Nutrient removal in different overlying water layers and their variation in pore water of drainage ditches in Sanjiang Plain, Northeast China

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**ABSTRACT**

Agricultural drainage ditches which deliver excess water from poorly drained farmlands to ensure consistent agricultural production but also transport field pollutants, especially nitrogen (N) and phosphorus (P). Ditch management has been proposed to alleviate nutrient loads that are transported to receiving water. Experimental drainage ditches with *Phragmites australis* were used to examine the N and P mitigation capacity of drainage ditches at different plant growth stages and different initial concentrations as well as the mitigation capacity in different water layers by the intermittent strategy. This study also investigated nutrient variations in sediment pore water of drainage ditches under existing ditch management systems. Significant reductions were observed on the efficiencies of nitrate nitrogen (NO\textsubscript{3}–N) and phosphate phosphorus (PO\textsubscript{4}–P) with plant growth. The efficiencies of ammonia nitrogen (NH\textsubscript{4}–N) remained the same at different growth stages. The rates of NH\textsubscript{4}–N, NO\textsubscript{3}–N and PO\textsubscript{4}–P were higher under high initial concentrations. However, the efficiencies of these substances were higher under low initial concentrations. The values of the NH\textsubscript{4}–N, NO\textsubscript{3}–N, and PO\textsubscript{4}–P efficiencies were 71.7–87.0%, 40.6–51.0%, and 52.8–78.3% in high water layers and 71.9–87.6%, 38.4–48.4%, and 52.6–77.2% in low water layers, respectively. Water quality stratification on NH\textsubscript{4}–N and NO\textsubscript{3}–N under high initial concentrations indicates that ditch plants, sediments, and soils are able to enhance nutrient mitigation. Low NH\textsubscript{4}–N and PO\textsubscript{4}–P concentrations in pore water show that ditch sediment adsorption plays a vital role in mitigating nutrients.

**Keywords:** Drainage ditch; Nitrogen; Phosphorus; Plant; Retention time; Water layer

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