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淹水土壤土-水界面磷素迁移转化研究

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中文摘要

通过室内PVC土槽实验,模拟了淹水条件下土壤上覆淹水和孔隙水中磷的释放及其影响因素Eh值、pH值、Fe²⁺、Fe³⁺和溶解有机质(DOC),以及土壤中无机磷组分的转化,并通过偏最小二乘主成分分析法分析影响磷迁移转化的因素,得到主要影响因子.实验结果表明,54 d淹水期间,上覆淹水可溶性磷浓度大于孔隙水的磷浓度,前者累积释磷量是后者的16倍;土壤磷的释放主要以Fe-P、O-P和Al-P为主,Ca-P基本不变,其中以Fe-P的贡献最大,淹水期间比初始值减少了30.4%~72%;主成分分析表明,Eh值、Fe²⁺、Fe³⁺和DOC是影响上覆淹水磷释放的主要因子,DOC络合Fe²⁺和Fe³⁺成水溶性三元复合体,释磷机制以络合增溶为主;DOC是影响土壤孔隙水磷释放主要因子,释磷机制以竞争吸附为主,高浓度铁离子的存在阻止了孔隙水中磷释放.

英文摘要

Mobilization and transformation of phosphorus from water-soil interface of flooded agricultural soils is a concern, and it has been a leading cause of eutrophication of lakes and rivers. Using PVC soil trough, we modeled the mobilization and transformation of P, ferrous iron, ferric iron, dissolved organic carbon(DOC) between soil floodwater and porewater induced by flooding, and characterized the main factors that contributed to phosphorus release by using the principal component-partial least squares method. This study shows that flooding soils induced significant release of phosphate to the floodwater over a 54-d period. Cumulative phosphate content in floodwater was 16 times as much as in porewater. The changes that occurred among the inorganic P forms during flooding were also investigated. Significant changes in the inorganic P fractions Fe-P, Al-P, Ca-P, and O-P occurred in soil during flooding. Typically, the Ca-P fraction was almost unchanged during flooding. The others decreased, and Fe-P contents during flooding decreased by 30.4%-72% of its initial value, which significantly contributed to the release of phosphate to floodwater and porewater. The major factors that affected the floodwater phosphate release were Eh, ferrous iron, ferric iron, and dissolved organic carbon (DOC). The factor that affected the porewater phosphate release was DOC. The predominant mechanism of DOC induced floodwater P release was ligand-enhanced dissolution, and that induced porewater P release was competitive sorption. Furthermore, ferric iron in porewater affected the porewater P release.

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