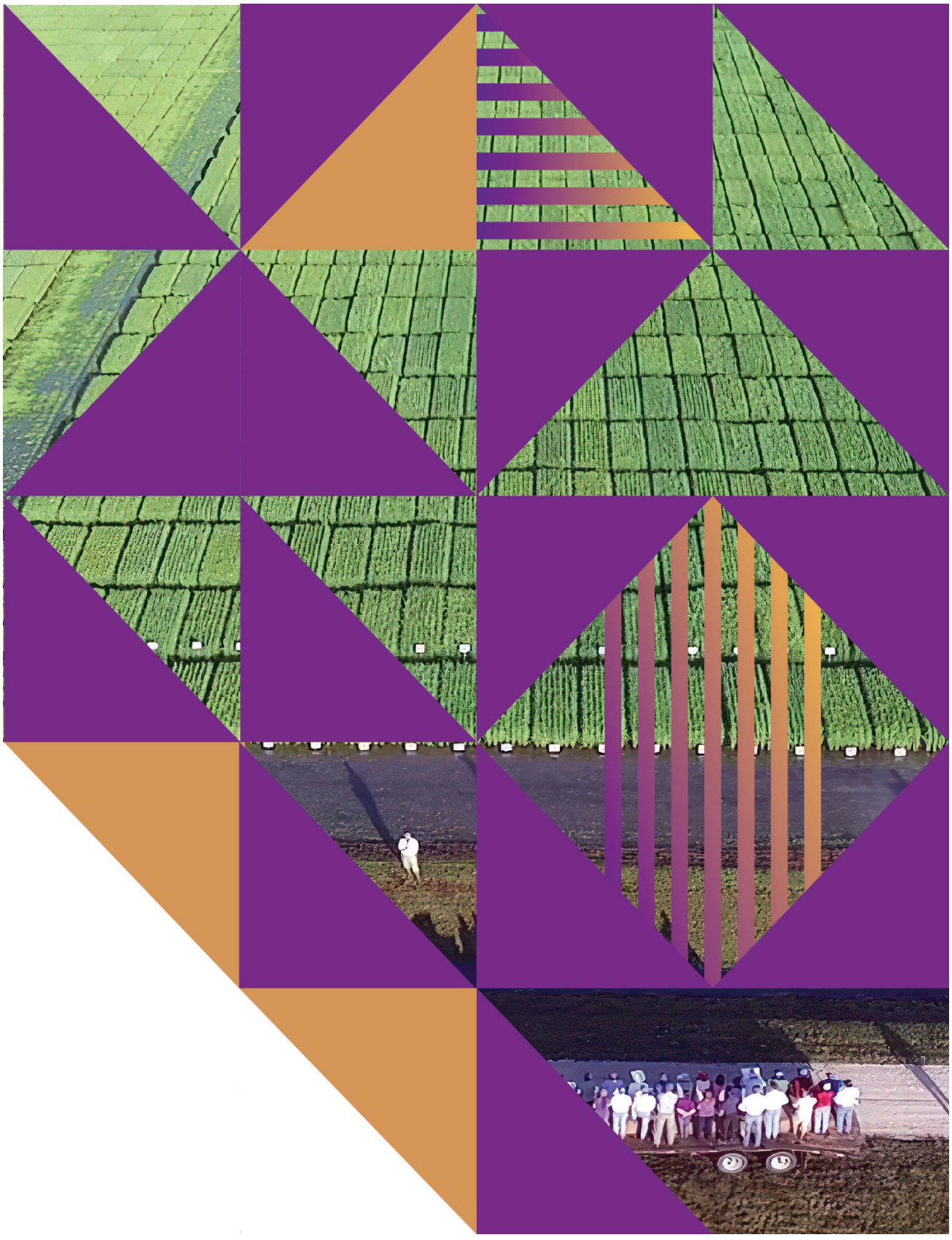
2024 INTERNATIONAL TEMPERATE RICE CONFERENCE



CULTURE AND SOIL SCIENCE – ORAL PRESENTATIONS

Irrigation and Phosphorous Fertilization Managements to Minimize Rice Grain Arsenic Content

Campos, F., Roel, A., Carracelas, G., Verger, M., Huertas, R., and Perdomo, C.

This research project was focused in minimizing inorganic arsenic levels in polished rice grain while maintaining crop yield and water productivity of the most planted *Indica* cultivar in Uruguay, INIA Merin. Two experiments were conducted during seasons 2018-2019 and 2019-2020. A split-plot experimental design with three blocks was used to test five irrigation treatments applied in main plots and two phosphorous fertilization treatments were applied in subplots. Irrigation treatments consisted in a control traditional continuous flooded (CF) and four alternative irrigation techniques (AIT) with one or two drying events during the crop cycle. Phosphorous fertilization treatments were an unfertilized control with 0 kg P_2O_5 ha^{-1} and the traditional fertilization practice commonly used in commercial farms of 50 kg P_2O_5 ha^{-1}. Accumulated inorganic arsenic in grain was below international maximum levels in all analyzed samples, with an average value of 0.084 mg kg^{-1}. Alternative irrigation treatment with two drying events, implemented at panicle initiation and full flowering stages, was the most effective irrigation treatment in reducing inorganic arsenic accumulation in grain, without neither affecting grain yield or water use. Cadmium rice grain levels that can potentially increase under this irrigation treatment were also well below international maximum levels. This irrigation technique could be considered as an alternative management to the traditional continuous flooded in order to reach minimal inorganic arsenic accumulation in grain to either attend special quality standards or specific market requirements.

Optimizing Rice Crop Management: Assessing Multispectral Images for Irrigation and Nitrogen Monitoring

Carracelas, G., Marchesi, C., Ballester, C., Roel, A., and Hornbuckle, J.

The rice sector is facing the challenge to keep increasing rice yields while maintaining or improving input use efficiency. Nitrogen and water are the main limiting factors to close the gap between actual and potential grain yield. Uruguay has room in specific areas to further increase the already registered high yields and resource use efficiency. The purpose of this study was to investigate remotely sensed indices that could provide useful information for optimizing rice crop management.

The study was conducted in the North experimental unit of Uruguay over the 2022-23 rice season. A split plot experimental design featured two irrigation treatments (main plots): traditional early continuous flooding and safe alternate wetting and drying until the start of the reproductive period. Nitrogen fertilization treatments (split plots) included no nitrogen, recommended rate based on soil analyses, and two additional doses (50% below and above recommendation). Multispectral images were collected at various phenological stages, with a specific emphasis on tillering and panicle initiation. Ground truth crop parameters, including biomass, nitrogen content, Greenseeker

readings, and SPAD measurements, were collected to assess correlation with calculated vegetation indices (VIs).

This research has shown that the recommended nitrogen fertilization rate based on soil analyses, determined the highest yield with no statistically significant differences with the fertilization 50% above it. Alternative irrigation did not reduce grain yield in comparison with the traditional flooded technique. VIs that uses the red edge band were more sensitive to detect crop differences due to fertilization management. This study indicated that it is possible to obtain high rice yields while optimizing water and nitrogen use. The findings are important to assist rice farmers in selecting sensitive and effective VIs for real time remote crop monitoring and management optimization.

Long-Term N-P-K Balances and N Use Efficiency in Contrasting Rice Rotations

Castillo, J., Macedo, I., Bordagorri, A., Roel, A., and Terra, J.A.

The maintenance of an adequate soil nutrient status is crucial for ensuring food security while avoiding nutrient imbalances, mining, or enrichment that may lead to environmental damage. In Uruguay, the traditional rice-pasture rotation, allowing for direct livestock grazing, has gradually shifted towards more intensive rotations over the last decade, primarily adopting a rice-soybean rotation. This has given rise to issues pertaining to the necessity of reviewing the fertilization strategy and assessing its long-term impact on crop yields and nutrient balances associated with these new intensive rotations.

To address these questions, we evaluated three contrasting rotations in a long-term experiment: a) rice-pasture (RI-PAST, involving two consecutive rice crops with *Lolium multiflorum* Lam. used as a cover crop between both crops, followed by three years of improved pasture grazed with lambs), b) continuous rice-soybean (RI-SOY), and c) continuous rice (RI-CONT). The latter two rotations included *Trifolium alexandrinum* L. as a winter cover crop. Fertilization followed a sufficiency level approach for the rice-pasture rotation and a maintenance approach for the other rotations, with soil nutrient levels built up at the start of the experiment. We quantified nitrogen (N), phosphorus (P), and potassium (K) balances, nitrogen use efficiency (NUE), and soil nutrient trajectories (0-20 cm) over 11 years, considering nutrient inputs and outputs. Major P and K inputs primarily consisted of fertilizers, while for N, atmospheric depositions and biological fixation were also considered. Outputs for P and K accounted for nutrients removed in grain and meat, while N outputs also considered losses, estimated based on the DNDC model. Calculations for NUE considered the N removed in food products in relation to all N inputs.

For rice, the common crop in all rotations, grain yield was higher in RI-SOY and RI-PAST compared to RI-CONT over the entire period. Nutrient inputs were greater in RI-CONT followed by RI-SOY and RI-PAST, while nutrient outputs were greater in RI-SOY and RI-CONT compared to RI-PAST for the entire rotation. This resulted in positive P and K balances in all rotations, with RI-CONT and RI-SOY reaching higher balances than RI-PAST. Regarding N, the balance was highly positive in RI-CONT, highly negative in RI-SOY, and approximately neutral in RI-PAST. Despite positive P and K balances in RI-CONT, available nutrient trajectories showed a decrease in the soil solution. For RI-SOY, there was a positive trend for P and a negative trend for K when comparing the beginning and end of the period. In RI-PAST, soil P and K maintained a steady state