Flood Level and Single Drawdown Effects on Rice Yield and Water Quality

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Introduction

Soil loss due to oxidation of organic matter is a major concern in the Everglades Agricultural Area (EAA) in South Florida. Growing flooded rice reduces losses by maintaining anaerobic conditions of flooded fields throughout the growing season. It also inhibits the formation of nitrate-nitrogen that results from oxidation which reduces the problem of nitrate enrichment of surface and ground waters (Schueneman et. al. 2000). Drainage and re-flooding of flooded organic soils has been shown to release plant nutrients, particularly phosphorus (P) that could potentially increase rice yields. Allowing sufficient time during midseason drawdown for organic biomass (algae and crop residues) to decompose and mineralize may provide increased levels of available N and P allowing for increased uptake by rice.

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

Keeping the rice paddy flooded with water can be expensive; therefore an economic water level is preferred to lower the costs of pumping in addition to reducing the negative effects of weeds and insect pests. For this reason two most predominant rice cultivars in the EAA were selected to be tested.

Objectives

To test the hypotheses that lowering the water table and introducing a midseason drawdown will:

- **Reduce irrigation pumping costs**
- **Increase rice crop N and P uptake**
- **Increase rice grain yield**
- **Improve on-farm water quality**

Methodology

- A strip-plot experiment was designed with four water level treatments and four replications (Fig.3).
- Treatments were: 15 cm midseason drawdown, 5 cm midseason drawdown, 15 cm continuous flood, 5 cm continuous flood.
- 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.

Action	Days After Planting
Flooding	21
Plant Sampling	56
Water Sampling	35,49,60,72,84,98
Drawdown	60
Reflood	71
Flag Leaf Sampling	78
Harvest	109

Figure 4. Project timeline.

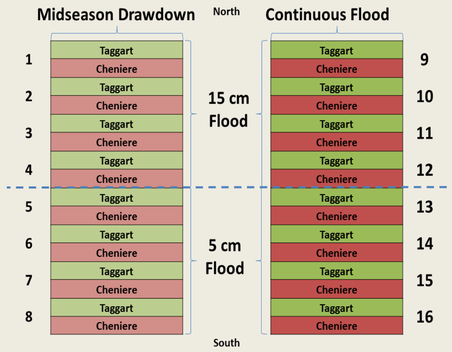


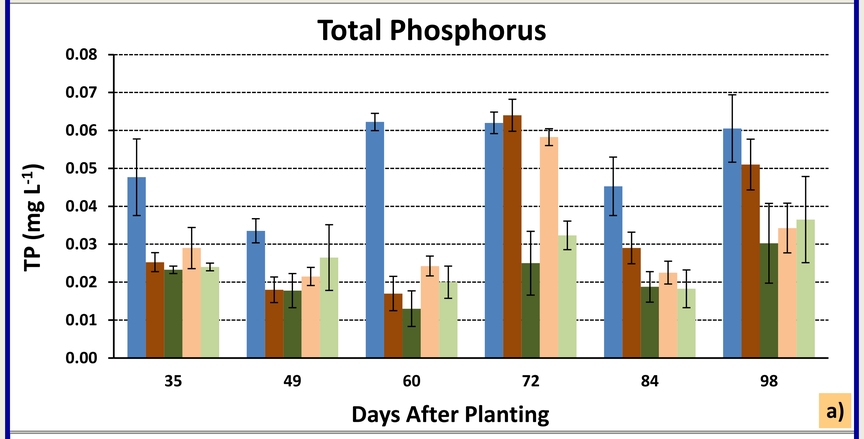
Figure 3. Experimental plot design.

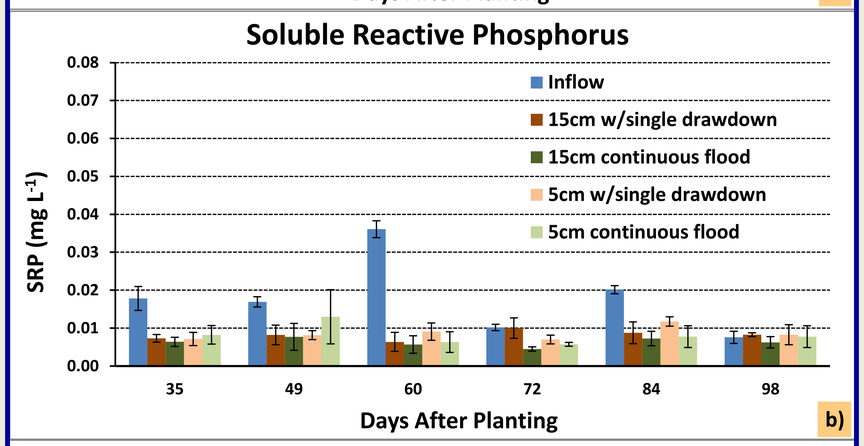
Figure 5. Early season inflow and outflow water structures.

Results & Discussion

Table 1. Percent reduction of TP, TDP, SRP and PP in drainage waters by treatment.

%Reduction	TP	TDP	SRP	PP
15cm Midseason Drawdown	42.0	38.1	51.1	50.2
5cm Midseason Drawdown	45.6	56.3	47.7	31.4
15cm Continuous Flood	57.7	67.0	53.4	56.1
5cm Continuous Flood	44.7	52.2	40.8	31.6





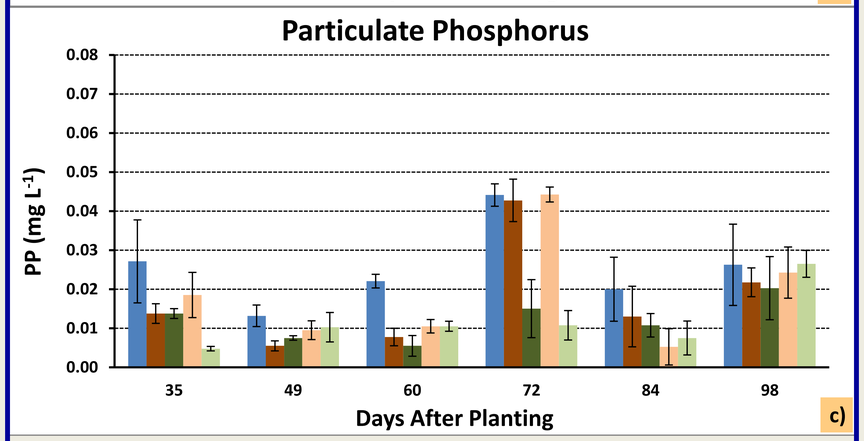


Figure 6. a) Total Phosphorus (TP), b) Soluble Reactive Phosphorus (SRP), and c) Particulate Phosphorus (PP) concentrations from inflows and outflows for 6 sampling times during the growing season.

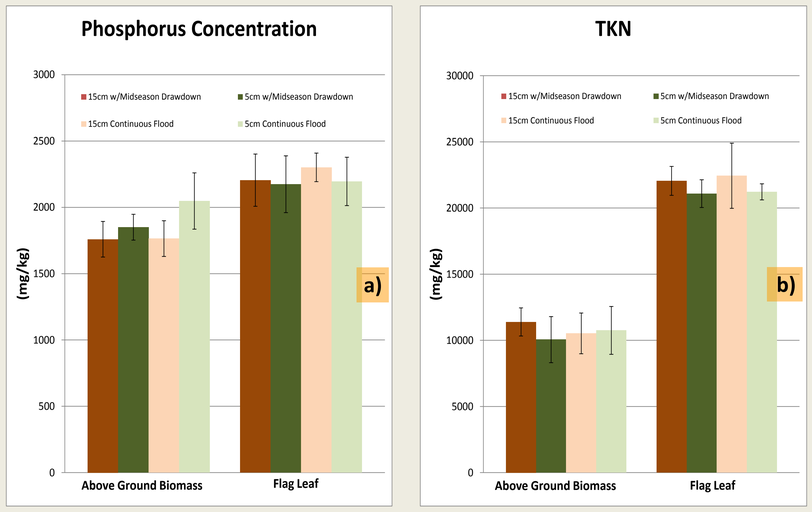


Figure 7. a) Phosphorus concentration and b) Total Kjeldahl Nitrogen (TKN) in above ground biomass and flag leaf samples.

Results & Discussion

- Highest grain yields were observed in "15cm Continuous Flood" (5.1 Mg ha^{-1}) and "5cm Midseason Drawdown" (5.0 Mg ha^{-1}) but they were not significantly different.
- Highest TP, SRP and PP percent reductions were observed in the 15cm continuous flood (57.7%) and 5cm midseason drawdown (45.6%).
- Plant tissue analysis of above ground plants and flag leaves showed no significant difference between different treatments.

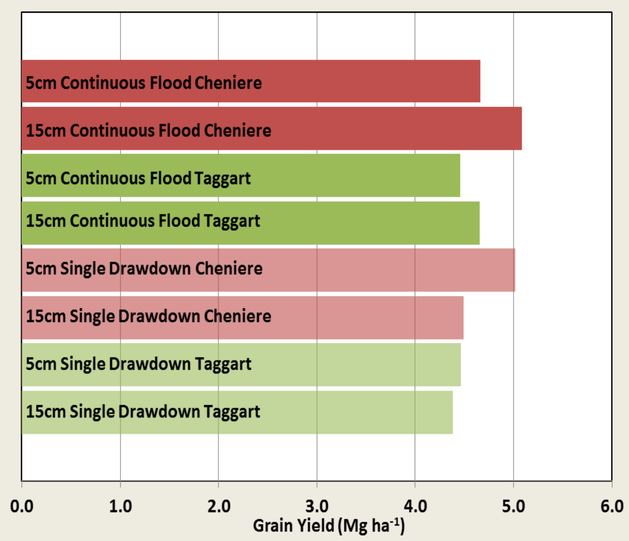


Figure 8. Rice grain yield from each treatment.

Conclusions

- Total phosphorus concentration in rice drainage water can be reduced through rice plant and associated aquatic vegetation uptake.
- Midseason drawdown has the potential to reduce the costs of pumping.
- Grain yields were almost the same in all different treatments; Cheniere cultivar had a better grain yield in each flood level.
- Drawdown didn't show any significant effect on nutrient uptake by plants but also did not reduce the grain yield.
- Total phosphorus reduction was slightly higher in the 15cm flood than the 5cm flood.

Ongoing Related Research

- Evaluation of different flood levels and midseason drawdown on populations of rice water weevil.
- Assessment of the total N and P total uptake by submerged aquatic vegetation and rice crop in the differing water depths and drawdown treatments.
- Weed inicidence and yield effects on rice with the different flood levels.
- Rice ratoon crop as a cash/cover crop in the Everglades Agricultural Area

Acknowledgement

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Reference

T. J. Schueneman and G. H. Snyder. 2000. Water-Use Considerations for Florida-Grown Rice. SS-AGR-87. Agronomy Department, Florida Cooperative Extension Service, Institute of Food and Agricultural.