Differential Uptakes of Fe and Zn by Hydroponically Grown Rice

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Heavy metal accumulation in rice has become a main public concern in Asia. Prior studies showed that the redox cycling of iron in paddy soils strongly affects the uptake of heavy metals by rice. It is not clear whether such effects are largely due to mass transfer processes within the external soil environment or due to physiological translocation processes within the plant. The objective of this study was to examine synergetic versus antagonistic effects of iron on translocation of heavy metals by rice. We grew rice hydroponically to minimize the external effects of soil biogeochemical processes. Nutrient solutions used for growing rice contained variable concentrations of zinc whereas the iron concentration was kept constant. Root, stem, leaf, husk and grain in different growth stages were divided after the whole plant samples were collected. Chemical analysis results showed different correlations between iron and zinc uptake by rice. With the increase of zinc concentration in nutrient solution, the zinc concentration also increases in all parts of plant. In tillering stage (the first growth stage), the iron concentrations in root increased as the aqueous zinc concentrations increased from 1 to 500 μM, whereas the iron contents in stem and leaf decreased as the solution-phase zinc concentration increased. In maturity stage (the last growth stage), the changes in aqueous zinc concentrations resulted in a different trends on iron accumulation. When the aqueous zinc concentrations increased from blank to 10 μM, the iron concentrations in different parts of the plant all increased. The iron concentrations decreased when the aqueous zinc concentrations were equal to or greater than 100 μM. The results suggested that in different growth stages, rice plant may have different mechanisms for translocation of iron and such mechanisms may be influenced in the presence of zinc. We are currently conducting experiments to quantify how aqueous iron concentrations affect uptake of zinc and cadmium by rice. The study could provide a dataset on differential uptake of metals by rice at varying background concentrations of heavy metals.