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Effects of salinity on the mobility of phosphate and iron at the soil water interface

RASHEDUL ISLAM[1], DEBASHIS KUMAR BARMAN[2], MAHBUB KABIR[2] AND DR. MD ABDUS SABUR, PHD[2]

[1]Bangladesh Council of Scientific and Industrial Research
[2]Department of Chemistry, Jahangirnagar University
Presenting Author: riju3295@gmail.com

Water and soil salinity is one of the major abiotic stresses for agricultural production in coastal agricultural lands across the globe. Here, we evaluate the potential effects of salinity on phosphate and iron mobility at the soil-water interface by conducting a series of batch experiments using the coastal agricultural soil of Bangladesh. While the bioavailability of phosphate was investigated by conducting phosphate adsorption experiments, that of iron was examined in terms of soil incubation experiments under subsequent anoxic and oxic conditions, as a function of solution salinity. Results from the phosphate adsorption isotherm and pH envelope experiments show that phosphate binding strength to the soil particles increases with increasing salinity and is enhanced under alkaline conditions. We hypothesize that the stronger binding of phosphate with soil particles under elevated salinity and pH conditions occurs via the potential co-adsorption of phosphate with Ca^{2+} and Mg^{2+} ions and exhibits a key control in phosphate binding mechanisms in addition to the adsorption process. Results from the soil incubation experiments demonstrate that elevated levels of water salinity restrict the reductive iron release to the aqueous phase. However, chemical extractions of initial and post-experimental soils show that iron minerals that form in soil under high salinity conditions, via oxidative precipitation flowed by an anoxic phase, are more susceptible to reductive dissolution. Therefore, elevated levels of salinity may limit phosphate mobility in the aqueous phase, the fluctuating redox conditions are expected to increase the mobility of iron at the soil-water interface in saline agricultural soils.