Mobilization of slurry injected phosphorus during sequential irrigation and drainage cycles compared to continuous irrigation

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Many studies show significant dynamics of phosphorus in soils connected to initiation of infiltration; large concentrations in phosphorus leaching directly after precipitation. We hypothesize that sequential irrigation and drainage cycles activates a larger volume of the soil pores and therefore can lead to a higher leaching of injected phosphorus compared to a situation of continuous irrigation. In this study, we examine the impact of sequential precipitation and drainage compared to continuous precipitation on phosphorus mobilization from slurry injected intact soil cores (20*20 cm) of a loam soil. Three experiments were conducted i) continuous irrigation (2 mm h^{-1}) at -5 hPa for 4.5 days; ii) cycles of irrigation of 2 mm h^{-1} for 5 hours (-5 hPa) followed by drainage for 5 hours at -20 hPa; iii) cycles of irrigation of 10 mm h^{-1} for 1 hour (-5hPa) followed by drainage for 5 hours at -20 hPa. The experiments were carried out so equal amounts of water was applied in each experiment.

Tritium and brilliant blue tracers revealed a more pronounced preferential flow behavior at high intensity (10 mm h^{-1}) compared to both continuous and transient flow at 2 mm h^{-1}.

Higher values of electric conductivity was observed with sequential irrigation at both 2 mm h^{-1} and 10 mm h^{-1} compared to continuous irrigation, reflecting activation of a larger volume of the soil pores by the drainage/and rewetting cycles. This was followed by leaching peaks of phosphorus at initiation of irrigation, whereas leaching of phosphorus decreased during drainage. During the experiment at 10 mm h^{-1} phosphorus leached at higher concentrations compared to the 2 mm h^{-1} leaching experiments during the irrigation events, however dropped to the same low values as the 2 mm h^{-1} experiments during drainage. Accumulated phosphorus leaching did then result in higher accumulated values in the sequential precipitation at 10 mm h^{-1} whereas accumulated phosphorus values did not differ among the sequential and continuous experiments at 2 mm h^{-1}.

These results imply as previous studies have shown that irrigation intensity is a major factor influencing leaching of phosphorus. Furthermore, the results suggest that at near-saturated conditions and under low precipitation, accumulated values of phosphorus are leached in similar values whether irrigated under sequential and continuous conditions despite activation of a larger volume of the soil pores by the drainage/ and rewetting cycles.