Rice Productivity and Stability in a Long-Term Rotations Experiment in Temperate S. America

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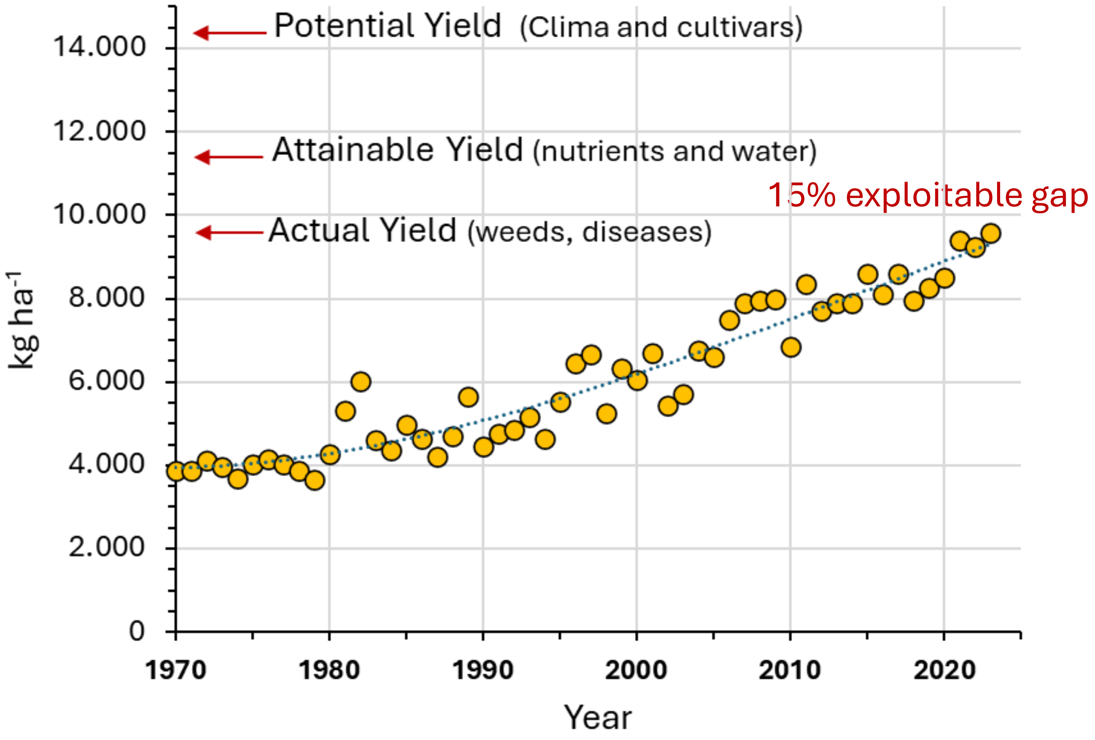
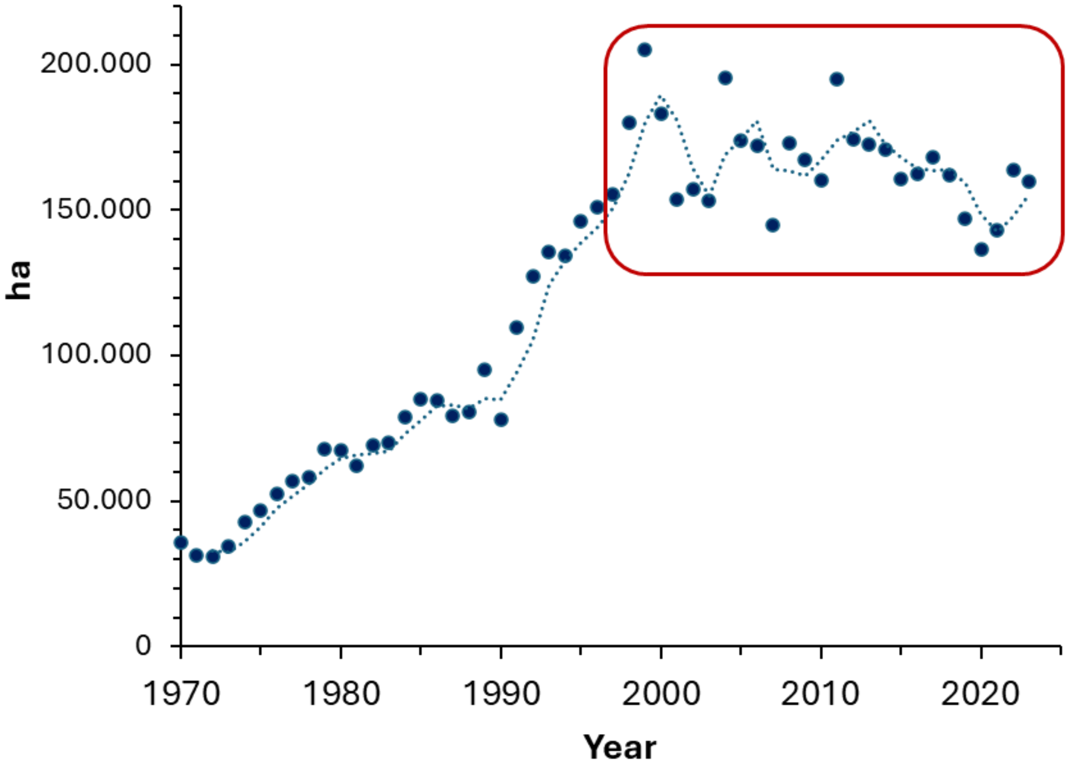
International Temperate Rice Conference
New Orleans, Louisiana. June 5-8, 2024

Rice Yield Potential and Gaps in Uruguay

Rice Historical Productivity



Rice Historical Cultivated Area



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Field Crops Research

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Field-level factors for closing yield gaps in high-yielding rice systems of Uruguay

Meng-Chun Tseng[a,*], Álvaro Roel[b], Ignacio Macedo[b], Muzio Marella[c], José Terra[b], Gonzalo Zorrilla[b], Cameron M Pittelkow[a,d]

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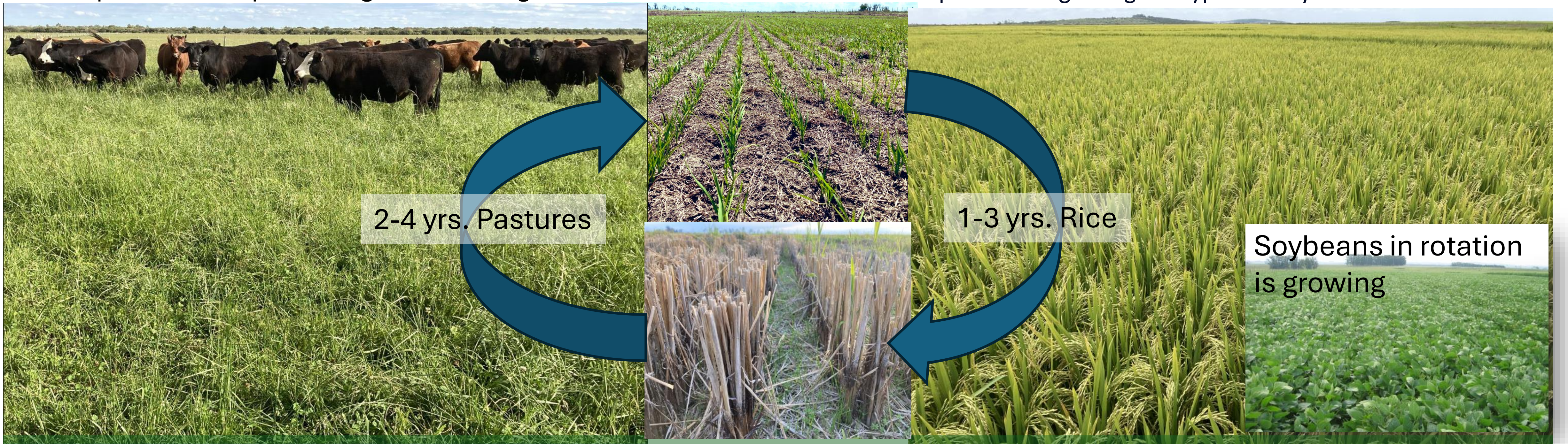
Distinguishing between yield plateaus and yield ceilings: A case study of rice in Uruguay

Gonzalo Carracelas[a,*], Nicolas Guilpart[b,c], Kenneth G. Cassman[b], Patricio Grassini[b]

Integrated Rice-Livestock Systems (IRLS):
Key of Uruguayan Rice Production Systems Sustainability.

LIVESTOCK: Attainable 350 kg meat/ha/yr. ≈750,000 ha.
75% Exported. Mixed perennial grasses and legumes.

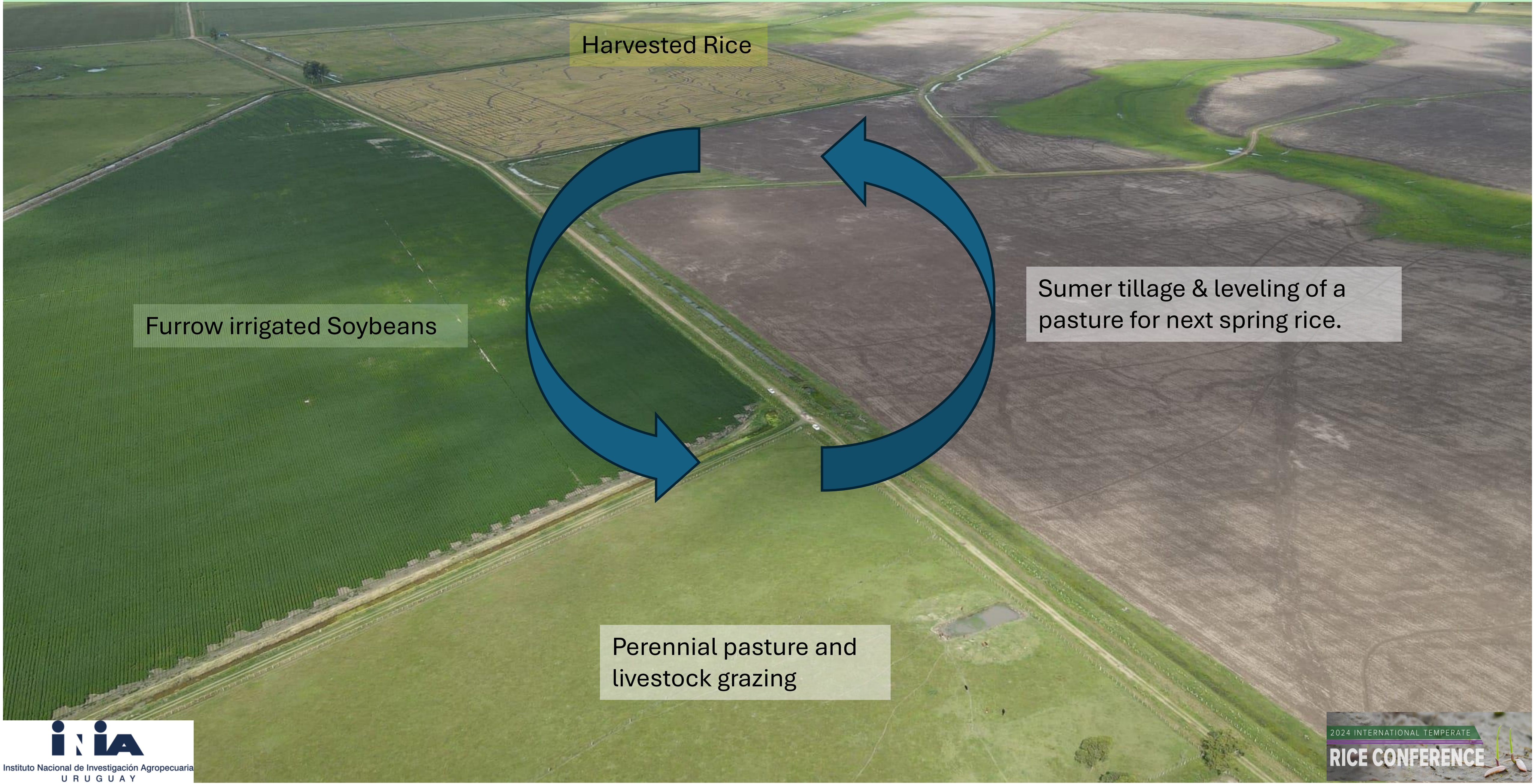
RICE: Attainable Potential Yield (11.5 Mg/ha). ≈ 160,000 ha.
95% Exported. Long-fine grain type. Mostly Indica.



IRLS allows sustained yields increases with relatively high ecoefficiency, optimizing economic results, diversifying incomes and reducing risk, preserving natural resources, promoting biodiversity and minimizing the environmental footprint.

Pittelkow et al. 2016, Glob. Food Sec.; Tseng et al., 2020,Sci. Rep. Macedo et al., 2021, J. Clean. Prod.; Castillo et al., 2021, Glob. Food Sec.; Tseng et al., 2021. Curr. Res. Environ. Sustain; Pereira-Mora et al., 2022. Appl. Soil Ecol. Macedo et al., 2022, Agric. Syst. Castillo et al., 2023. Front. Sustain. Food Syst. Martinez, 2023, Plant Dis.

Ex: Rice-Soybeans-Livestock Integrated Farm (Guerrina Farm: 19/03/2024)



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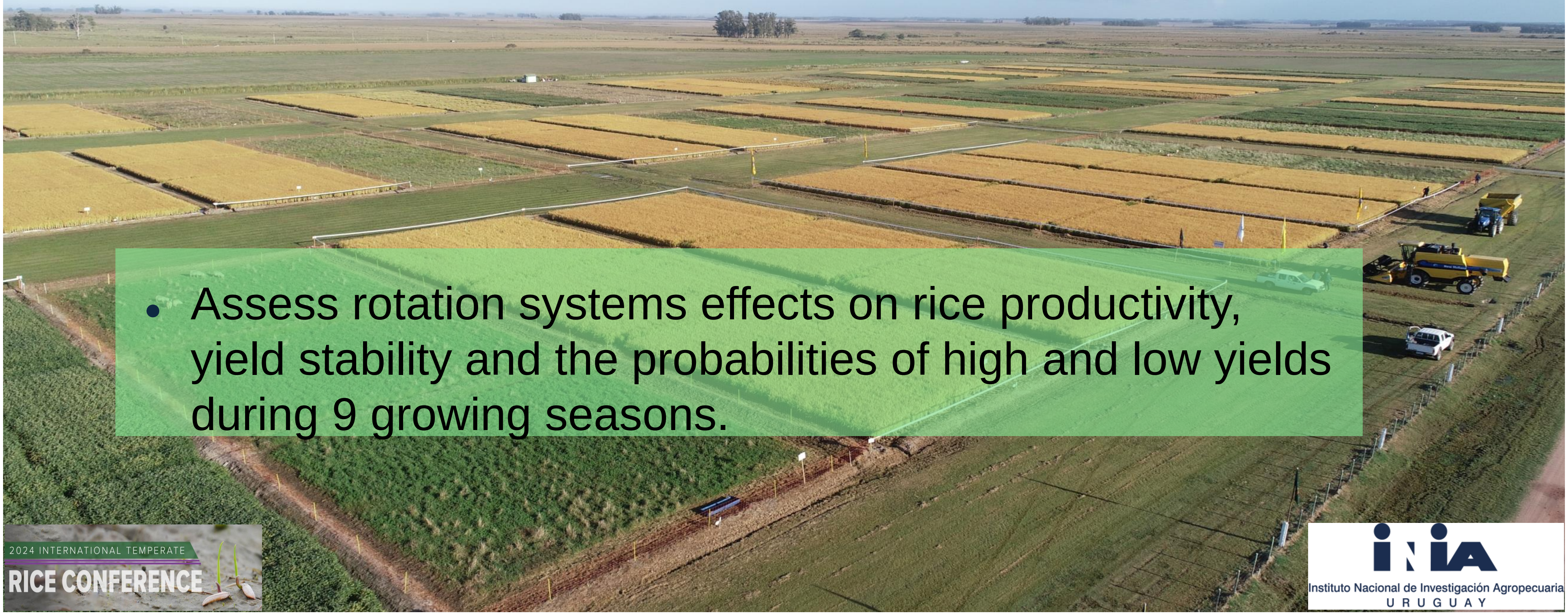
The Long-Term Rice Rotation Systems Experiment

Year: 2012;
33°16'21.47"S;
54°10'23.17“W. 22m OSL

Goal: Evaluate the productivity, economics, ecoefficiency & environmental footprint of contrasting rice rotation intensification scenarios.



- Assess rotation systems effects on rice productivity, yield stability and the probabilities of high and low yields during 9 growing seasons.

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Rotations contrasted in the Long-Term Experiment (LTE:2012)

Intensification gradient

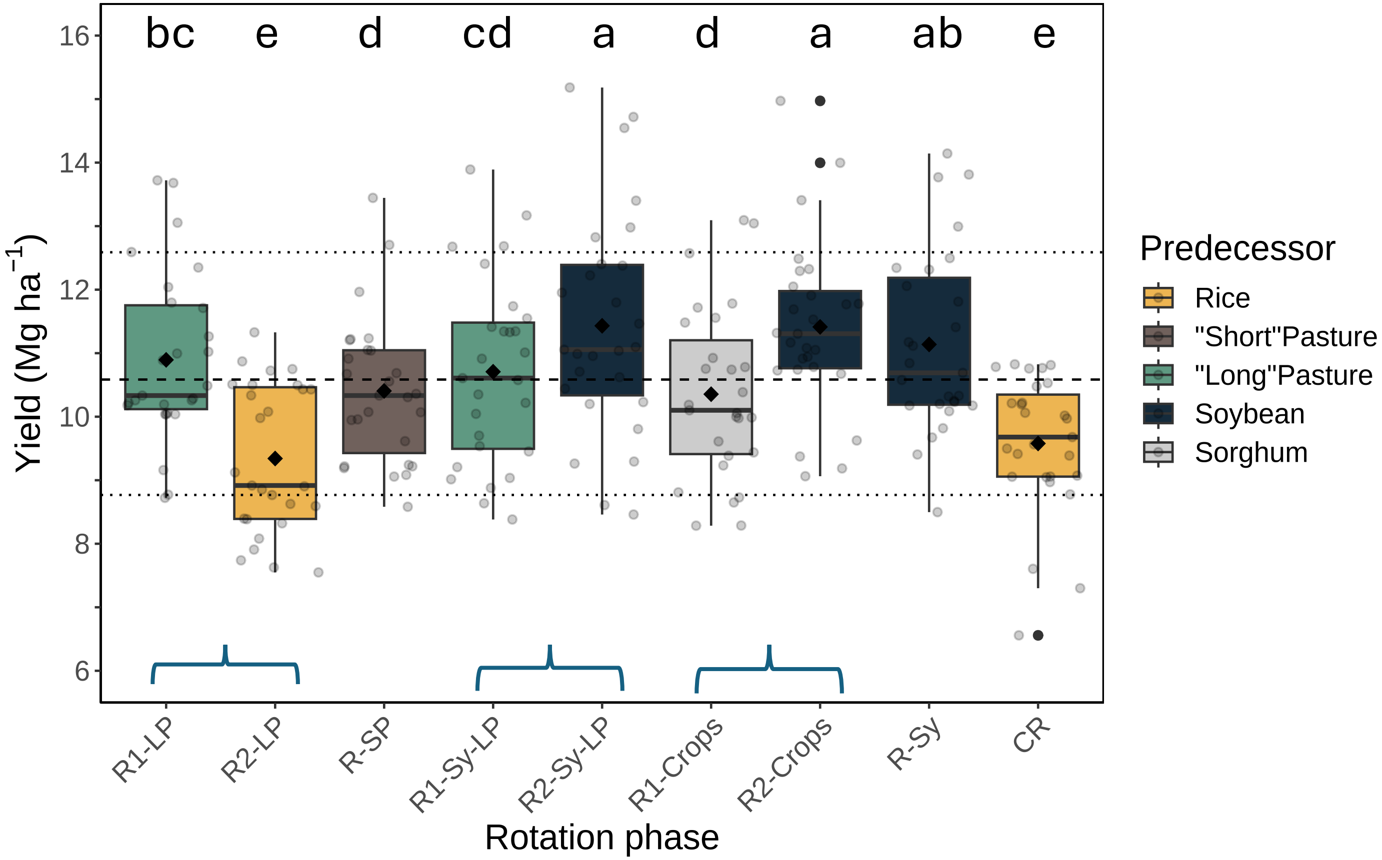
	1		2		3		4		5		6	
	Spr-Sum	Fall-Win	Spr-Sum	Fall-Win	Spr-Sum	Fall-Win	Spr-Sum	Fall-Win	Spr-Sum	Fall-Win	Spr-Sum	Fall-Win
Rice-Long Pasture	RICE	Ryegrass	RICE	Tall Fescue-White Clover-Birdsfoot trefoil								






Rice Yield by Rotation, Phase, & Previous Crop

(LTE: 9 yrs.; n: 243, mean yield: 10.6 Mg/ha)



- Rice yield in Soy rotations was 8% higher than with only pastures (R-LP & R-SP: 10.2 Mg.ha^{-1}) & 15% than Cont. Rice (9.6 Mg.ha^{-1}).
- No yield differences among rotations with Soy (R-Sy, R-Sy-LP, R-Crops), nor between only pastures were found.

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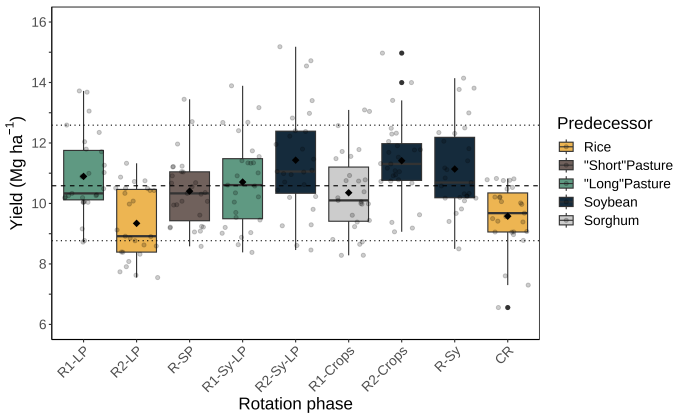
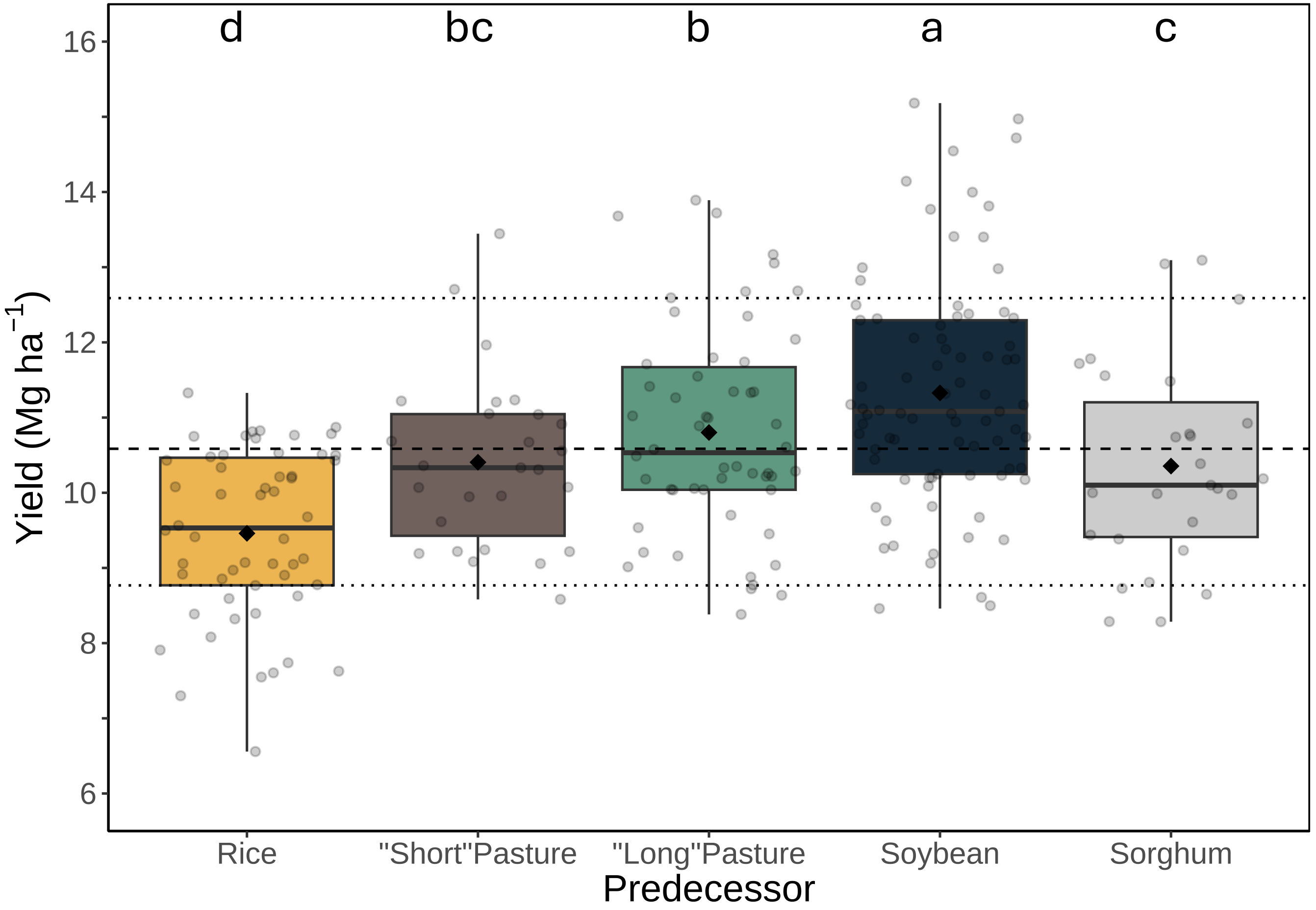
Rice Yield by Previous Crop

(LTE: 9 yrs.; n: 243, mean yield:10.6 Mg/ha)

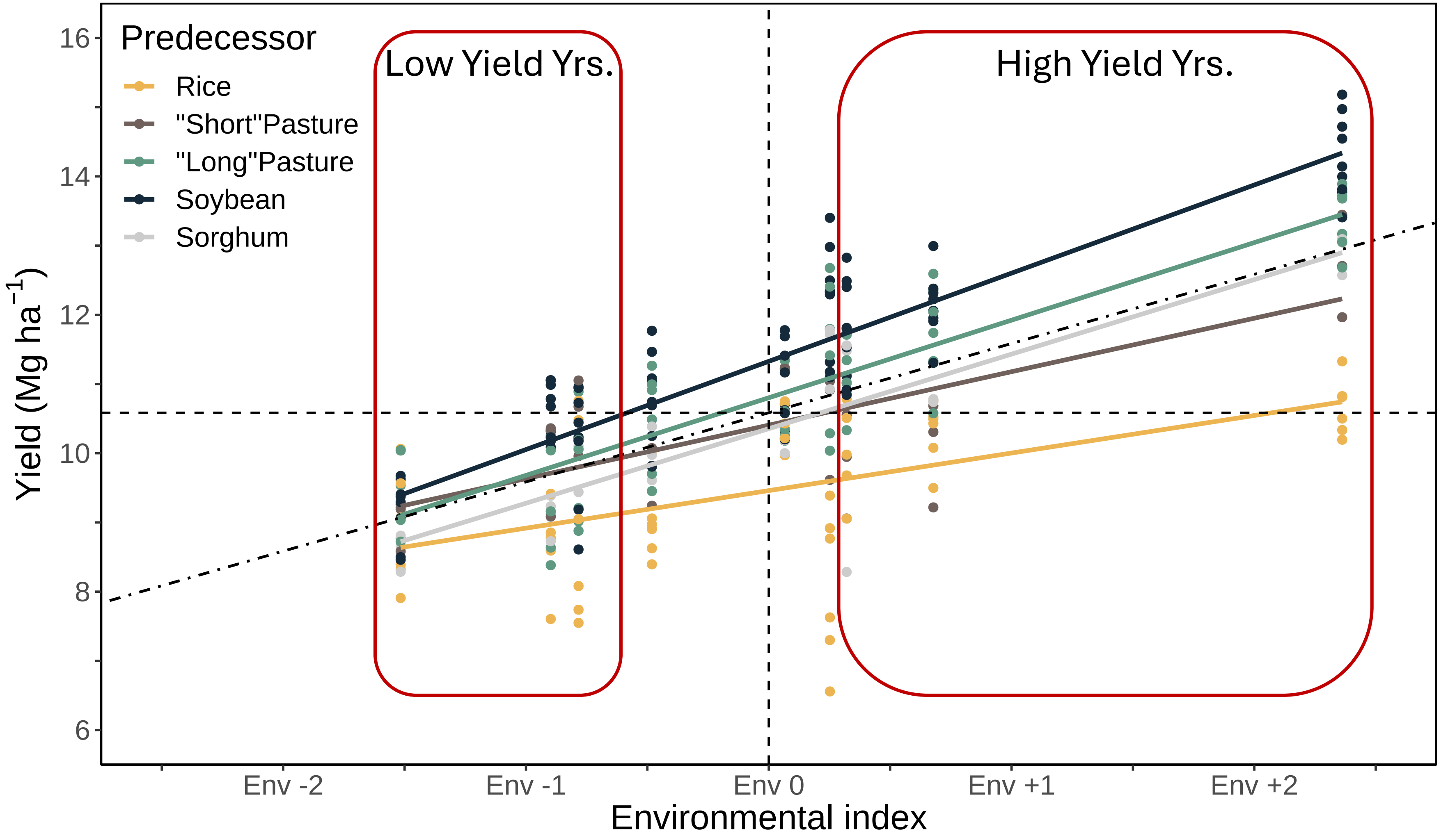




Grouping by predecessor, the highest yield was after Soy (11.3 Mg ha^{-1}), followed by long pastures (10.6 Mg ha^{-1}); & the lowest after rice (9.5 Mg ha^{-1})

Rice Yield Stability by Previous Crop.

(LTE: 9 yrs.; n: 243, mean yield 10.6 Mg/ha)



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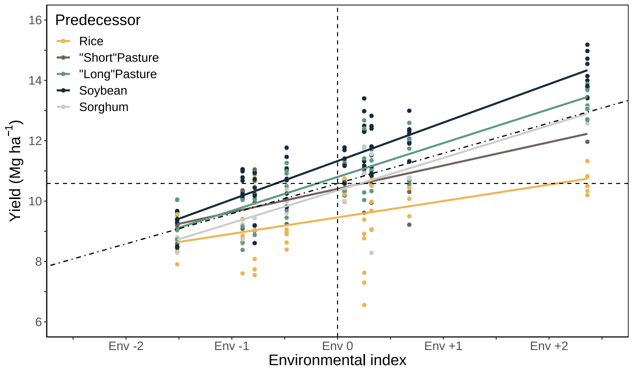
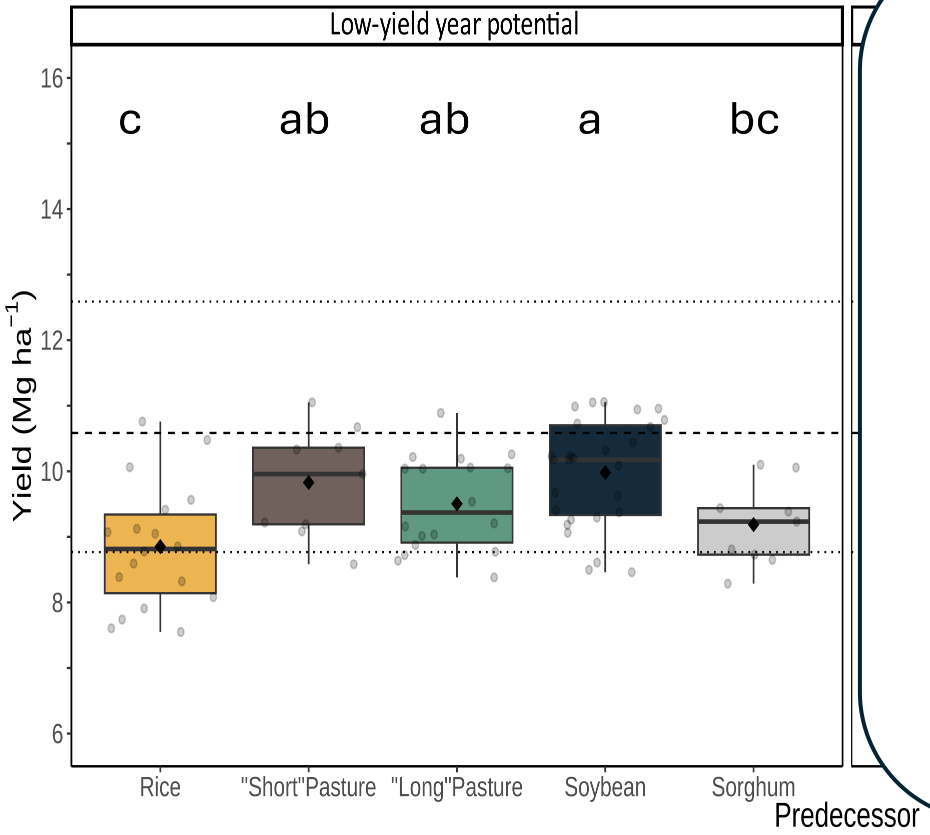
Rice Yield Stability by Previous crop in contrasting years.

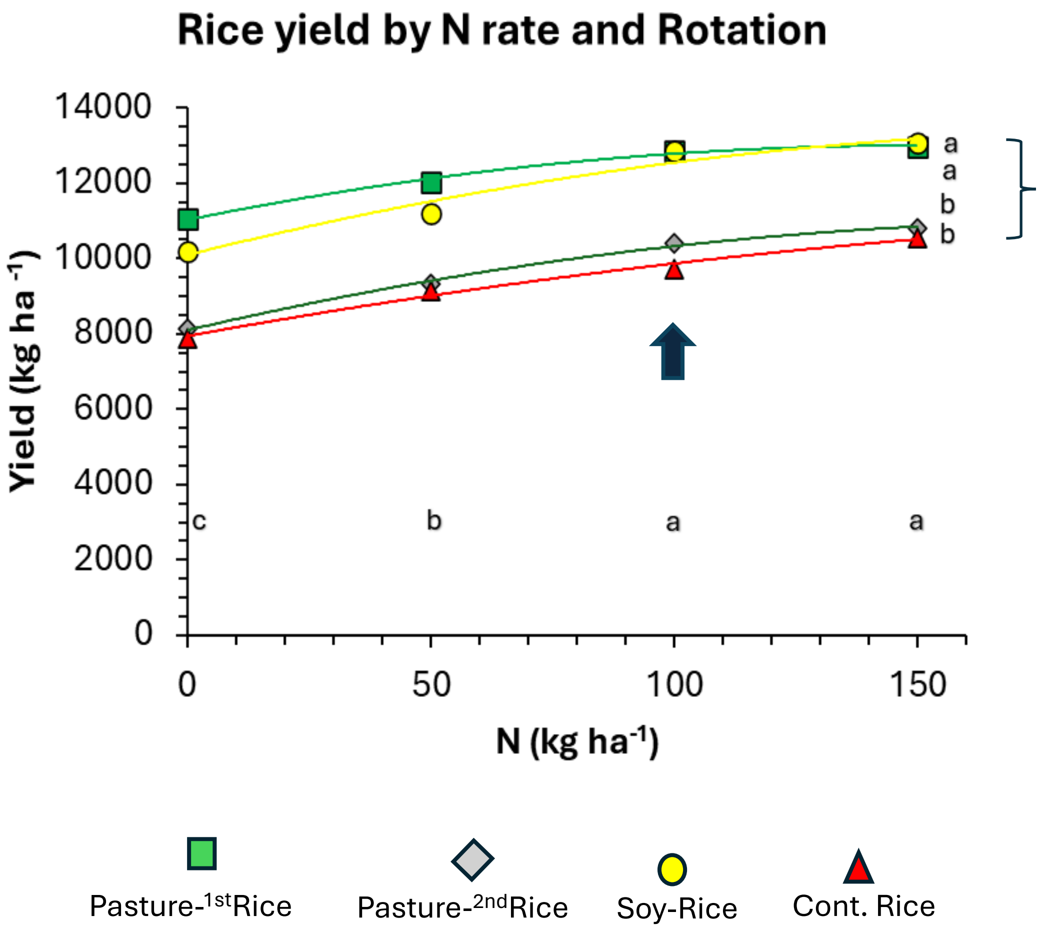


Mean (3 yrs.): 9,52 Mg ha^{-1}.



- Low potential yrs.: rice yield after pastures (9.5 Mg ha^{-1}) or Soybeans (10 Mg ha^{-1}) was similar, but both, higher than rice on rice (8.8 Mg ha^{-1}).

Was N related with yield differences among rotations/predecessors? (3 yrs. of the highest yield potential)



Fabini et al., in preparation

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Final Remarks

- Previous crop affected rice yield, even more than rotation.
- Soybean as previous crop had positive impacts on rice yield in all rotations and years.
- The greatest effects of soybeans and/or perennial pastures on rice productivity were observed in high yield potential environments.
- Rice yield after rice was less productive and more stable than other rotations/predecessors.
- Info contributes for the re-design of future intensive rice-pasture systems and the analysis of their sustainability.

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Thanks,

- José A. Terra; jterra@inia.org.uy

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