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Groundwater dynamics in wetland soils control the production and transfer mechanisms of dissolved reactive phosphorus in an agricultural landscape

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Because of its high sorption affinity on soils solid phase, mitigation options to reduce diffuse P transfer usually focus on trapping particulate P forms delivered via surface flowpaths. Therefore, vegetated buffer zones placed between croplands and watercourses have been promoted worldwide, sometimes in wetland areas. To investigate the risk of such P trapping riparian wetlands (RWs) releasing dissolved P to rivers, we monitored molybdate reactive P (MRP) in the free soil solution of two RWs in an intensively farmed catchment. Two main mechanisms causing MRP release were identified in light of the geochemical and hydrological conditions in the RWs, controlled by groundwater dynamics. First, soil rewetting after the dry summer was associated with the presence of a pool of mobile P, limited in size. Its mobilization started under conditions of water saturation caused by groundwater uprise in RW organo-mineral soil horizons. Second, the establishment of anoxic conditions in the end of the winter caused reductive solubilization of Fe oxide-hydroxide, along with release of P. Comparison between sites revealed that the first MRP release occurred only in a RW with P enriched soils, whereas the second was recorded even in a RW with a low soil P status. Seasonal variations in MRP concentrations in the stream were synchronized with those in RW soils. Hence, enriched and/or periodically anoxic RWs can act as a key component of the P transfer continuum in agricultural landscapes by converting particulate P from croplands into MRP released to rivers.