Supplemental documentation: Phase 1, Irrigation pathway study, 2014-15

1. Results

Concentrations of SRP for samples collected in 2014 and 2015 exhibited various degrees of change across well, field drain, and canal sampling locations (Table S4a,b). However, while concentrations were generally above the laboratory detection limit (LDL) of 0.004 mg/L, they were generally low, ranging from 0.006 to 0.026 mg/L (Table S4a,b, Figure S1a). SRP concentrations sampled in 2015 generally increased from the well to canal and median SRP concentrations calculated for canal samples were 3 to 6 times the median SRP concentrations calculated for associated well samples (Figure S1b).

TP concentrations measured in samples collected in 2015 were much more variable than SRP concentrations (TP was not analyzed for samples collected in 2014). TP concentrations ranged from 0.043 to 3.66 mg/L across the three types of samples (Table S4b). TP concentrations measured in well samples were several times higher than TP concentrations measured in associated field edge samples and were generally more than twice TP concentrations measured in canal samples (Figures S1c,d).

2. Discussion - Phase 1, Irrigation pathway study, 2014-15

SRP and TP concentrations measured in samples collected at the field edge suggest that geochemical processes that occurred after fields were irrigated resulted in slight increases of SRP concentrations in standing irrigation water. More specifically, slightly lower TP concentrations and slightly higher SRP concentrations in samples collected at the field edge relative to samples collected at the well head likely resulted after the precipitation of TP onto field sediments and subsequent cycling of TP to SRP in the reducing environment common to flooded soils [30].

Two possible explanations for the observed increase in SRP and TP concentrations from the field edge to the canal involve turbidity and the effects of irrigation return water released from other fields in the area. Because GW generally has little turbidity and little turbulence occurs between the time irrigation water is pumped into and returns to canals from rice fields, irrigation return water from fields generally is less turbid than water in canals. These clay particles comprising turbidity provide a sorption site for SRP, resulting in P being converted from a dissolved to particulate state (as TP). In addition to this strong turbidity/P association, TP concentrations in any canal could be affected when irrigation return water from other fields in the area mixed (through downstream or backwater effects) with water leaving the study field.
GW data collected in Phase 1 demonstrate that SRP concentrations and SRP:TP ratios are affected by sampling location particularly as it related to atmospheric exposure. Although SRP concentrations for samples collected near the well head were very low, substantial amounts of suspended TP were detected from the same location. The difference in those SRP and TP concentrations likely resulted because GW samples collected from the well head were exposed to oxygen for a brief period prior to sampling when dissolved SRP likely sorbed onto ferric oxides/hydroxides (rust) and quickly precipitated from the water column. Evidence of this flocculation process is apparent throughout the study area. Soils that have a high degree or extended exposure to irrigation water near Delta (and MAP) well heads are often stained orange

as a consequence of ferric hydroxides precipitating out of suspension after reduced GW is exposed to atmospheric oxygen.

In summary, Phase 1 data collected at the well head, field edge, and canal indicated that (1) SRP concentrations generally increased from GW to SW while TP concentrations generally decreased from GW to SW, (2) TP concentrations in SW were much greater than SRP concentrations in SW, (3) P concentrations were highly variable between wells, and (4) SRP concentrations exhibited subtle increases from the well to field while TP was higher at the wells than at the edge of field or in canals.

Literature cited

30. Mitsch, W.J., Gosselink, J.G., Zhang, L. and Anderson, C.J. Wetland ecosystems. **2009**, John Wiley & Sons.