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Phosphorus Adsorption Saturation of Synthetic Iron Oxides in Relation to Phosphorus Availability for Paddy Rice

YONGSONG ZHANG¹, XINGHUA SHAO², XIANYONG LIN²

¹*Zhejiang University, Institute of Agrochemistry, China*

²*Zhejiang University, College of Natural Resources and Environmental Science, China*

Abstract

The characteristics of phosphorus (P) sorption/desorption of artificially synthesized iron oxides (ferrihydrate, goethite and hematite) and the relationship between P adsorption saturation of ferrihydrate and P uptake by rice were studied. The results obtained from experiments showed that P adsorption properties of three synthetic iron oxides could be described by the Langmuir equation with a correlation coefficient >0.9 at 1% significant level. It was found by comparing Q_m (maximum quantity of adsorption), K (adsorption constant) and MBC (maximum buffering capacity) of three synthetic iron oxides that ferrihydrate (amorphous) was much larger than crystalline iron oxides (goethite and hematite) in both intensity and capacity of P adsorption. Phosphorus adsorbed by ferrihydrate was much more difficult to be desorbed than that absorbed by goethite and hematite. It could be found from P desorption curves that the corresponding quantities of P adsorbed by ferrihydrate, goethite and hematite for desorbed P reaching to 0.1 mg g^{-1} were 28, 2.5 and 1.4 mg g^{-1} , respectively. However, when P desorption curves were changed to plot saturation of P adsorption (adsorbed P/ $Q_m \cdot 100$) with P desorbed it was found that the corresponding saturation of P adsorption of three kinds of iron oxides for desorbed P reaching to 0.1 mg g^{-1} was all about 70%. This suggested that P adsorption saturation may be used as an integrative index for estimating the intensity and capacity of P adsorption-desorption in soils or iron oxides. A bioassay using rice indicated that P uptake by rice was significantly correlated to the saturation of P adsorbed by ferrihydrate and 50% of P adsorption saturation could be used as a critical index for diagnosing status of P supplied by ferrihydrate-bonded P at the tillering stage of rice.

Keywords: Adsorption saturation, adsorption-desorption, iron oxides, P uptake, phosphorus