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Tracing remobilization of nutrients and toxic elements after application of rice straw or derived ash / biochar in paddy soils

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More than 600 million tons of rice straw are produced each year as byproduct of rice grain production. As an increasing application, besides e.g. composting or fodder for animals, the straw remains on the field for decomposition and nutrient supply. A central concern during rice cultivation is accumulation of arsenic, but it is currently unclear how the application of rice straw or derived ash or biochar to paddy soils will influence arsenic uptake by the next generation of rice plants. Consequently, we assessed the element mobilization via soil microcosm incubations with straw or derived ash or biochar or without those amendments under flooding (40 days) and subsequent drainage (14 days). We focused on elements potentially influencing the uptake of arsenic by the next generation of rice plants (e.g. silicon, phosphorus, iron), or which are nutrients but toxic themselves at higher levels (sulfur, sulfide, iron, iron(II), manganese, copper, and zinc). We found significant differences in the release of arsenic, iron(II), sulfide, total sulfur, DOC, manganese, copper, and zinc . For example highest pore water Mn and As concentrations were found for soil amended with straw, whereas the straw amendment reduced S mobilization, possibly due to sulfate reduction by straw decomposing microbes. For P, we found highest pore water concentrations for straw, followed by biochar, ash and control. In summary, application of rice straw or derived ash or biochar strongly affect the element availability in paddy soil.