl. Acad. Sci. *96*, 5952–5959.

Cordell, D., Drangert, J.-O., and White, S. (2009). The story of phosphorus: Global food security and food for thought. Glob. Environ. Change *19*, 292–305.

Genot, V., Renneson, M., Colinet, G., Goffaux, M.J., Cugnon, T., Toussaint, B., Buffet, D., and Oger, R. (2012). Base de données sols de REQUASUD.

Murphy, J., and Riley, J.P. (1962). A modified single solution method for the determination of phosphate in natural waters. Anal. Chim. Acta *27*, 31–36.

Renneson, M., Dufey, J., Legrain, X., Genot, V., Bock, L., and Colinet, G. (2013). Relationships between the P status of surface and deep horizons of agricultural soils under various cropping systems and for different soil types: a case study in Belgium. Soil Use Manag. *29*, 103–113.

Ulén, B. (1997). Nutrient losses by surface run-off from soils with winter cover crops and spring-ploughed soils in the south of Sweden. Soil Tillage Res. *44*, 165–177.