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Effect of Soil Water Conditions and Ph on Micronutrient Uptake by Aerobic Rice

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Abstract

Lowland rice consumes about four times more water than other cereal crops. With emerging water scarcity in many part of the world, the traditional way of lowland rice cultivation can no longer be sustained. New water-saving rice production systems urgently need to be developed. Among different water saving strategies, "aerobic rice" is considered a promising cultivation system for water scarce areas. In the aerobic system, rice is grown with no standing floodwater during the entire growing cycle. The absence of floodwater leads to an elevated soil redox potential and the offsetting of the carbonate buffer system that regulates the pH in flooded soils. Manganese and iron are oxidised and their plant availability is lowered. In the absence of the carbonate buffer, the pH of originally alkaline aerobic soils will increase and further affect the availability of Zn, Mn, and Fe. Such pH increases can also be mediated by nitrification in aerobic soils and the enhanced take up of NO_3 instead of NH_4^+, which also causes the rhizosphere pH to increase, concomitantly lowering micronutrient availability. Consequently, micronutrient disorders are seen to be one of the key limiting factors for the production of aerobic rice. This calls for new strategies in managing micronutrients under aerobic rice production system. We evaluate the effect of soil aeration status (Eh) and pH on the availability and uptake of micronutrient (Zn, Mn, Fe) by rice. A greenhouse study comparatively evaluates 5 genotypes (Apo and two aerobic lines from IRRI, and IR72 and CK73 as reference cultivars) at two levels of soil aeration status (aerobic and flooded) and at acidic, neutral and alkaline soil pH conditions. Symptom occurrence, biomass accumulation, and the uptake and partitioning of Mn, Fe and Zn are monitored at different growth stages. This work is seen as a first step towards identifying rice genotypes for aerobic cultivation systems. Such genotypes will subsequently be used to determine adaptation mechanisms to aerobic soil conditions (micronutrient efficiency, rhizospheric pH adjustment, root architecture) and to test soil-specific management interventions.

Keywords: Iron, aerobic rice, manganese, *Oryza sativa*, pH, redox potential, zinc

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