

Response to Potassium Fertilization in Hybrid Rice-Maize Cropping System in Calcareous Soil of Eastern India

Shiveshwar Pratap Singh^{1*}, M. P. Singh², S. Jha³, S. S. Prasad⁴, S. K. Chaudhary⁵, Sudarshan Dutta⁶, Kaushik Majumdar⁷, V. Shahi⁸ and T. Satyanarayana⁹

¹ Dr. Rajendra Prasad Central Agricultural University, Pusa, Samastipur, Bihar, India

^{2,3,4,5} Dr. Rajendra Prasad Central Agricultural University, India

^{6,7,8,9} International Plant Nutrition Institute-South Asia Program

*Presenting Author (sp26814@gmail.com)

INTRODUCTION

- Rice-maize system is vital for meeting quality food requirements and improving food security for people of South Asia.
- The availability of K in fields could be assessed by omission plot study
- Hybrid rice and hybrid maize cropping system uptake more K from soil
- Hence, to cater the needs of these crops, soil nutrients reserves alone are not sufficient making it implicit to supply them through fertilizers.

OBJECTIVES

- To assess the response of K in hybrid rice-maize cropping system,
- To evaluate the impact of K on nutrient uptake by hybrid rice and maize
- To estimate the response of K on soil health and economics

METHODOLOGY

Treatments

*T ₁	Ample dose of N+P+K+ S + Zn	*T ₂	P+K+ S + Zn (-N)	*T ₃	N+K+ S + Zn (-P)
*T ₄	N+P+ S + Zn (-K)	*T ₅	N+P+K+ Zn (-S)	*T ₆	N+P+K+ S (-Zn)
#T ₇	Inbred variety under the unfertilized check	#T ₈	Inbred variety under ample fertilizer treatment	*T ₉	Control (without any fertilizer)

*Kharif- Hybrid rice (Arize 6444), Rabi- Hybrid maize (DKC9081), *Kharif- Inbred rice (Rajshree), Rabi- Inbred maize (Laxmi)

Rate and time of fertilizer application

Rice	Fertilizer N (kg/ha): 3 splits				Total P ₂ O ₅ (kg/ha) basal	Fertilizer K ₂ O (kg/ha): 2 splits		
	Total N	Basal N	Active tillering	Panicle initiation		Total K ₂ O	Basal	Panicle initiation
Yield target (t/ha)								
5 (IR)	125	55	35	35	50	60	30	30
7 (HR)	175	75	50	50	70	80	40	40
Maize								
Yield target (t/ha)	Total N	Basal N	At V6	At V10	Total P ₂ O ₅ (kg/ha) basal	Total K ₂ O	Basal	At V10
6 (IM)	150	50	50	50	70	120	60	60
10 (HM)	210	70	70	70	140	200	100	100

Note: S (@ 30kg S/ha) and Zn- @ 25 kg Zn-EDTA/ha

Location of the experimental sites

Location: Farmers fields in Samastipur and Muzaffarpur district of Bihar, India
Design: RBD
Net plot size: 100 m²
Cropping system: Rice-maize

RESULTS

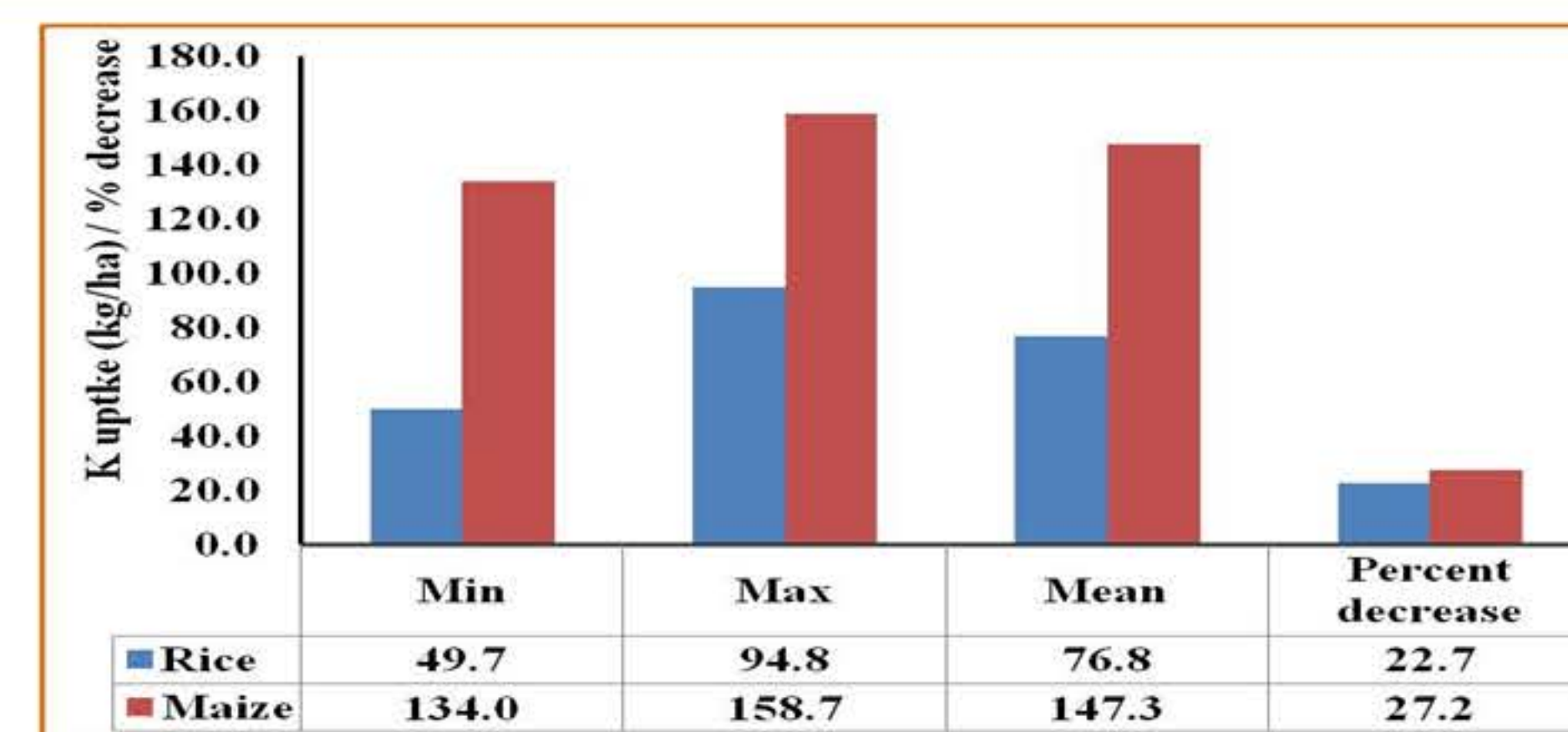
Initial Soil properties

Variables	Range	Mean
pH (1:2, soil : water)	7.43 – 8.15	7.87
EC (dS/m) at 25°C	0.21 – 0.72	0.34
Organic carbon (%)	0.42 – 0.80	0.58
Available N (kg/ha)	190.4 – 285.8	223.8
Available P (kg/ha)	12.4 – 56.6	24.2
Available K ₂ O (kg/ha)	110.9 – 239.7	188.3
Available S (mg/kg)	8.4 – 35.9	16.4
Available Zn (mg/kg)	0.38 – 2.16	1.09

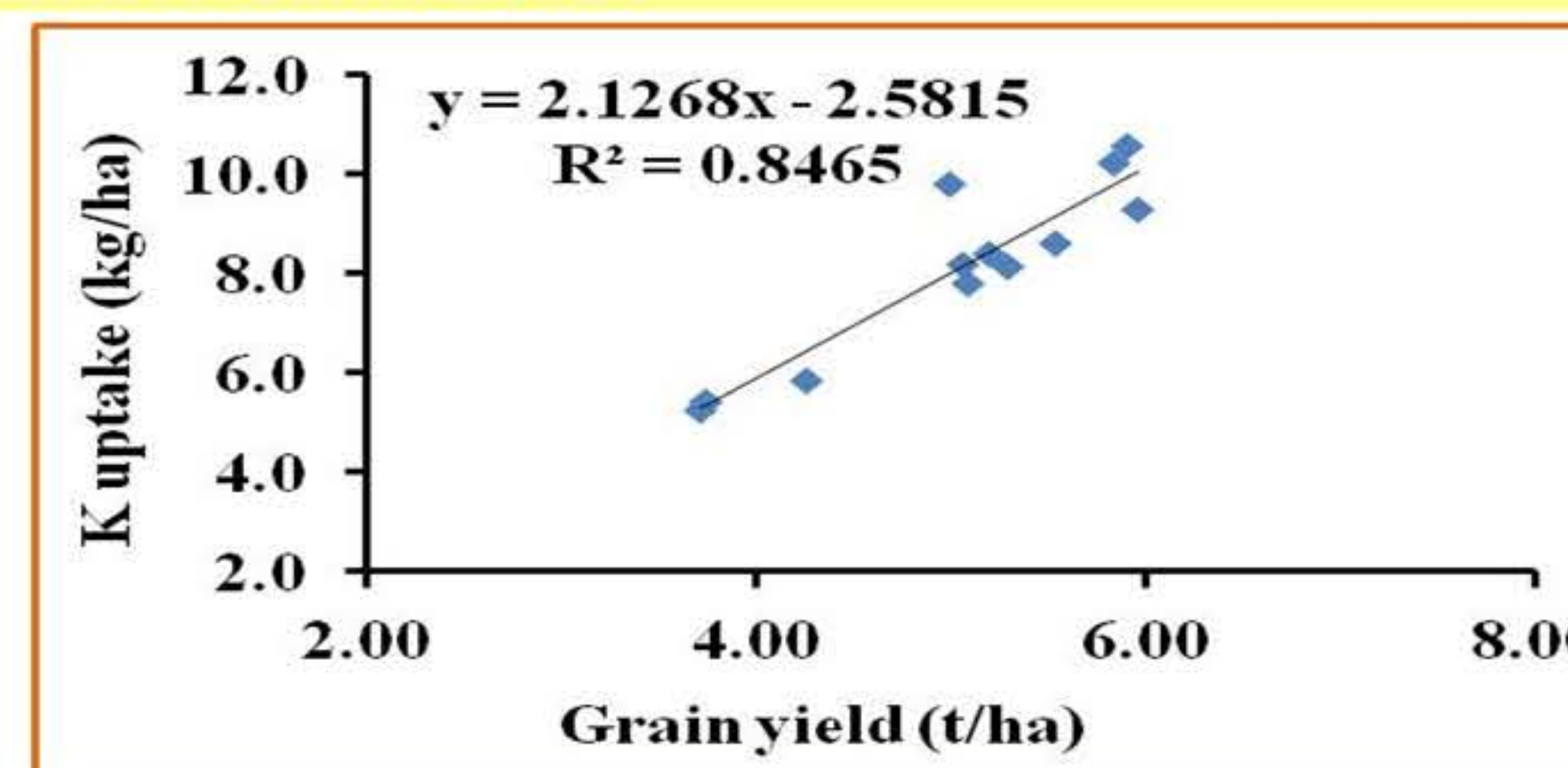
Rice equivalent yield (REY), sustainable yield index (SYI) and percent decrease in REY over ample fertilization

Treatment	REY (t/ha)			SYI	Percent Decrease		
	Min	Max	Average		Min	Max	Average
T1	13.2	14.9	14.1	0.91	-	-	-
T2	6.9	8.4	7.7	0.49	40.2	52.1	45.0
T3	11.5	13.3	12.2	0.78	7.9	17.4	13.5
T4	11.8	13.6	12.5	0.80	4.8	15.1	11.1
T5	11.8	13.7	12.7	0.82	5.2	12.4	9.6
T6	12.5	13.8	13.1	0.85	4.0	11.0	7.0
T7	3.5	5.5	4.3	0.37	40.6	57.7	51.4
T8	7.7	10.2	8.8	0.79	-	-	-
T9	5.2	7.6	6.5	0.37	45.2	64.9	54.0
LSD (p ≤ 0.05)	-	-	0.38	-	-	-	-

Total potassium uptake in K omitted plot and percent decrease over ample fertilized (NPKSZn) plot by hybrid rice and maize



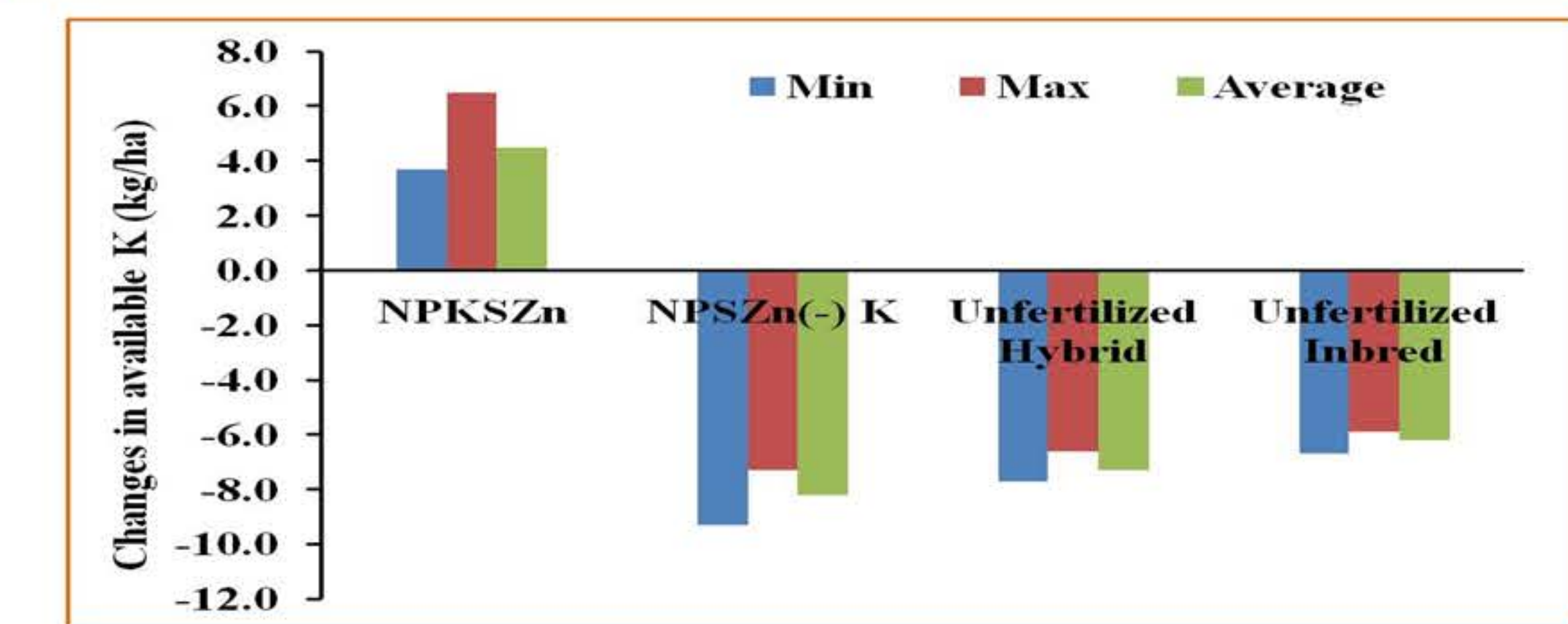
Relationship between potassium uptake by hybrid rice grain and grain yield in K omitted plot



Return on Investment (ROI) in hybrid rice and maize due to omission of potassium



Changes in available potassium in post harvest soil (0-15 cm) nutrient omission trial



CONCLUSIONS

- The percent decrease in hybrid rice-maize system grain yield due to omission of K varied from 5 to 15% at different farmers' fields.
- The hybrid rice and maize yielded 34 and 37.5 percent more grain yield, respectively than the inbred crop with ample fertilization based on target yield.
- The hybrid rice grain yield loss due to K omission was equivalent to economic loss of INR 4672 – 7773/ha, while in hybrid maize it was 2547 – 22270/ha.
- The sustainable yield index (SYI) indicates that hybrid rice-maize cropping system was more sustainable in ample fertilized plot than the K omission plots.
- There was decline in availability of K in omitted plots in post harvest soil (0-15 cm), while there was build up in available K in ample fertilized plots.
- The present findings indicate that there is a direct link between soil supplying capacity and K requirement by the different types of crops.
- Thus, adoption of hybrid crops with balanced application of K fertilizer could be one of the options for enhancing the productivity to dress food demand for the increasing populations and also helps in maintaining the soil health.

Acknowledgements:

The financial support of International Plant Nutrition Institute (IPNI) for conduct of the project is thankfully acknowledged. The authors are also thankful to the participating farmers for their help in proper execution of the experiment.

Status of maize showing deficiency of K under K omitted plot

