Effects of water management on vivianite crystallization on paddy rice roots

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green method.

Phytic acids concentrations in some organic manures were determined. Proportions of phitic acid (phytase labile phosphorus) in total phosphate were 5 % in a poultry manure from egg farm, 46 % in a poultry manure from a broiler house, 10 % in a green manure made by above-ground part of buck-wheat and 55 % in a rice bran. Most of the organic phosphate in seeds; soybean and buck-wheat, was phytase labile.

References

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【Introduction】 The availability of phosphate (P) for paddy rice plants is higher than that for upland plants because of enhanced P solubility under reducing conditions. In recent years, vivianite aggregates, ferrous phosphate crystals, have been identified on thin roots of paddy rice (Nanzyo et al.,2010). Recognition of vivianite will improve understanding P dynamics under reducing condition like paddy fields. In this article, we describe (i) effects of water management on vivianite crystallization and (ii) a quantitative method to estimate the content of vivianite.

【Materials & methods】 (i) Rice plants (Oryza sativa, L.) were grown in three small paddy field plots (1m×1m). Water management for each was (1) intermittent irrigation after mid-summer drainage, (2) continuous flooding during cultivation, and (3) re-flooding after mid-summer drainage. Rice roots were separated from soil blocks by washing with fresh water, and air-dried. After drying, we observed vivianite attached to roots by optical microscope and scanning electron microscope (SEM)-energy dispersive X-ray analysis (EDX).

(ii) After rapid oxidation with heating, vivianite dissolves little in dilute hydrochloric acid. The difference in P solubility between before and after heating at 105˚C was used for estimation of the quantity of vivianite aggregate.

【Results & Discussion】 The longer the term of flooding, the more vivianite aggregates are observed by optical microscope. The aggregates crystallized mainly on the thin roots, and were identified to be vivianite by EDX. The crystal aggregates appeared like laminae from the root surface to bulk soils by SEM, and they suggests mobilization of P in soil. On the other hand, the amount of the crystal aggregates reduced after drainage under oxidizing conditions. These observations suggest the changes in redox status by water management affect crystallization and dissolution of vivianite.

Synthetic vivianite dissolve little after heating at 105˚C for 48h. The decrement of P in the root extractant after heating showed a correlation with the abundance of vivianite found by optical microscope observation.