























Long Term Paddy riceupland rotational experiment: Uruguay

BACKGROUND - Uruguay





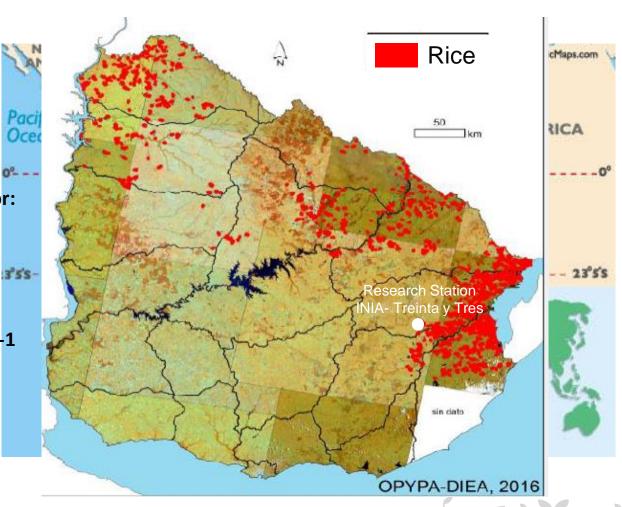


Mean temperature Sept-Apr: 19. 2ºC

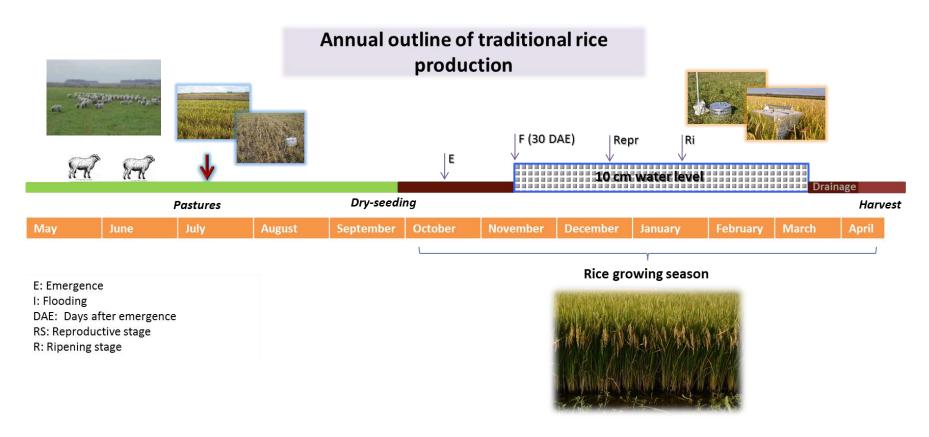
Annual Rainfall: 1361 mm

Area: 160500 ha

Rice Yield: 8000-8500 kg ha-1



Satellite images Jan-Feb 2016



✓One or two N top dressings are normally used (tillering /panicle initiation). The first top dressing is applied on dry soil 1-2 days before flooding to prevent N losses; the second one is applied, when the soil is flooded.

Traditional rice production system





Year	1		1		2	2		3		4		5		6	
Treatment	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW			
T. Control	Rice1	Pa	Rice2	Impr Pa											

SS: spring- summer; AW: autumn-winter



Previous studies on GHG emissions





Irisarri, P., Pereyra, V., Fernández, A., Terra, J., Tarlera, S.

Summary

CH₄ and N₂O Emissions in a Rice Field: First Measurements in the Uruguayan Productive System

Irrigated rice fields are major sources of two important greenhouse gases (GHG), methane and nitrous oxide. As an initial step towards obtaining local information, emissions of CH₄ and N₂O from rice paddy soil were measured by the static chamber technique in greenhouse and field experiments conducted in eastern Uruguay. In the greenhouse experiment, the effect of two flooding moments (21 and 45 days after emergence) and nitrogen fertilization (0 and 50 kg N ha⁻¹) on gas emissions was studied. Early flooding and nitrogen fertilization tended to increase N₂O emissions. In the field experiment, effect of winter saoil cover crop and nitrogen fertilization (0 and 82 kg N ha⁻¹) were tested. Higher CH₄ fluxes were observed mainly during the reproductive stage of the plant in the N-fertilized treatment with ryegrass winter crop. N₂O flux peaked at flushing. Results indicate that the use of cover crops might increase GHG emissions during the rice cycle. Despite differences in agronomic management practices employed in Uruguay, CH₄ and N₂O fluxes are within magnitudes previously reported for rice fields worldwide.

Key words: rice paddy soil, greenhouse gases, N fertilization.



Previous studies on GHG emissions





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Yield-scaled global warming potential of two irrigation management systems in a highly productive rice system

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ABSTRACT: Water management impacts both methane (CH₄) and nitrous oxide (N₂O) emissions from rice paddy fields. Although controlled irrigation is one of the most important tools for reducing CH, emission in rice production systems it can also increase N₂O emissions and reduce crop yields. Over three years, CH, and N₂O emissions were measured in a rice field in Uruguay under two different irrigation management systems, using static closed chambers: conventional water management (continuous flooding after 30 days of emergence, CF30); and an alternative system (controlled deficit irrigation allowing for wetting and drying, AWDI). AWDI showed mean cumulative CH, emission values of 98.4 kg CH, ha-1, 55 % lower compared to CF30, while no differences in nitrous oxide emissions were observed between treatments (p > 0.05). No yield differences between irrigation systems were observed in two of the rice seasons (p > 0.05) while AWDI promoted yield reduction in one of the seasons (p < 0.05). When rice yield and greenhouse gases (GHG) emissions were considered together, the AWDI irrigation system allowed for lower yield-scaled total global warming potential (GWP). Higher irrigation water productivity was achieved under AWDI in two of the three rice seasons. These findings suggest that AWDI could be an option for reducing GHG emissions and increasing irrigation water productivity. However, AWDI may compromise grain yield in certain years, reflecting the importance of the need for fine tuning of this irrigation strategy and an assessment of the overall tradeoff between relationships in order to promote its adoption by farmers.

Keywords: greenhouse gases, emissions, methane, nitrous oxide, mitigation



Long-term paddy rice-upland rotation experiment





Year	1		2		3		4		5		6	
Treatment	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW
1	Rice	Pa										
			_				_		_			
2	Rice1	Pa	Soybean	Pa	Rice2	Pa	Sorghum	Pa				
			_									
3	Rice	Pa	Pa	Pa								
4	Rice1	Pa	Rice2	Impr Pa	Impr Pa	Impr Pa	Impr Pa	Impr Pa	Impr Pa	Impr Pa		
5	Rice1	Pa	Soybean1	Pa	Soybean2	Pa	Rice2	Impr Pa				
								ı			T	
6	Rice	Pa	Soybean1	Pa								

SS: spring- summer; AW: autumn-winter



Long-term paddy rice-upland rotational experiment





General Goal:

 Identify systems of intensification of soil use by paddy rice-upland crop and pastures rotations that are economically and physically sustainable.



Benefits of rotational plots in paddy rice





- Multiple use of the land
- Improvement of nutrient imbalance in the plant and soil
- Increase in crop production
- Mitigation of methane emission



Long-term paddy rice-upland rotational experiment





General Goal:

 Identify systems of intensification of soil use by paddy rice-upland crop and pastures rotations that are economically and physically sustainable.

✓ Specific goal:

- Characterize these systems in relation to GHG emissions and the soil-microbial dynamics involved.

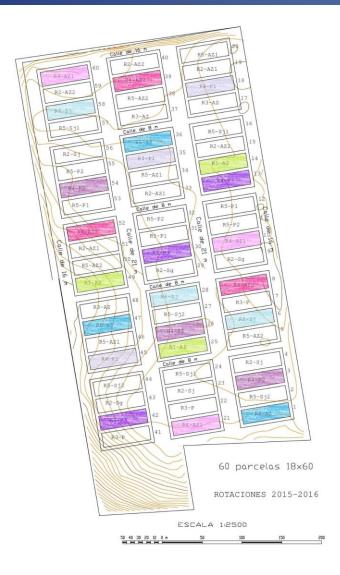
Structure and function of the methanogenic microbial communities in Uruguayan soils shifted between pasture and irrigated rice fields. Fernández Scavino et al.; Environmental Microbiology, 2013.

Long-term paddy rice-upland rotation experiment





Year	1		
ROTATION	SS	AW	
1	Rice	Pa	
4	Rice1	Pa	Ri
6	Rice	Pa	Soy



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S	AW	SS	AW
r Pa	Impr Pa		

Long-term paddy rice-upland rotational experiment: Interactions among GHG emissions, microbial dynamics and past soil management



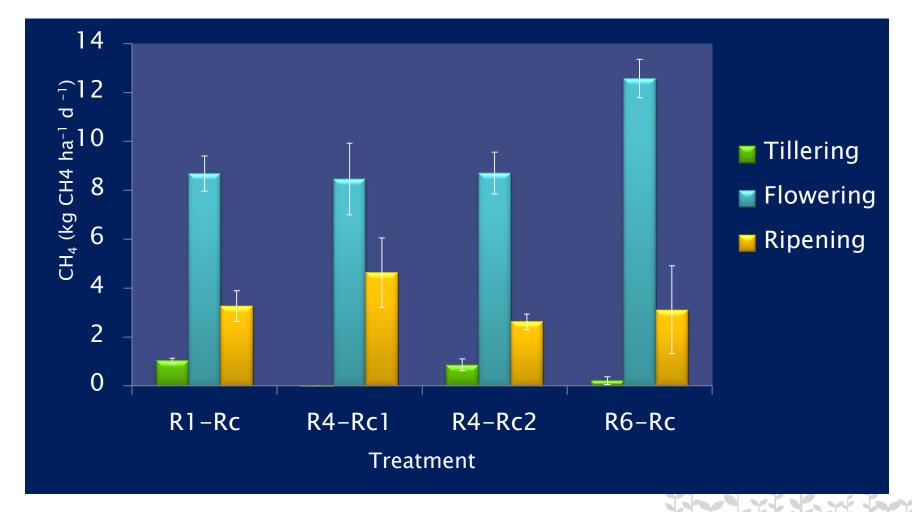


- Physicochemical parameters of the soil: pH, redox potential, NO₃ - , NH₄ + , Org C
- Potential microbial activities: nitrifying, denitrifying, methanogenic and methanotrophic in the lab
- Quantitative PCR of key genes: nirK, nirS, nosZ, amoA, amoB, pmoA and mcrA
- Gas fluxes with the closed chamber method in the field on an annual basis

Soil CH₄ flux at different rice growth stages



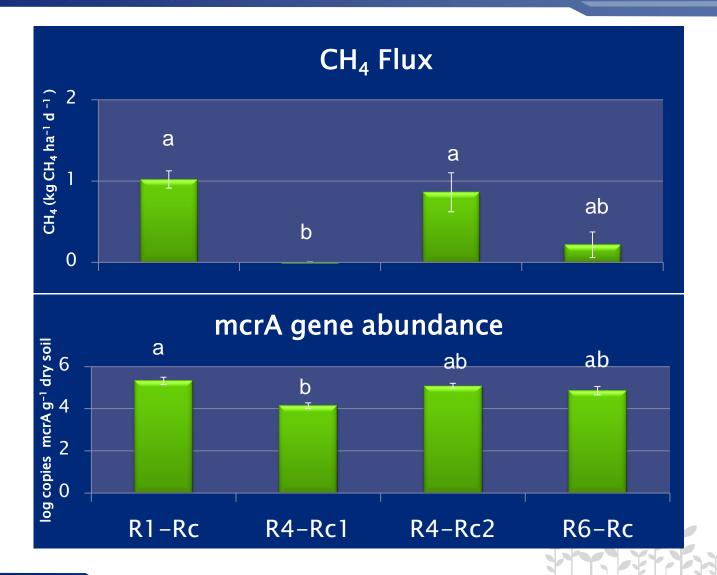




Tillering stage







Long-term paddy rice-upland rotation experiment



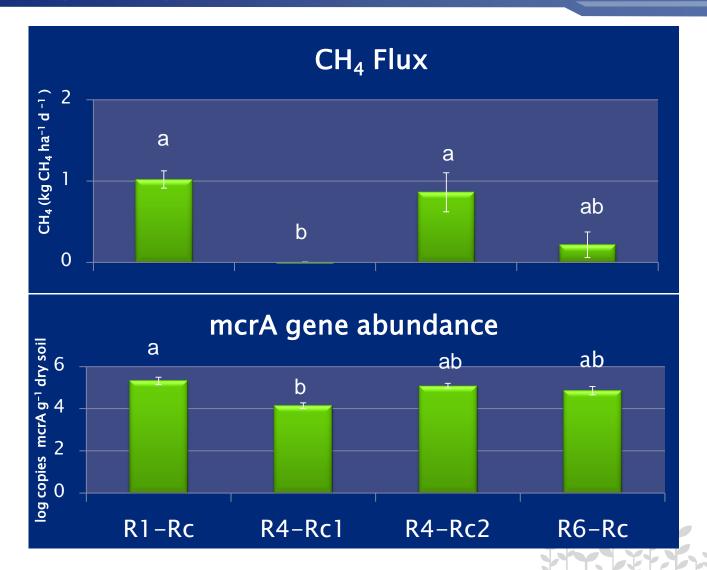


Year	1 2			3		4		5		6		
ROTATION	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW
1	Rice	Pa										
4	Rice1	Pa	Rice2	Impr Pa								
6	Rice	Pa	Soybean	Pa								

Tillering stage



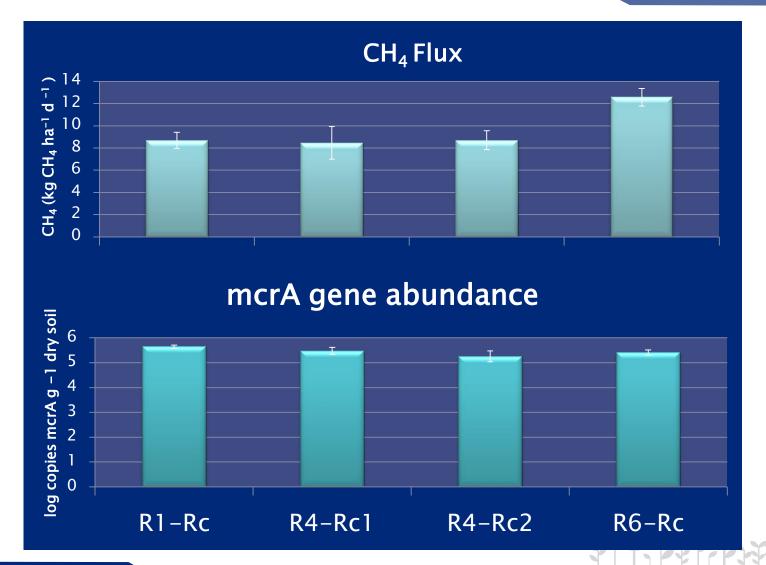




Flowering stage



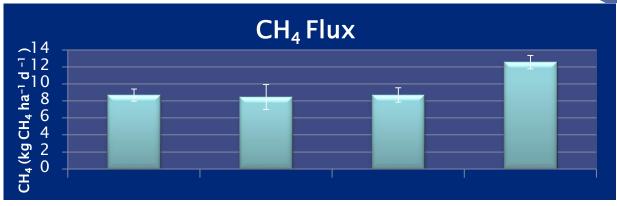


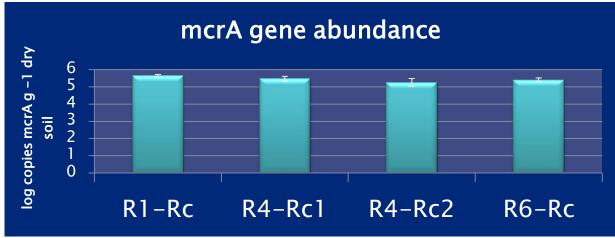


Flowering stage







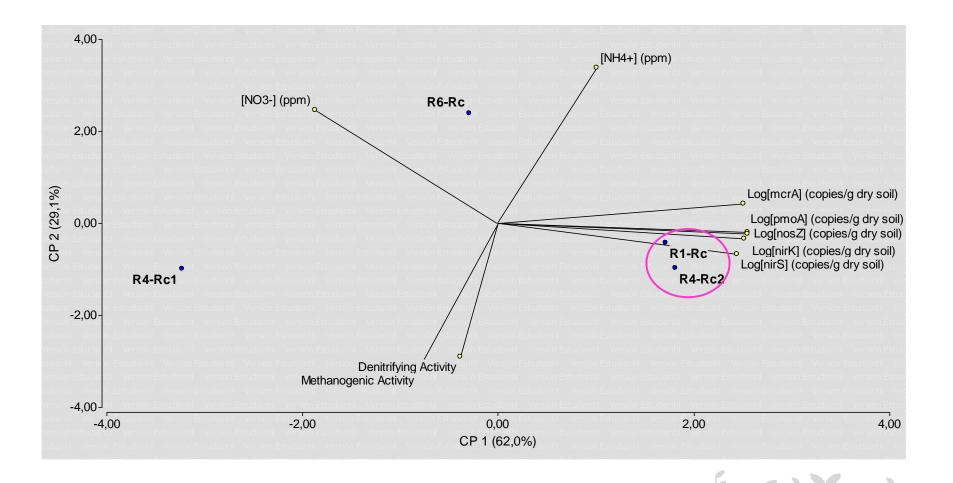


No significant differences observed

Biplot of Principal Component Analysis of the variables studied at the tillering stage







Long-term paddy rice-upland rotation experiment





Year	1 2		3		4			5		6		
ROTATION	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW	SS	AW
1	Rice	Pa										
4	Rice1	Pa	Rice2	Impr Pa								
6	Rice	Pa	Soybean	Pa							<u> </u>	

Long-term paddy rice-upland rotational experiment: Interactions among GHG emissions ,microbial dynamics and past management







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Thank You!



