Water management impacts on the accumulation of potentially toxic elements in rice grain: a meta-analysis

Nawal Taaime[1], Sigride Vencesla Jenniska Asseko[2], Daniela R. Carrijo[3], Luisella Celi[4], Abhishek Kumar[5], Maria Martin[4], Marco Romani[6], Sarah E. Rothenberg[2], Angelia L. Seyfferth[7], Bruce Linquist[1]

[1]*Department of Plant Sciences, University of California Davis, Davis, CA, USA*

[2]*College of Health, Oregon State University, Corvallis, OR, USA*

[3]*Department of Plant Science, The Pennsylvania State University, University Park, PA, USA*

[4]*Department of Agricultural, Forest and Food Sciences, University of Turin, Turin, Italy*

[5]*Department of Land, Air and Water Resources, University of California Davis, Davis, CA, USA*

[6]*Rice Research Centre, Ente Nazionale Risi, Castello d'Agogna, Italy*

[7]*School of Life Sciences, Arizona State University, Tempe, AZ, USA*

***Keywords*:** Rice; Water Management; Heavy Metal; Metalloids, Potentially Toxic Element

***Abstract*:**

Rice can be a source of potentially toxic elements (PTE). Non-continuous flooding practices (NCFP) reduce methane emissions and water use, but they can alter the bioavailability of PTE by modifying soil redox potential, pH, and other geochemical processes. This meta-analysis evaluates the effect of NCFP on PTE accumulation in rice grain, explains the mechanisms of their observed increase/decrease, and highlights research gaps. Fifty-five studies comparing PTE grain concentration under continuous flooding and NCFP were selected, with 130, 67, 100, 36, 30, 19, 11, and 11 observations for As, inorganic arsenic (iAs), Cd, Pb, Cr, Hg, MeHg, and Ni, respectively. Due to limited data, pot and field studies were combined for PTE other than As and Cd. On average, NCFP decreased As, iAs, Pb, Hg, and MeHg grain concentrations by 39%, 24%, 21%, 63%, and 81%, but increased Cd and Ni concentrations by 115% and 187%, respectively. The effect on Cr was not clear due to discrepancies between pot and field experiments. Severe drying resulted in greater decreases in As and iAs but showed no significant difference from mild drying for Cd. Further field studies are needed to clarify NCFP effects, especially for Ni and Cr, where results were highly variable.

***Contact Information for Presenting Author**: ntaaime@ucdavis.edu*