Field Scale Relationships between Soil Chemistry and Arsenic Abundance and Speciation in Rice

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Rice is an important dietary pathway of arsenic (As) exposure for humans. Most studies of As in rice are based on market surveys [1] and are unable to link patterns in the abundance and speciation of As in rice to the geochemical characteristics of the paddy soils in which the rice was grown. Here we present results from a field survey of As in rice from the Mekong Delta of Vietnam in which rice grains and paddy soils were sampled along a 60 km stretch of the Bassac River. The objective was to link patterns in rice grain As to soil chemical variables and As concentrations in groundwater.

Total As concentrations in dehusked rice ranged from 63 to 527 µg As/kg rice (mean: 249 µg/kg), and the methylated fraction varied from 0 to 48% (mean: 33%). Arsenic concentrations in soil and in nearby groundwater did not predict rice grain As concentrations. Significant inverse correlations were observed between soil phosphorus (P) and both inorganic and organic As. The relationship with inorganic As is consistent with competitive inhibition of arsenate uptake by phosphate [2]. A significant inverse relationship was also observed between rice grain sulfur (S) content and inorganic As, but not methylated As. This observation may be due to the effect of phytochelatins, cysteine-rich peptides that complex inorganic As and prevent its translocation to rice grains via vacuolar sequestration, and whose synthesis is up-regulated by greater S nutrition [3]. These observations provide evidence that interactions between As, P, and S inferred from controlled laboratory studies may exert controls on As uptake and grain accumulation at field scale.

[1] Williams et al. **2005**, *Environ. Sci. Technol.* 39, 5531-5540.

[2] Abedin et al. **2002**, *Plant Physiology* 128, 1120-1128

[3] Zhang et al. **2016**, *Plant Mol Biol Rep* 34, 556-565