Flooded rice yield response to phosphorus fertilizer application

M.D. Ruark, B.A. Linquist, and C. van Kessel

Department of Plant Sciences, University of California-Davis

Introduction

- Straw management for California rice has changed dramatically over the past decade.
- Burning rice straw is no longer the common management practice; growers typically incorporate their straw after harvest and flood the field over winter to enhance decomposition.
- Little is known regarding how this change in straw management has affected soil fertility and phosphorus (P) availability.
- Current P fertilizer recommendations for California rice were developed for burned systems.

Objectives

- Determine the yield response to P fertilizer application for rice in soils throughout the Sacramento Valley.
- Evaluate the critical soil P value for rice in California.

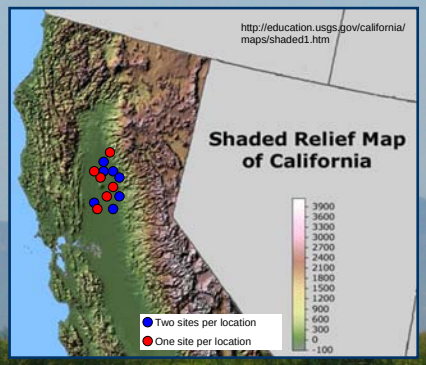
Materials and Methods

- Twenty grower fields (5 in 2005, 15 in 2006)
- Two treatments: +0 kg-P ha^{-1} and +40 kg-P ha^{-1}
- Randomized complete block design, 3 replications, plot size (2.2 x 3.3 m)
- Applied 40 kg-N ha^{-1} and 50 kg-K ha^{-1}; growers applied aqua-ammonium to all sites
- Soils collected in the spring, prior to fertilization.

Table 1. Straw management, soil characteristics and early season vigor response to P fertilization.

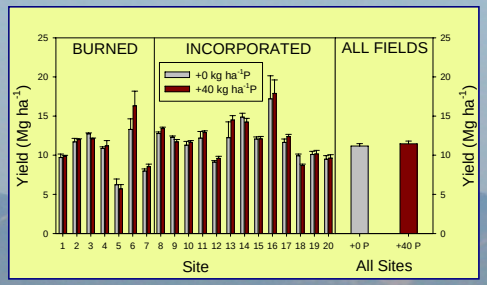
Site	Straw Management	Year	pH	Olsen-P	Bray-P	OM	CEC	Early season response?
				mg kg^{-1}		%	meq/100g	
1	Burn	2006	5.1	5	2	1.8	48	Y
2	Burn	2006	6.4	9	4	1.9	50	N
3	Burn	2006	7.3	14	18	1.5	45	N
4	Burn	2006	4.7	10	2	1.8	44	Y
5	Burn	2006	5.0	11	5	1.1	40	Y
6	Burn	2006	5.4	6	3	1.7	53	N
7	Burn	2005	6.3	4	2	2.5		N
8	Incorp	2006	5.3	2	1	1.7	50	Y
9	Incorp	2006	6.3	5	2	2.4	51	N
10	Incorp	2006	4.5	15	2	3.7	24	N
11	Incorp	2006	5.7	4	1	1.6	31	Y
12	Incorp	2006	5.4	7	2	1.5	30	N
13	Incorp	2006	6.5	25	29	1.4	50	N
14	Incorp	2006	6.1	32	30	1.4	46	N
15	Incorp	2006	5.3	12	1	1.7	16	N
16	Incorp	2006	5.9	5	2	1.4	47	N
17	Incorp	2005	5.2	9	5	2.2		N
18	Incorp	2005	5.7	4	3	2.3		Y
19	Incorp	2005	5.5	5	1	3.9		N
20	Incorp	2005	5.2	19	3	1.9		N

Materials and Methods

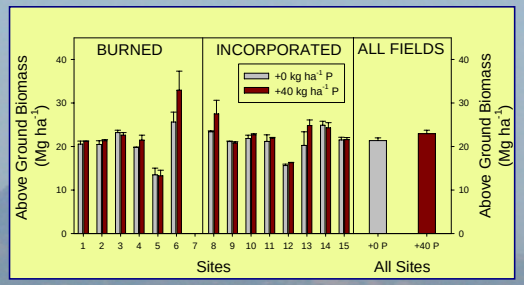


The critical value for soil P is 6 mg kg^{-1} based on the Olsen-P soil test. Application of P fertilizer is recommended when soil P levels are below the critical level.

Results – Effect of P fertilization

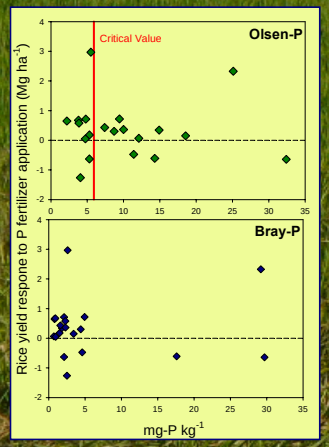


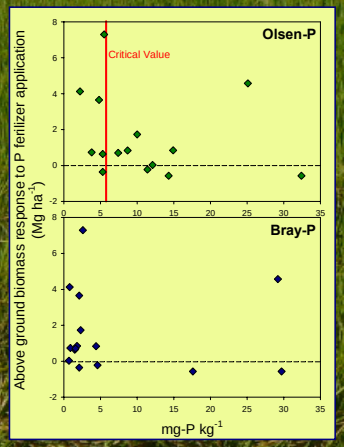
- **There was a significant effect (α<0.05) of P application on yield among all field sites, however the overall increase was small.**
- **There was a significant effect (α<0.05) of P application on yield at two sites (#3 and #18); both effects were negative (+40 kg-P ha^{-1} had lower yields than +0 kg-P ha^{-1}).**



- **Above ground biomass (AGB) was determined only in 2006.**
- **There was no significant effect (α<0.05) of P application on AGB among all sites.**
- **There was no significant effect (α<0.05) of P application on AGB within any site.**

Results – Evaluating the Critical P Value





- **The Olsen-P soil test does not appear to be a reliable indicator of P fertilizer need.**
- **The Bray-P soil test also does not appear to be a reliable indicator of P fertilizer need.**
- **There was an early season vigor effect from P fertilizer application at some sites (Table 1).**
- **These sites did not show a yield effect from P fertilizer application, but typically occurred on soils with Olsen-P values <6 mg kg^{-1}.**

Conclusions

- **A consistent response in rice yield or rice biomass to P-fertilization was not determined.**
- **Standard P soil tests (Olsen-P, Bray-P) did not appear to be reliable indicators of P fertilizer need.**
- **A re-evaluation of the current P fertilizer recommendations is warranted. This includes the critical soil P value and the soil P test on which it is based on.**
- **P fertilizer recommendations may need to consider available organic P as well as soil parameters that can affect P availability (e.g. pH, OM, CEC).**

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