Effects of water saving irrigation managements on greenhouse gas emissions and micronutrients uptake in Philippine paddy soils

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Introduction
The main challenge for global rice research and development in addressing climate change is how to reduce emission of greenhouse gases (GHG) and limit micronutrient deficiency in soils using less water. Specific water management and soil types might play an important role in regulating N₂O and CH₄ emissions and micronutrient availability in paddy soils. This study was conducted to investigate the effect of water-saving irrigation management in rice farming on the GHG emissions and micronutrient availability in three contrasting Philippine paddy soils.

Methodology
1. Experimental design

- Randomized Complete Block Design
- 3 water management: 
  - CF - Continuous Flooding
  - MSD - Mid-Season Drainage
  - AWD - Alternate Wet and Dry
- 3 soil type: 
  - S1 - Silty Clay Loam
  - S2 - Sandy Loam
  - S3 - Loam
- 3 replicates

2. Analyses

1. Gas
   - N₂O and CH₄

2. Soil micronutrients
   - Fe, Mn, and Zn

3. Agronomic Parameters
   - biomass
   - no. of leaves
   - tiller count

Results and discussion
1. Greenhouse fluxes

- CH₄ and N₂O fluxes are high at the beginning of the growing season, though quickly decline with a time span of about three weeks.
- CH₄ emission increases in the order AWD < MSD < CF in all soil types.
- N₂O emission increases in the order of CF < MSD < AWD in all types of soil.
- Although there was an increase in N₂O in AWD, the amount of methane was still large enough to offset the increase in N₂O.

2. Micronutrients

- DTPA-extractable Fe and Mn were more available for the rice plants when CF was employed (negative redox values, results not shown).
- DTPA-extractable Zn was more available under AWD in all types of soils (positive redox, results not shown).
- Reduced availability of Fe and Mn under an AWD compared to CF regime, particularly during the reproductive growth phase of the rice plants. This maybe due to less Fe and Mn reduction under aerobic conditions.
- Extractable Zn in three types of soils increased with rice crop growing period. Under AWD and MSD, less SO₄ reduction to S, which can form very insoluble ZnS or by co-precipitation with Mn and Fe in new minerals.

Conclusions

- Water saving irrigation management through AWD can help to conserve water and reduce GHG emission.
- Water saving management in rice farming reduces emissions of CH₄, but limit the Fe and Mn availability and uptake for rice.

References


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** DTPA-TEA Diethylenetriaminepentacetate acid Thioglycolamine

*** ICP-OES Inductively Coupled Plasma-Optical Emission Spectrometry