

Contrasted response of colloidal, organic and inorganic dissolved phosphorus forms during rewetting of dried riparian soils

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Riparian vegetated buffer strip (RVBS) are currently used to protect surface waters from phosphorus (P) emissions because of their ability to retain P-enriched soil particles. However, this protection role may be counterbalanced by the development in these zones of conditions able to trigger the release of highly mobile dissolved or colloidal P forms. Rewetting after drying is one of these conditions. So far, the potential sources of P mobilized during rewetting after drying are not clearly identified, nor are clearly identified the chemical nature of the released dissolved P species, or the role of the soil P speciation on these forms. In this study, two riparian soils (G and K) showing contrasting soil P speciation (65% of inorganic P species in soil G, as against 70% of organic P) were submitted to three successive dry/wet cycles in the laboratory. Conventional colorimetric determination of P concentrations combined with ultrafiltration, and measurements of iron (Fe) and aluminum (Al) and dissolved organic carbon (DOC) contents using ICP-MS and TOC analyzers, respectively, were used to study the response of the different P forms to rewetting after drying and also their release kinetics during soil leaching.

For both soils, marked P release peaks were observed at the beginning of each wet cycles, with the organic-rich K soils giving, however, larger peaks than the inorganic one (G soil). For both soils also, concentrations in molybdate reactive P (MRP) remained quite constant throughout each leaching episode, contrary to the molybdate unreactive P (MUP) concentrations which were high immediately after rewetting and then decreased rapidly during leaching. A speciation change was observed from the beginning to the end of all leaching cycles. Colloidal P was found to be a major fraction of the total P immediately after rewetting (up to 50-70%) and then decreased to the end of each wet cycle where most of the eluted P was true dissolved inorganic P. Colloidal-P exhaustion was tightly associated with DOC, Fe and Al exhaustions. Colloids were larger in size at the beginning than at the end of all cycles. Peak at the beginning of each wet cycles remained quite constant even after two drying/leaching cycles, evidencing the existence of mechanisms able to rebuild a pool of leachable P during drying process.

Thus, there was clearly a control of soil characteristics on the released P forms in leachates. Colloidal P carriers appeared to consist of Fe and/or Al oxyhydroxide nano/microparticles associated with organic matter. Most importantly, a survey of colloidal size distribution during leaching indicated that the rapidly exhausted MUP pool consisted of larger size MUP and colloidal P phases, which probably originated from soil macropores, while the relatively infinite MRP pool consisted of smaller size colloidal P and true dissolved MRP phases, which was mobilized from soil micropores. These results further demonstrate the ability of rewetting after drying to lead to pulses of dissolved and colloidal P in riparian soils, thereby evidencing the risks that P-enriched soil particles accumulated in RVBS could constitute a long-term threat for surface water.