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Silicate solubilizing rhizosphere bacteria reduce arsenic uptake into rice plants

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Statement of the Problem: The global problem of uptake and accumulation of toxic elements (e.g. arsenic, As) in food plants (e.g. rice) urges for solutions, in order to satisfy the demand of food-safe plants for the growing world population (ML: 0.2 mg/kg rice). High bio-available silicate (Si) and phosphate (P) contents in soil lower As accumulation in the grain. Sustainable advancements in future farming practices may involve the use of silicate and phosphate solubilizing bacteria (SPSB) that could increase soil fertility and minimize As uptake. This study aimed at elucidating the role of SPSB in the mitigation of As contamination of rice in relation with Si addition as part of future farming practices in paddy rice soils.

Methodology: Three mitigation strategies were tested in lab-to-field approaches (hydroponic growth pouches, soil-plant-pots): i) amendment of Si, ii) rice seed inoculation with natural rice root SPSB with As(III)-oxidation activity and iii) the combination of i) and ii).

Findings: The combination of two factors resulted in a positive synergy that significantly increased germination and root development compared to no treatment or Si amendment only. In simplified hydroponic systems, presence of As(III) oxidizing SPSB-inoculum reduced uptake of As, possibly due to enhancement of competition between the two ions on aquaporin transporters in the roots. In soil-plant-pots, presence of Si decreased the concentration of As in plants, emphasizing possible competition between Si and As on radical level conveyors. However, the SPSB inoculum promoted As mobilization, thus, resulting in higher as uptake.

Conclusion & Significance: The characterization of rice rhizosphere bacteria indicated that most of SPSB are hold in the endosphere and that their application improved plant germination and decreased As uptake. When in soil, addition of Si reduced As uptake into the rice plant and seems to be a good application for future farming practices.

Biography

Marie Markantonis is an Environmental Microbiologist. Her research interest is dedicated to interdisciplinary studies, dealing with mitigation and remediation of industrial and pesticide pollution in soil, groundwater and plants. Her expertise lies in the establishment of different scale model systems, such as constructed wetlands, micro- and mesocosms, to monitor mitigation processes. She wants to push forward environmental friendly and economical sustainable assessment strategies and measures to mitigate and eliminate man-made environmental pollution, which harm animals and humans when entering the food chain through livestock and food plants. Her research work focuses on "The analytical and biological assessment and distribution of pesticides, solvents and heavy metals, and their metabolism in the environment and the risk of food ingestion and the associated risks for humans".

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