Reducing Drainage Phosphorus Loads through Rice Cultivation in South Florida

Mohsen Tootoonchi (m.tootoonchi@ufl.edu), Timothy Lang, Jehangir Bhadha, Ronald Cherry and Samira Daroub

Everglades Research and Education Center and Soil & Water Science Department, Institute of Food and Agricultural Sciences, University of Florida, Belle Glade, Florida

UID: 93903

Introduction

- A major concern in the Everglades agricultural area (EAA) in South Florida is reducing phosphorus (P) concentration in drainage water from farms.
- Rice can possibly accumulate and immobilize the nutrients in the rainy season when the potential for runoff of nutrient-rich water is the greatest (Jones et.al. 1994).
- Birch (1958) reported a flush of mineralization that occurs after the reflooding the dry soil which subsequently increases nutrient availability and yields.
- Soil loss due to oxidation of organic matter is also a concern in the EAA. Growing flooded rice can help mitigate soil losses by maintaining anaerobic conditions of flooded fields throughout the growing season (Schueneman & Snyder 2000).

Fig 1. a) Soil Subsidence and b) aquatic vegetation in canals.

Objectives

To test the impact of different flood depths and midseason drawdown on:

- **Drainage water quality**
- **Rice yield**
- **Aquatic vegetation and rice P uptake**
- **Irrigation pumping costs**

Methodology

- A strip-plot experiment was designed with four water level treatments and four replications (Fig.3).
- Treatments were: 15cm continuous flood, 5cm continuous flood, 15cm flood with drawdown, 5cm flood with drawdown.
- In each subplot two predominant EAA rice cultivars were planted: Cheniere and Taggart.
- Preparation methods: Disc tillage followed by dry-seeding in 20 cm rows.

Fig 2. Planting rice on Muck soil and the inflow and outflow water structures.

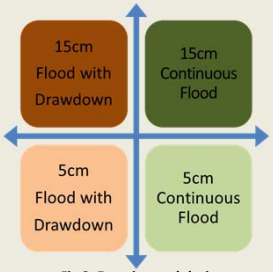

Fig 3. Experimental design.

Results & Discussion

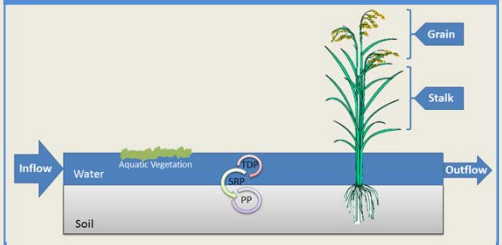

Fig 4. A simple sketch of flooded rice field with measurements conducted.

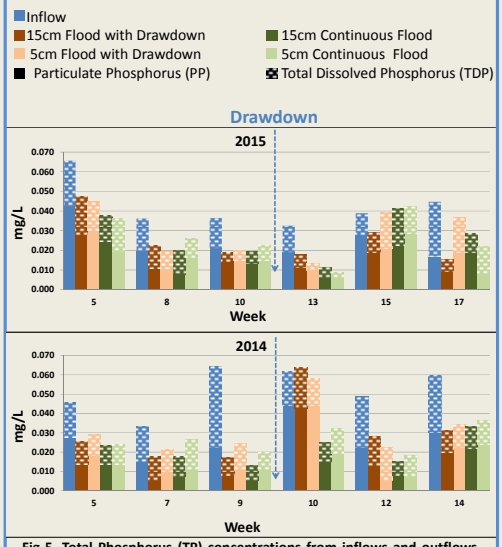

Fig 5. Total Phosphorus (TP) concentrations from inflows and outflows over two years. See Table 1 for the percent reduction comparisons.

Table 1. Percent reduction of TP, TDP, SRP and PP in drainage waters by treatment (44% TP Reduction on average).

%Reduction	TP	TDP	SRP	PP
15cm Flood with Drawdown	44.0	40.0	30.3	40.4
5cm Flood with Drawdown	**37.8**	39.1	29.7	33.7
15cm Continuous Flood	**49.3**	45.1	35.7	40.4
5cm Continuous Flood	43.8	41.8	24.2	41.7

Note: Total Phosphorus (TP) and Soluble Reactive Phosphorus (SRP)

Fig 6. Aquatic vegetation in different treatments a) 15cm continuous flood, b) 15cm flood with drawdown, c) 5cm continuous flood and d) 5cm flood with drawdown.

Results & Discussion

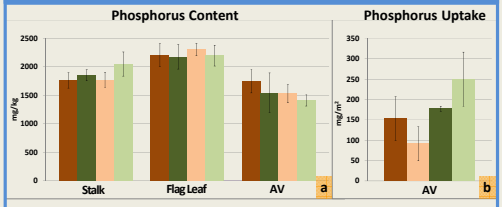

Fig 7. a) Phosphorus content of rice plant and aquatic vegetation (AV), b) Phosphorus uptake by aquatic vegetation

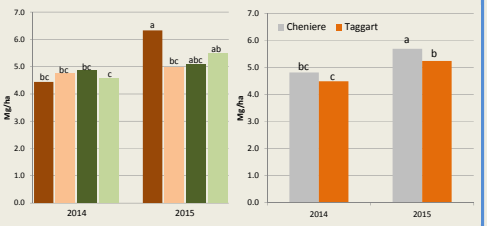

Fig 8. Rice grain yield (Mg ha^{-1})

- Highest grain yields was observed in 15 cm flood with drawdown (7.0 Mg ha^{-1}).

Conclusions

- Total phosphorus in rice drainage water can be reduced through particulate settling, aquatic vegetation and plant uptake (44% on average).
- 15cm continuous flood and 5cm flood with drawdown had highest and lowest TP reduction respectively.
- Rice yield was not significantly different in any of treatments in both years. However, Cheniere variety always had higher yield than Taggart.
- Grain harvest exported 14.8 kg ha^{-1} of phosphorus per year.
- Drawdown did not affect nutrient uptake by plants. However, it has the potential to reduce pumping costs and conserve 3600 m^3 ha^{-1} of water per day.

Ongoing Related Research

Compare drainage water phosphorus and dissolved organic carbon concentrations in the experimental field with local commercial fields.

Acknowledgement

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References

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