# PHOSPHORUS DYNAMICS IN ACIDIC SOILS THAT UNDERGO FLOODING AND DRYING

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## ABSTRACT

Phosphorus dynamics in acidic soils subjected to flooding and drying are discussed in relation to P availability to rice and to upland crops grown after rice. During flooding, soil reduction processes lead to increases in the concentration of soil solution P and labile P, which increase P availability to rice. The reductive dissolution of Fe(III) hydrous oxides is responsible for increases in the availability of native P and P that has been added in previous cropping seasons. The rise in the pH of acidic soils during flooding predominantly affects P adsorbed on clay and oxide surfaces and may also increase the solubility of aluminium phosphates. Factors which affect the rate of soil reduction, particularly the organic matter content, also affect the rate and quantity of P released during flooding. P released to the soil solution during flooding is subjected to re-adsorption by clay, aluminium oxides, Fe(III) oxides that have not been reductively dissolved, and mixed Fe(II)-Fe(III) hydroxy compounds that form after the pH has risen. Adsorption of P usually controls the soil solution P concentration below that required for vivianite ($Fe_2(PO_4)_3 8H_2O$) precipitation. Organic matter mineralization is also a direct source of available P during flooding, and organic acids produced during reduction causes increases in P mobility in reduced soils. In general, acidic soils with relatively high levels of free Fe(III) and(e.g. Inceptisols) show large increases in P availability during flooding and P fertilization for rice may not be required. However, many soils, particularly Vertisols, do not show significant increases in P availability during flooding, and sandy soils have insufficient P buffering capacity to maintain P availability, and P fertilization for rice is required for such soils.

Soil solution and labile P are co-precipitated with Fe(III) hydrous oxide (ferrihydrite) when soils oxidize during drying below saturation. P availability decreases markedly during oxidation and causes P deficiency in upland crops grown after rice. In addition, ferrihydrite formed during oxidation has a large capacity to adsorb P. P added freshly oxidized soils is less available to upland crops than that added to similar soils that has not been recently flooded and drained.