Comment on "Growing Rice Aerobically Markedly Decreases Arsenic Accumulation"

In a detailed study conducted with potted plants in a greenhouse, Xu et al. (*1*) recently showed that reducing conditions in soil water maintained by flooding are a significant factor contributing to the uptake of As by rice plants. This is an important issue relevant to human health because a portion of the As taken up by the rice plant is transferred to the rice grain and eventually eaten. We do not dispute the main finding that aerobic cultivation, by reducing the release of As to soil water, can lower the uptake of As by the plant and the incorporation of As in the rice grain. We are compelled to point out, however, that the scale of transfer of As from soil to soil water as well as the transfer from soil water to rice grains observed during this greenhouse study with a nonrice soil differ significantly from observations conducted in cultivated rice paddies in Bangladesh. Such discrepancies warrant further study and suggest that more emphasis should be placed on controlled field studies in current efforts to reduce the uptake of As by rice.

The soil used by Xu et al. (*1*) contained 15 mg/kg As and a subset of the pots were amended with an additional 10 mg/kg As. These levels are somewhat higher than typical background levels <10 mg/kg, as noted by the authors, but representative of moderate levels of contamination of paddies irrigated with groundwater containing As. It is, therefore, striking to note that soil water As concentrations in the potted plants never exceeded 50 μg/L, even under continuous flooding of amended soils and in the presence of high dissolved Fe. Two studies of As in soil water of paddy fields of Bangladesh, one of which appeared before the Xu et al. study, have documented As concentrations in soil water ranging from 100 to 1000 μg/L for soils containing 10−30 mg/kg As, and even higher for more contaminated soils (*2, 3*). Soil water As concentrations have previously been shown not to exceed 50 μg/L only for uncontaminated paddies (*2, 4*).

For reasons that are presently unclear, the roots of potted plants grown in a greenhouse were exposed to much lower As levels in soil water than in cultivated fields. It is, therefore, all the more surprising that the (unpolished) rice grains analyzed contained no less than 1 mg/kg As for plants grown in unamended soil under flooded conditions. Such high levels are only occasionally observed (*5*−*8*) and are at least 2-fold higher than found for rice grains grown in Bangladesh on soil containing up to 70 mg/kg (*2, 3*). Whereas greenhouse conditions underestimate the amount of As released to soil water, for reasons that are presently unclear, they also seem to vastly over-represent the transfer of As from soil water to the rice grain relative to what has been observed in actual rice paddies.

Greenhouse studies undoubtedly provide valuable insights, but the significant discrepancies pointed out in this comment suggest that the detailed As speciation data reported for soil water and rice grains by Xu et al. (*1*) should also be interpreted with caution. It is certainly premature to draw conclusions concerning genetic vs environmental controls on As speciation in rice grains (*1, 9*); there may be an arsenic threshold that triggers methylation that is not reached in aerobic soils. Finally, it is worth remembering that as long as people continue to drink groundwater >100 μg/L As, which millions continue to do throughout southern Asia (*10*), this direct path of exposure is more important than eating rice, even in large quantities, grown on fields irrigated with groundwater elevated in As.

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