Rice Technical Working Group

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PROCEEDINGS. . .

Thirty-Seventh Rice Technical Working Group

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capacity and to AWD (drying to 40%) only during vegetative growth stages followed by maintained flood during reproductive growth stages. The AWD treatments began 14 days after the initial flood. The control was permanent flood throughout the growing season. All nitrogen (N) fertilizer was applied in a single pre-flood application. In the second and third years, N cycling was investigated through ^{15}N micro-plots imbedded within three of the four field replicates. Rice uptake of ^{15}N estimated crop uptake of fertilizer N, and rice uptake of ^{14}N estimated crop uptake of soil N.

AWD improved water use efficiency (kg grain m^{-3} water applied) by 22 to 43%. It also reduced in-season greenhouse gas emissions by 38 to 90% depending on cropping history (continuous rice or first-year rice) and duration of drying cycles (vegetative growth only versus season-long). Methane emissions fell by 43 to 94%, and N_2O emissions rose only slightly due to coordination of AWD with the timing of N fertilizer inputs. Grain yield decreased by 5% with season-long AWD (drying to 60%) compared to the flood control, and any N uptake decrease was insignificant. With AWD drying to 40%, grain yield and N uptake were limited by water stress; this treatment will not be discussed further. For continuous rice, grain yield did not decrease in the treatment having AWD during vegetative growth followed by maintained flood during reproductive growth, which we attribute to a late-season increase in available soil N as measured in the ^{15}N micro-plots. At harvest, continuous rice had taken up 20 to 47 kg N ha^{-1} more in this treatment than in the season-long AWD or the continuous flood control, due mostly to the late-season soil N flush. The size of this N flush grew during the three years of continuous rice cropping, possibly reflecting a gradual accumulation of higher quality soil organic matter resulting from more aerobic decomposition of crop residues. The aeration treatments had no clear effect on N cycling or yield trends for first-year rice. All aeration treatments for first-year rice had greater grain yield and N uptake than did all continuous rice treatments, especially for third-year rice.

The evolution of this yield gap during second- and third-year rice cropping was driven by decreasing crop uptake of soil (^{14}N) nitrogen, consistent with our earlier research on an observed yield gap between continuous rice versus rice-soybean cropping. Details will be provided on the biochemical composition of the soil organic matter, including phenol levels which our earlier work associated with the inhibition of soil N cycling under continuous rice. Combinations of crop rotation and AWD offer growers a range of options to meet their desired balance of grain yield, water savings, and reduction of greenhouse gas emissions. They also provide producers with strategies to better use available soil N.

Breaking Yield Barriers of Uruguayan Rice Farmers

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The costs of rice cultivation in Uruguay increased significantly in recent years. Higher crop yields and more efficient use of resources and inputs are needed to maintain or increase producers' profit. Average farm yields in a region or country are smaller than Yield Potential (Y_p) because achieving it requires a perfect management of soil and crop that could affect plant growth and development along its cycle. Best farmers sometimes can get that objective, but in general it is not profitable. Given that the average productivity obtained in Uruguay is already high and that the yield gap among farmers has decreased in recent years, it has been questioned if there are opportunities to increase it more and in a sustainable way through new integrated crop management proposals.

A project was initiated in 2013 with the objective of testing the feasibility of increase yields at least 10% over the best farmers, integrating available technologies and practices of crop management. Thirty-nine rice farmers who belonged to the top yield quintile during the period 2009-2013 in the Eastern Region of Uruguay were identified, from industry records. All of them were interviewed to identify the most important practices that contribute to this maximum regional productivity. Based on the environmental characteristics three sub-regions were characterized resulting in 3 groups of producers. Twenty technologies for integrated management of rice cultivation associated with these producers were recorded, and the relative frequency of use of different options, was analyzed within each group. From this study, a baseline technology from best farmer´s on each three sub-regions was defined.

Four factors were proposed as alternative practices for increasing yields, to be evaluated in 2014-15 and 2015-16 experiments: 1) cultivar (high yield potential/Blast disease resistance), 2) crop installation (seed treatments/number of plants to be installed per unit area), 3) fertilization management (basal and split/ macro and micro-nutrients applications), 4) disease protection (only one fungicide application plus aggregates of potassium phosphate and silicon).

Twelve treatments arranged in a RCB Design with 3 replications were tested in 4 locations. Plots of 6.12m wide by 20m long were installed. The first treatment corresponds to the top farmer technology (TFT); in each of the following five treatments (2 to 6), one of the factors is substituted by their proposed alternative. In a similar, but reverse way, in treatment 7 all alternative practices in the four factors were used. In each of the remaining treatments (8 to 12), on factor at a time was substituted by the original on treatment 1. In summary, the objective was to evaluate if at least one of the 11 combined treatments (2 to 12) in each location, was able to obtain a 10% yield increase over the treatment 1, trying to exploit the positive interactions among several factors.

Eight experiments were performed in 2014-15 and 2015-16 growing seasons (GS), with statistical coefficients of variation ranging between 2.4 and 5.3. Top farmer´s treatments (Trt.1) yielded 12.8 Mg ha^{-1} and 13.9 Mg ha^{-1} in Rincon de Ramírez; 11.5 Mg ha^{-1} and 12.3 Mg ha^{-1} in 7ª Section. - San Francisco Treinta y Tres; 9.4 Mg ha^{-1} and 12.1 Mg ha^{-1} in Cebollatí; and 11.6 Mg ha^{-1} and 12.2 Mg ha^{-1} in India Muerta (first and second year, respectively). Productivity percent increments over treatment 1 of 16.4 - 6.2 - 15.1 - 9.3 in 2014-15, and 0 - 7.7 – 7.1 – 11.5 in 2015-16 GS, were obtained with some of the alternative treatments. Significant statistical differences between treatments and locations were detected within a growing season analysis, and also between years and location within the same place.

The last year of the project was devoted to validation of experimental results in large areas in farmer´s fields. Two paired plots of 4-5 ha each were installed in six commercial farms along the three sub-regions and they were completely managed by the rice farmer. In one of the plots the baseline technology of top farmers was applied (treatment 1 of previous experiments) and the best resulting treatment from the two-year experiment was used in the other plot. Yield average of improved technology plots was 10.5 Mg ha^{-1} (range 9.3 to 12.2 Mg ha^{-1}), obtaining 14.5% increase over the average of plots with the best producer's management (TFT: mean 9.2 Mg ha^{-1} range 8.6 to 10.1 Mg ha^{-1}). These results suggested there is no yield ceiling for Eastern Uruguayan rice farmers and bring opportunities to improve yields and profit.

Soil Health Evaluation of Flooded Rice Cultivation in South Florida

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Flooded rice (*Oryza sativa L.*) in South Florida is grown commercially in rotation with sugarcane and vegetables. From 2008 to 2015, rice production has increased more than 80%. During the spring-summer, more than 50,000 acres of fallow sugarcane land is available for rice production. In 2017, approximately 28,000 acres of rice were planted in the region. The net value of growing rice in the Everglades Agriculture Area (EAA) as a rotation crop far exceeds its monetary return. In addition to being a food crop in Florida, production of flooded rice provides several benefits to the agroecosystem. By flooding fields, growers greatly reduce the negative impacts from issues related to soil subsidence, nutrient depletion, and insect pests. This, in turn, enhances the subsequent sugarcane crop and maximizes the longevity of the soil by reducing soil loss due to oxidation. Our objective was to evaluate soil quality parameters before and after rice cultivation and compare them against two other common summer farming practices of fallow fields and flooded fallow.

The soil health parameters that were tested as part of this study included soil pH, bulk density, water holding capacity, cation exchange capacity, organic matter, nutrient content, and carbon microbial biomass. Quantifying these changes and comparing them to flooded fallow or fallow field practices will help assess the impact of rice cultivation on soil health parameters. Six 40-acre fields were considered for each land-use practice. The goal of the study was to evaluate rice cultivation from a soil health perspective.

Results indicated a slight increase in soil pH, and a significant reduction in soil bulk density as a result of rice cultivation. Water holding capacity increased significantly under all flooded land use practices compared to fallow fields. Cation exchange capacity significantly increased when sugarcane fields were cultivated with rice and ratoon rice, nearly doubled from 58 to 101 cmolc/kg. Small, yet significant 3% increase in organic matter was observed when sugarcane fields were cultivated with ratoon rice. Almost 16 g/kg of active C is being generated within fallow soils, whereas no more than 8 g/kg of active C under flooded practices. From a soil sustainability point of view what this