

Spatial Variation of Arsenic in the Irrigation Water-soil-rice Plant System in Sonargaon, Bangladesh

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INTRODUCTION

Arsenic contamination of groundwater in Bangladesh occurs predominantly in shallow aquifers. Apart from domestic use, significant quantities of water from shallow aquifers are being used in the dry season especially for irrigating Boro rice which contributes significantly to the country's food grain production. Long-term use of As contaminated irrigation water from shallow tubewells (STW) may result in elevated As concentration in soils and plants and also may lead to yield loss. The As concentration in irrigation waters, soils and plants may vary between the STW areas and also between sites within a STW command area.

METHODS

The study was conducted during dry season (Boro rice, January–May) of 2003 to examine the spatial variation of arsenic (As) in a single STW command area of 4.85 ha of irrigated rice land in Sonargaon. The experimental site is a medium low land characterized by 90-180 cm seasonal flood depth. Boro rice has been cultivated with STW irrigation water having 200 ppb As for the last 12 years. Changes in STW water As concentrations were monitored across the dry months (February to May 2003). Spatial variation of As along the irrigation channel was monitored at 15-meter intervals. Arsenic concentrations in 144 each of geo-referenced soil, rice grain and straw samples were studied. Further, the As contents in soils at various depths (0-15, 15-30, 30-45 & 45-60 cm) at 15 sites within the STW command area have been measured.

RESULTS AND DISCUSSION

Arsenic concentration in STW water over the 4-month period remained almost unchanged. This element concentration in the STW waters along the irrigation channel decreased with increase in distance from the STW site. Both Fe and As contents in the irrigation channel water that settled for 12 hours decreased considerably. Arsenic concentrations in soil, rice grain, straw and husk varied widely between fields within the command area (Fig. 1). Soil As content ranged from 4.31-22.71 ppm with a mean of 9.12 ppm, rice grain As 0.156-0.685 ppm having mean value of 0.316 ppm and the rice husk As was in the range of 0.25 to 1.41 ppm with 0.652 ppm as the mean. Further, As concentrations in grain and husk did not vary with rice varieties. Arsenic concentration in rice straw was about 10 times that in rice grain. From soil depth-wise As analysis, it appeared that As content decreased as soil depth increased indicating a tendency of As built-up in soil due to STW irrigation. The As contents of soil in 3m each side of the irrigation channel and also near the STW were much higher compared to all other sites of the study area, and at some places flowering did not take place.

Available As (ammonium oxalate extractable) content in soil was positively correlated with total As content, however, there was no significant correlation between available soil As and soil pH or organic matter content. Ammonium oxalate extractable As was correlated

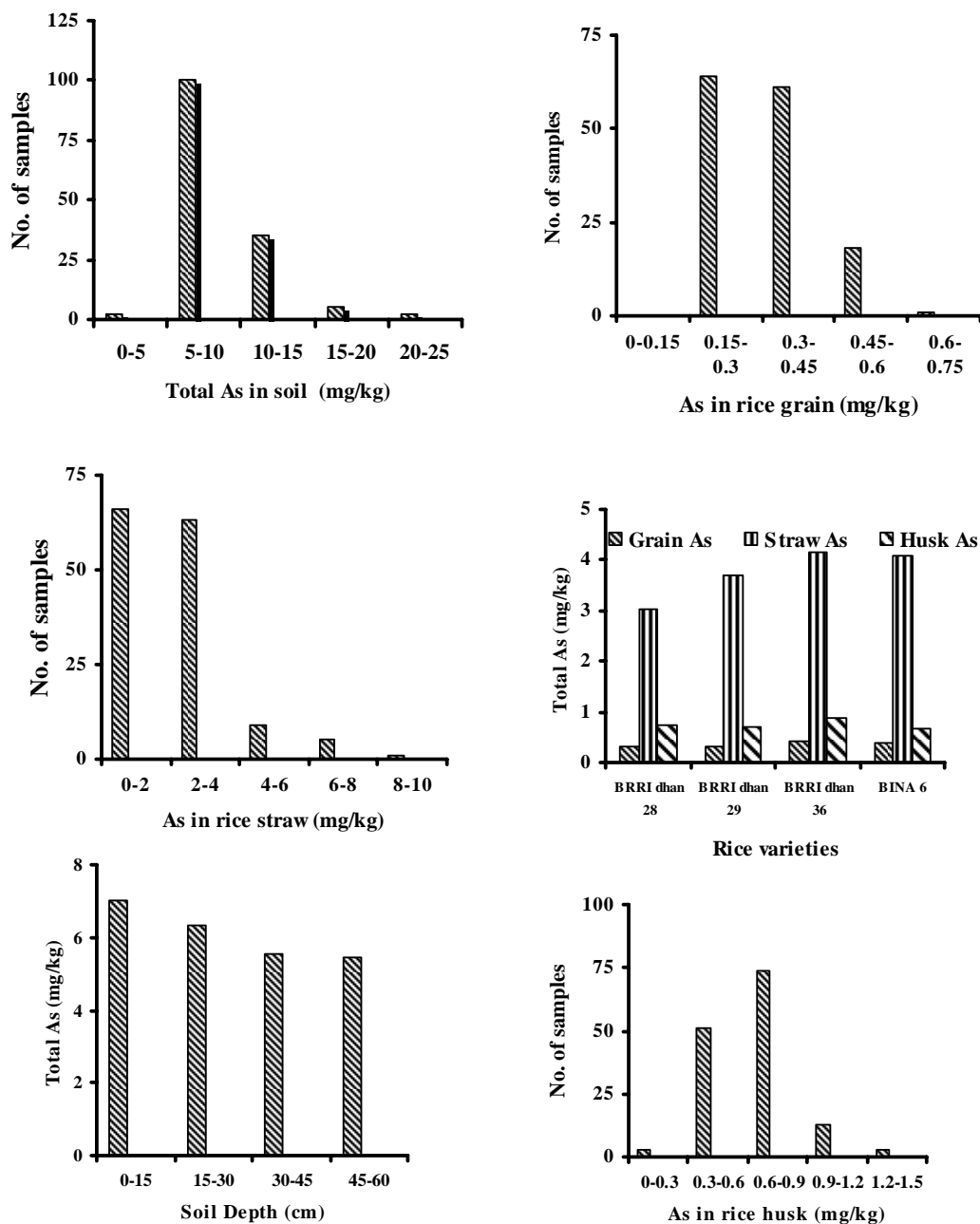


Fig. 1 Arsenic concentrations in soils, rice grain, husk and straw

significantly with available Fe content, but not with available P, K, S, Zn, Cu or Mn contents. Correlation did not exist between soil As and rice grain or straw As contents or grain yield. On the other hand, there was a good correlation between straw As and grain As contents. Overall results indicate that plant As content cannot be explained in terms of water or soil As content.

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