

CULTIVATING FLOODED RICE AS A TREATMENT TECHNOLOGY TO MITIGATE PHOSPHORUS LOADS FROM AGRICULTURAL WATERSHEDS



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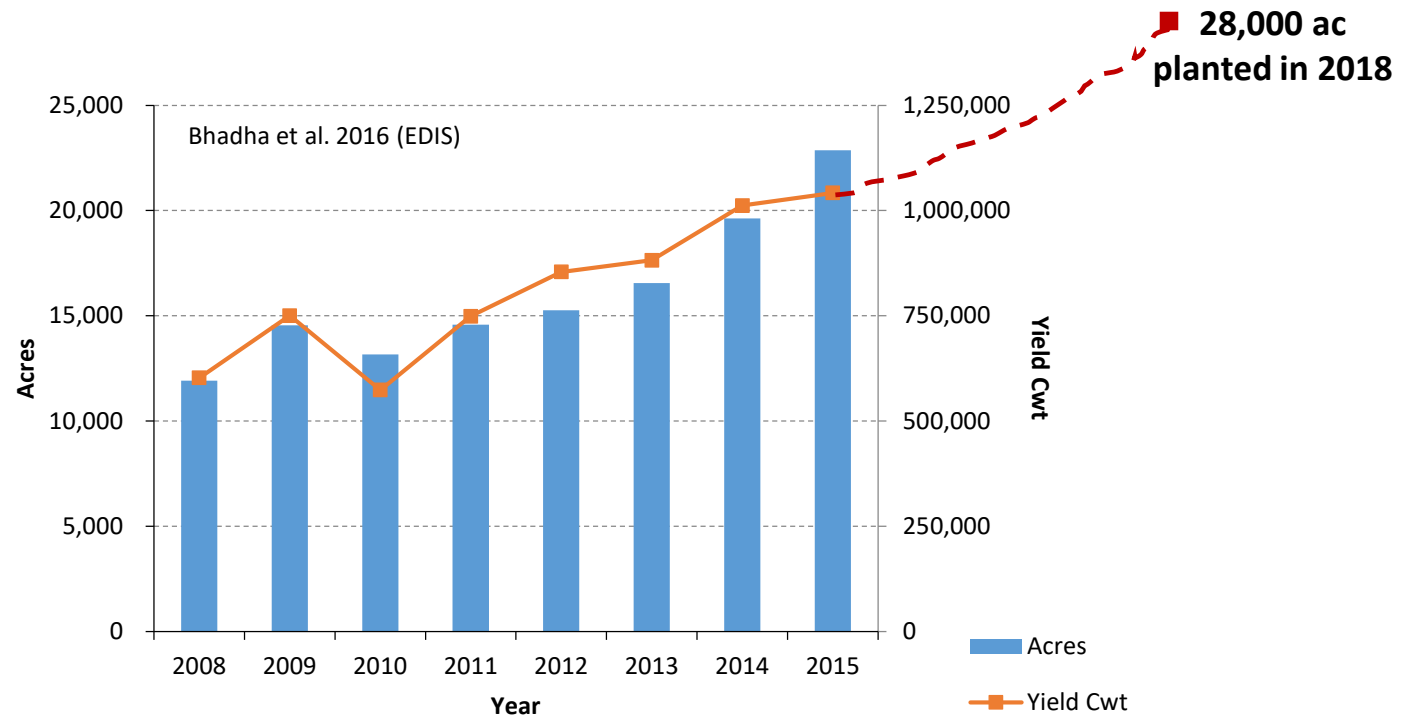
**Soil &
Water**
SCIENCE

Historical Background

- Rice production in the Everglades Agricultural Area (EAA) of South Florida dates back nearly seven decades
- For a brief period of time during the 1950s about 2,000 acres of rice was grown
- Although the rice industry produced satisfactory yields, the discovery of the rice 'hoja blanca' (white leaf) virus, which was reported first in the late 1950s in Columbia and Venezuela, led to a federal quarantine of rice production in the state of Florida
- Rice was reintroduced in the EAA in 1977 after it was demonstrated that rice could be successfully incorporated into the sugarcane production cycle during the fallow period

Farming in the EAA





- **Rice grown as a rotational crop in the EAA**
> 50,000 acres of available sugarcane fallow land in the summer
- **445,000 acres of histosols in EAA**
Vulnerable to subsidence
- **Flooded rice provides benefits to growers**
Reduces subsidence, soil arthropod pests, nutrient depletion



Hypothesized utilizing flooded rice to reduce P loading

- Since no N, P, K is added prior to planting, rice may help reduce nutrients from the water column.



← Study 1

Study 2 →

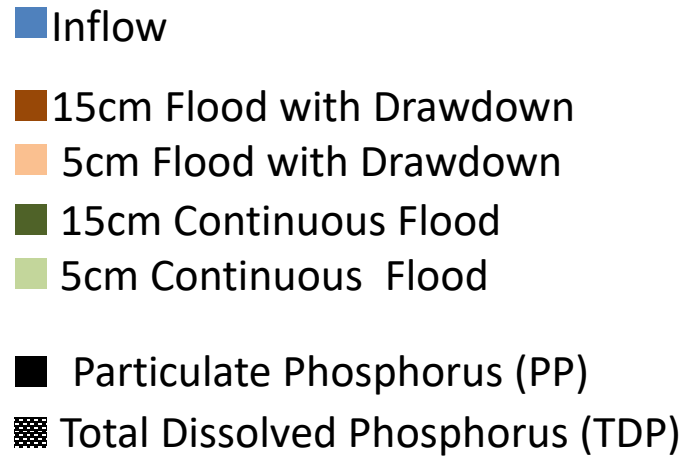


Experimental Design Study 1

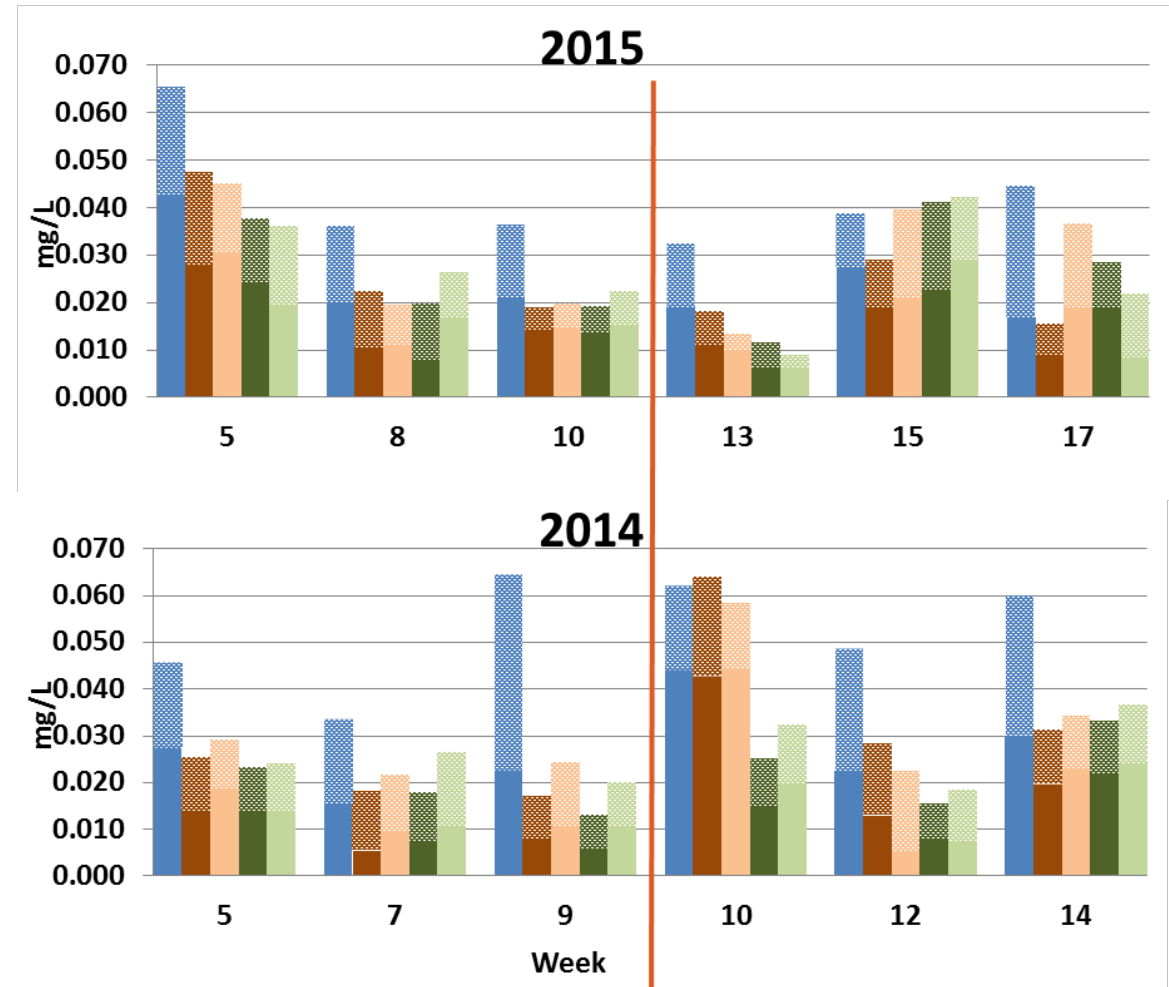
- This study was conducted at the Everglades Research and Education Center.
- During summer of 2014 and 2015.
- Two dominant rice varieties in the EAA were selected, Cheniere and Taggart.
- Sowing method was dry-seeding with 112 kg/ha of FeSO_4 at a 2.4 ha field and no other fertilizer was applied (Conventional method).
- Flooding started 20 days after planting.
- Water treatments:
 - 15 cm continuous flood (CF15)
 - 5 cm continuous flood (CF5)
 - 15 cm flood with drawdown (DD15)
 - 5 cm flood with drawdown (DD5)
- With four replications
- Plots were flooded by canal water.



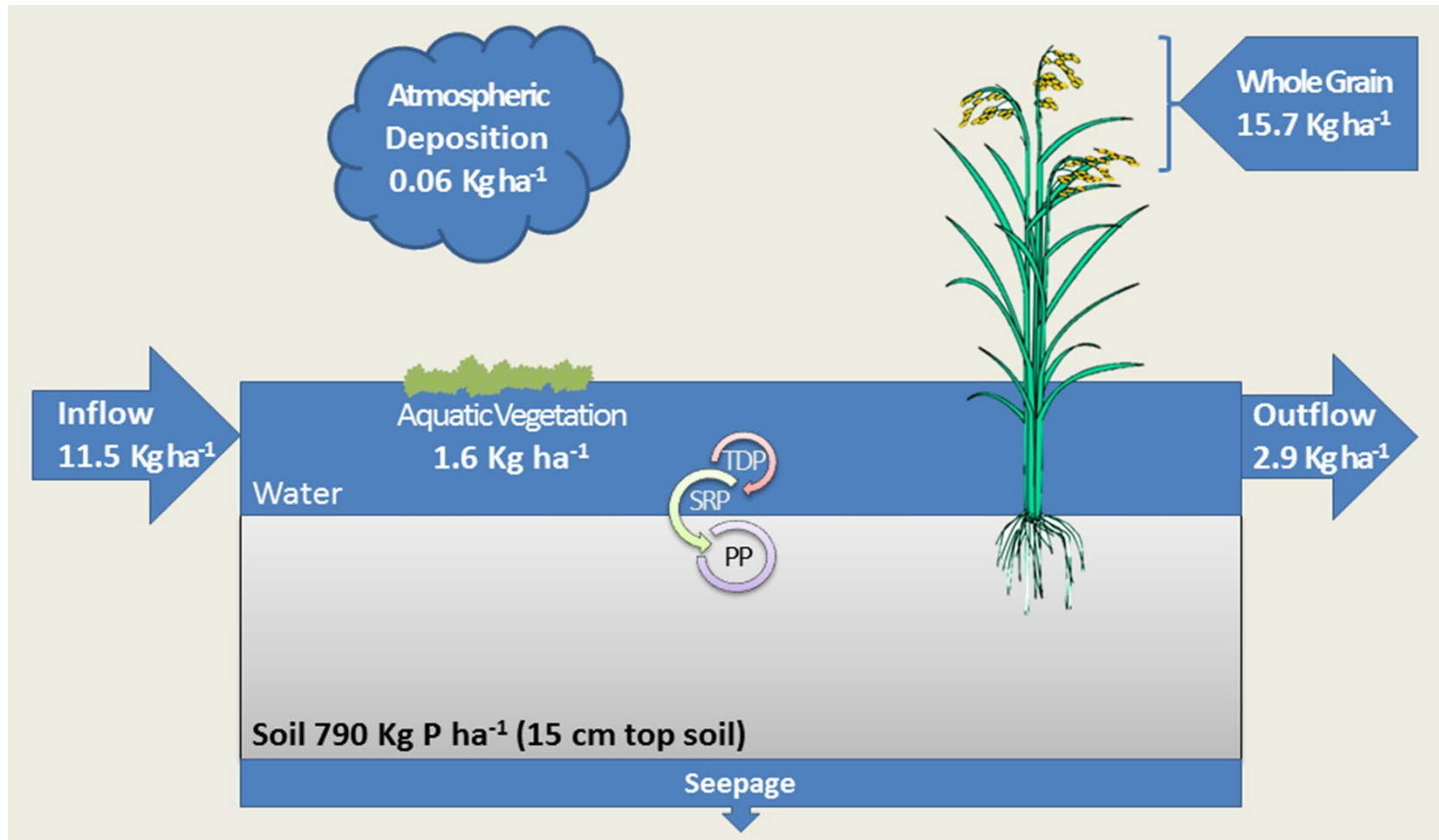
Results



- **Total P and total dissolved P concentrations were reduced in both years by 42% and 38%, respectively.**
- **15 cm flood generally had higher reductions of total P and total dissolved P than 5 cm flood.**
- **Drawdown did not show any significant effects on water quality parameters.**



Drawdown



Phosphorus budget in the experimental rice field. Calculations are based on kg P per ha per 84 days of flooding in the growing season



The Prize was designed to inspire groundbreaking innovation to remove excess phosphorus from freshwater sources.

<https://www.youtube.com/watch?v=3u2u4Bxw8LE>

Experimental Design Study 2

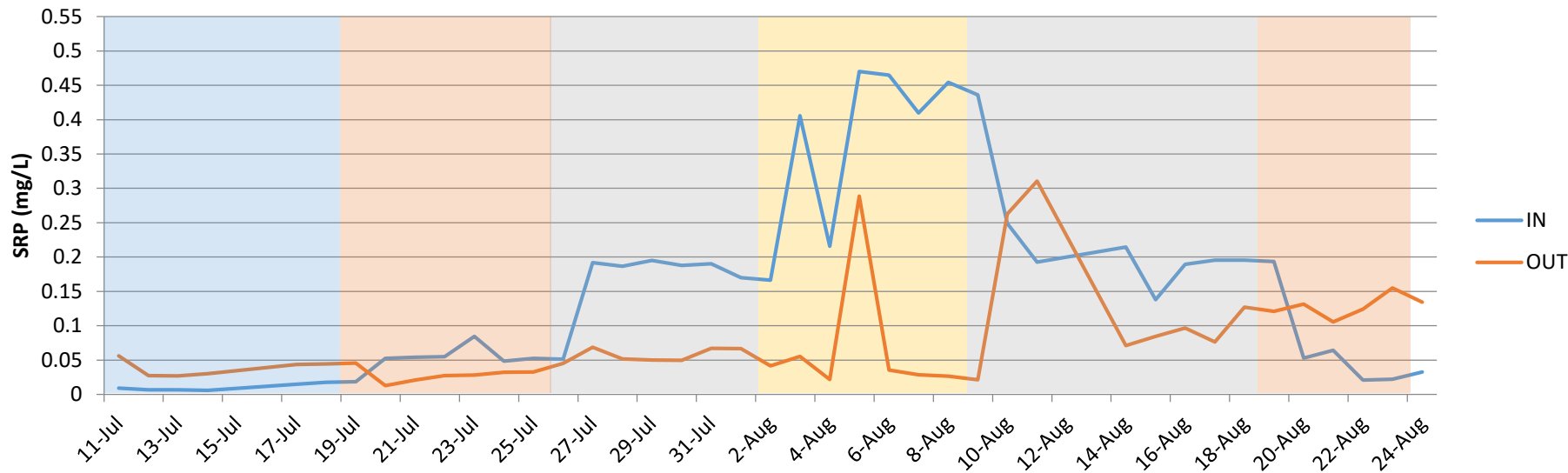
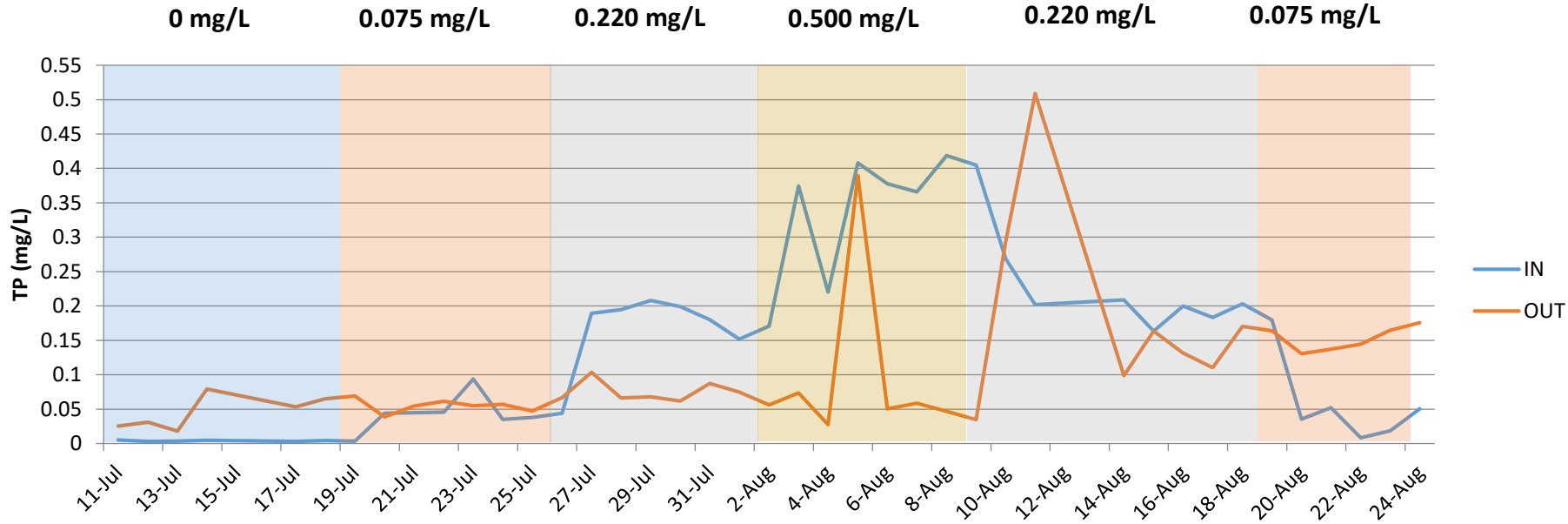
Inflow P concentration (mg/L)	Number of days
0	7/11 - 7/19 [7]
0.075	7/20 - 7/26 [7]
0.220	7/27 - 8/02 [7]
0.500	8/03 – 8/09 [7]
0.220	8/10 – 8/19 [8]
0.075	8/20 – 8/24 [5]

150 gal of water “treated” per day for 45 days





Results



Phosphorus use efficiency in rice cultivars

Goal is to identify rice cultivars that can grow well under low P conditions, without compromising on yield

Screening 16 common cultivars grown in Southern U.S.

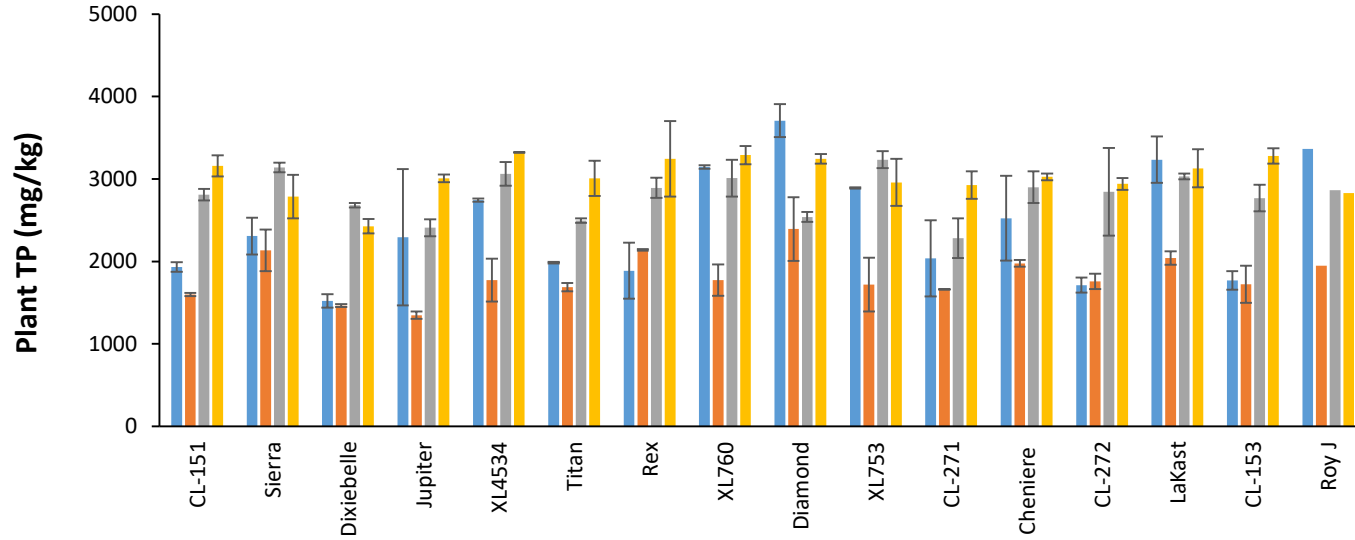
Tracking the P content in root, stalk, panicle, and grain at two sites within the EAA



Genotype	Yr released / State	Description
Cheniere	2003 / Louisiana	A short season, semi-dwarf long-grain variety with good yield potential and milling quality comparable to Cypress. Susceptible to sheath blight and blast.
CL-151	2007 / BASF	A mid-season, semi-dwarf long-grain Clearfield variety similar to Cocodrie with good yield potential. It is very susceptible to blast and straight-head, and susceptible to lodging and sheath blight.
CL-153	2016 / BASF	A mid-season, semi-dwarf long-grain Clearfield variety similar to CL151 with good yield potential. Susceptible to sheath blight, kernel smut, and false smut. Moderately susceptible to blast.
CL-271		
CL-272	2016 / BASF	A mid-season, medium-grain Clearfield variety. High tolerance to Newpath herbicide. Very susceptible to bacterial panicle blight. Susceptible to sheath blight and blast.
Diamond	2016 / Arkansas	A mid-season, long-grain variety with excellent yield potential and good milling quality. Very good straw strength. Susceptible to blast and sheath blight, moderately susceptible to bacterial panicle blight. Very susceptible to false smut.
Dixiebelle	1996 / Texas	Short-season long-grain with 'Newrex' quality; specialty rice used for canning and steam tables.
Jupiter	2006 / Louisiana	A mid-season, semi-dwarf, medium-grain variety with excellent yield potential and milling quality. It has a small grain size but has moderate resistance to bacterial panicle blight.
LaKast	2014 / Arkansas	A mid-season, long-grain variety with excellent yield potential and good milling quality. Susceptible to blast and sheath blight.
Rex	2010 / Mississippi	A short season, semi-dwarf long-grain variety with excellent yield potential and good milling quality. Very good straw strength, but is susceptible to most diseases
Roy J	2010 / Arkansas	A mid-season, long-grain variety with excellent yield potential and good milling quality. Excellent straw strength. Susceptible to blast and moderately susceptible to sheath blight.
Sierra	2005 / Texas	An aromatic long-grain with the fragrance and cooking qualities of a basmati style rice.
Titan	2016 / Arkansas	A short season, medium-grain variety with excellent yield potential. Moderately susceptible to blast and bacterial panicle blight. It has a preferred large grain size
XL4534	2013 / RiceTec, Inc	A short season, long-grain Clearfield hybrid with good yield potential.
XL753	2011 / RiceTec, Inc	A short season, long-grain hybrid with excellent yield potential. Resistant to blast, moderately susceptible to sheath blight and straight-head.
XL760	2014 / RiceTec, Inc.	A short season, long-grain hybrid with good yield potential.

Preliminary Results

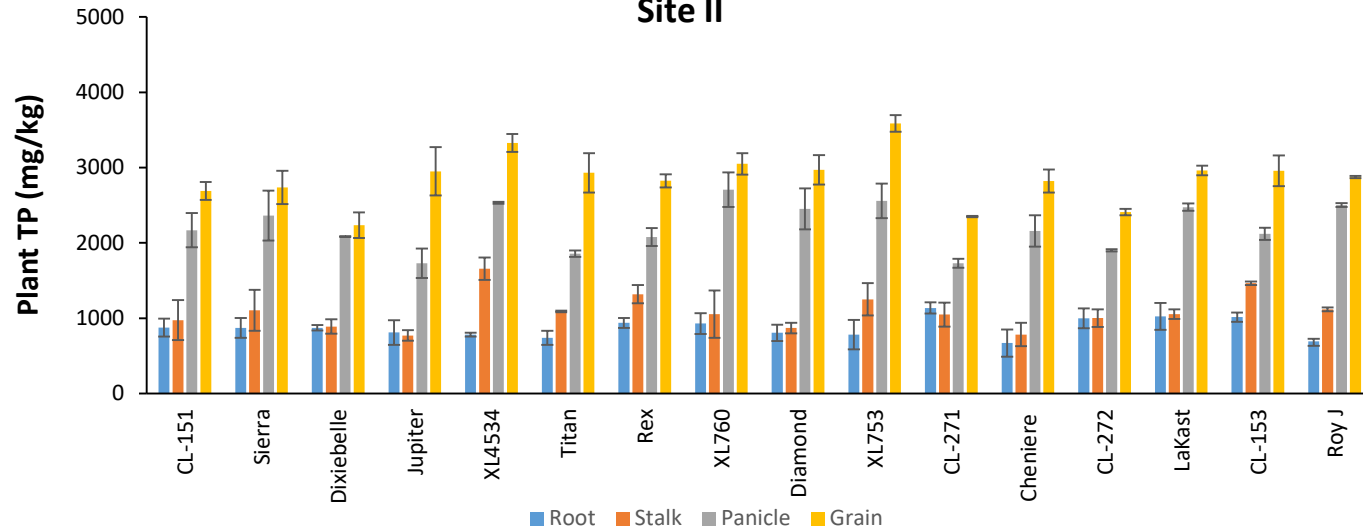
Site I



pH = 6.96

Soil P (Mehlich 3) = 28.67 mg/kg

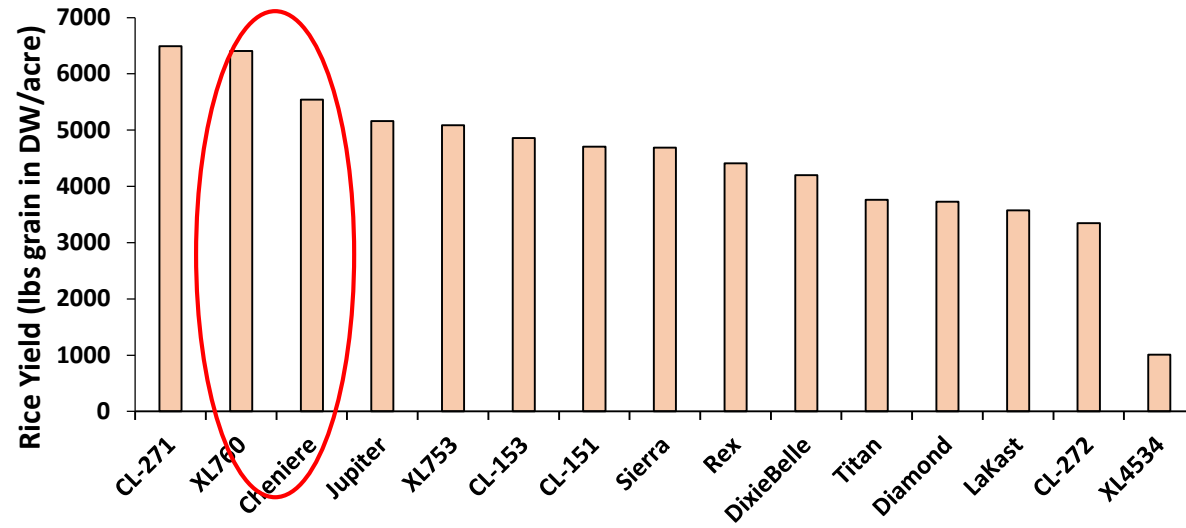
Site II



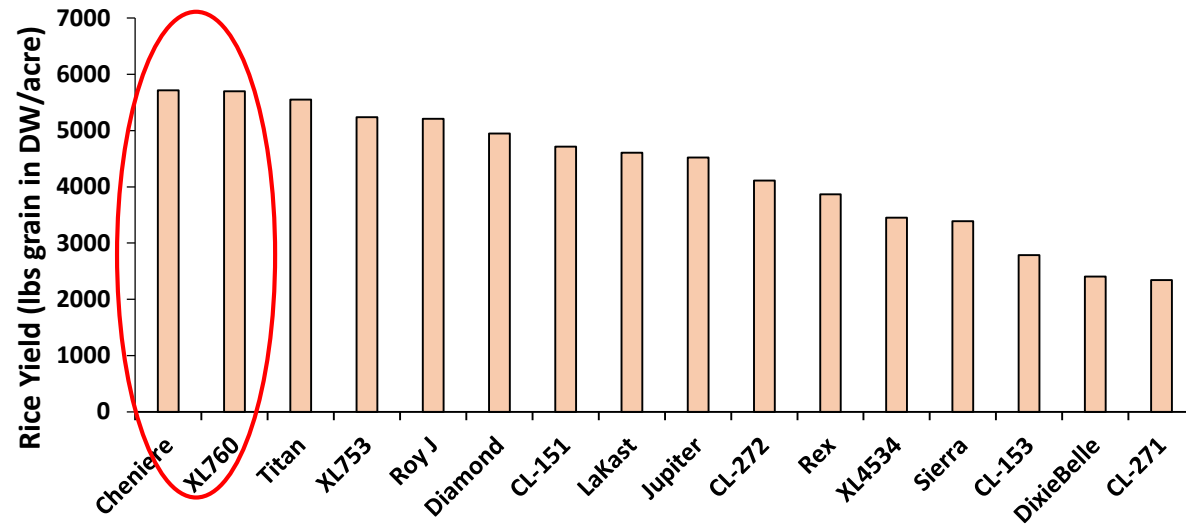
pH = 7.10

Soil P (Mehlich 3) = 14.98 mg/kg

Site I



Site II



THANK YOU!

Poster #60 “Speciation and dynamics of phosphorus: The role of rice plants in sequestering phosphorus compounds”. Duersch et al.