Rice Technical Working Group

Arkansas California Florida Louisiana Mississippi Missouri Texas

PROCEEDINGS. . .

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Edited by: Michael Salassi, Bruce Linquist and Lee Tarpley

by 33 and 20%, respectively, compared to control. Similar to 23ºC treatment, DCD application led to higher NH_3 losses compared to control at 30ºC.

Increase in temperature from 23 to 30ºC significantly increased the N_2O emissions in all sub-treatments. At 23ºC, NBPT and K32 increased N_2O emissions by 101 and 76%, respectively, compared to control. However, application of DCD significantly decreased N_2O emissions by 95% compared to control. Similar to 23ºC treatment, N-stabilizers NBPT and K32 increased N_2O emissions by 3.9 and 4.1 times, respectively, compared to control, while DCD decreased N_2O emissions by 31%. These results prove that DCD was very effective to suppress nitrification in PL applied soils, similar to inorganic-N fertilizer applied soils, leading to lower N-losses as N_2O. The effectiveness of DCD was lower at higher temperature. Additional research is needed to understand the increased N-loss as N_2O by NBPT and K32. The study revealed that temperature significantly effects the N-losses as NH_3 and N_2O. While N-stabilizers can minimize N-losses from PL applied soils, they were more effective at minimizing NH_3 losses at the higher temperature. Though DCD is effective in reducing N-loss as N_2O, its efficacy was lower at the higher temperature.

Effect of Nitrogen Source and Rate on Soil Microbial Community Structure during Rice Production

Li, X., Dou, F., Guo, J., Velarca, M.V., Chen, K., Gentry, T., and McNear, D.

Selections of nitrogen source, rate and cropping system are important management practices to meet increasing demand in rice yield. Soil microbial community structure shifts with changes in management practices and varies at different rice growth stages. A greenhouse trial was conducted to study effects of rice cultivation (XL753), cropping system (organic system received Nature Safe, and conventional system received Urea), and nitrogen rate (0, 50, 100, 150, 200, and 250 kg N ha^{-1}) on PLFA profiling of microbial community structure at four growth stages of rice (Day 8 germination, D39 maximum tillering, D55 heading, and D111 after harvest). Total microbial biomass (TMB) was significantly ($P < 0.0001$) higher in soils with rice cultivation than control and significantly ($P < 0.0001$) affected by growth stages, which was dramatically higher at D111 (261 nmol g^{-1}, in average) than at D8 (72.4 nmol g^{-1}), D39 (61.9 nmol g^{-1}), and D55 (71.0 nmol g^{-1}). Of TMB, General FAME (average 30.5%) > G+ or G− bacteria (25.7%, 24.9%) > Actinomycetes (12.8%) > Fungi or Arbuscular Mycorrhizal Fungi (2.5%, 2.8%) > Protozoa (0.9%). Rice growth stages significantly ($P < 0.001$) affected all individual PLFAs; nitrogen rate only had significant ($P < 0.05$) effect on fungal PLFAs; while neither N source nor cultivation had significant effect ($P > 0.05$) on any individual PLFAs. Bacterial PLFAs, rather than fungal, dominated the community with a mean bacterial / fungal ratio of 11.3 – 13.8, which was significantly higher ($P < 0.0001$) at heading than other stages, higher ($P < 0.05$) in Control than XL753, and higher in Urea than Nature Safe. The result indicated that the capacity of soil to sequester C, reflected by B/F ratio, was lower at heading than other stages, lower in control soils than soils with rice cultivation, and lower in conventional system than organic system.

Yield Gap Analysis and Prognosis of Yield Increase of Irrigated Rice in Uruguay

Carracelas, G., Grassini, P., Guilpart, N., Cassman, K., and Zorrilla, G.

The Uruguayan rice sector has become one of the most successful and most integrated agricultural industries in the country, which has contributed to increased yields at one of the highest rates worldwide (145kg^{-1} ha^{-1} yr^{-1} from 2000 to 2017). However, this yield trend has shown a marked slowdown in recent years, which may be indicating that average rice yields are approaching the biophysical yield ceiling. A robust yield gap analysis was conducted to distinguish between a temporary or permanent yield plateau and determine if would be possible to further increase yields in Uruguay. For this purpose rice yield potential (Yp) and current exploitable yield gaps (Yg) were estimated at local farm-level to regional and national scales, and a comparative analysis with other rice countries included in the Global Yield Gap Atlas (GYGA) was conducted. Estimation of rice Yp and Yg is essential to identify opportunities for future yield gains. Also unknown was if the rapid rate of increase in Uruguayan rice yields since 2000 was associated with favorable climate change.

Methodology developed by GYGA (www.yieldgap.org) was followed to select data sources, define the agro-climatic zones, simulate rice Yp and estimate Yg at reference weather stations (RWS) within Uruguay. Data on current farm yields (Ya) were collected from the Uruguayan rice Industry database. The crop simulation model Oryza (v3) was used to simulate Yp over a period of 18 years for each of the 7 selected RWS. Two independent datasets were used for model calibration and validation. Comparison of simulated flowering and maturity dates against measured collected data from experiments and yield validation indicated good agreement between simulated and observed values giving confidence in model performance for rice in Uruguay.

The *exploitable* Yg was calculated as the difference between 80% of Yp and average Ya over five years (2010-2014). Estimated national average Yp was 14 t ha^{-1} (14% moisture) with a relatively small range across RWS of 13.0-14.7 t ha^{-1}. Average Ya across RWS was 8 t ha^{-1} ranging from 7.7 to 8.5 t ha^{-1}, which gives a national Yg = 3 t ha^{-1} with a range of 1.9-4.1 t ha^{-1}. The lack of significant trend in the average yield potential in Uruguay during the 18 years analyzed ($P<0.05$) indicates there was no significant effect of climate change on the rate of rice yield increase for most regions in Uruguay. Because current Ya is only 57% of Yp, it should be possible to continue improving rice yields and close much of the existing Yg. An additional 0.5 million metric tons of rice production would be possible if average farm yields reached 80% of Yp. Comparing these results with that for rice in other countries included in the GYGA, shows that it would be possible to maintain or increase yields within existing rice production areas, which will contribute to meet the growing demand for rice worldwide.

Effect of Long-term Potassium Fertilization on Rice Yield and Mehlich 3 Extractable Potassium

Jones, G.T., Slaton, N.A., Norman, R.J., Roberts, T.L., DeLong, R.E., and Liyew, Y.D.

Potassium (K) is important in dry matter production, stalk strength, and other plant health components that contribute to yield in rice [*Oryza sativa (L.)*]. In the mid-South, rice is most commonly grown in rotation with soybean [*Glycine max (L.) Merr.*], which has a high demand for K. A long-term trial has been conducted on a Calhoun silt loam for the previous 18 years to determine the effect of five fertilizer-K rates (149, 112, 75, 37 and 0 kg K ha^{-1}) on rice and soybean yields and Mehlich 3 extractable soil K. Regression analysis was performed to determine crop yield and extractable soil K trends among K rates over time.

Rice yield was a quadratic function across time that was dependent upon annual K rate. When averaged over nine rice crops (years), rice yields averaged 7044, 8102, 8499, 8677, and 8887 kg ha^{-1} for the 0, 37, 75, 112, and 149 kg K ha^{-1} rates, respectively. Rice yields were not significantly different in the first year of the study. Since the third year of rice (year 5 of the study), rice yields in the 0 kg K ha^{-1} have been significantly lower than all other treatments with relative yields ranging from 75 to 85% of the maximum yields produced by rice receiving fertilizer K. Also, since the third rice crop, rice fertilized with 37 kg K ha^{-1} has produced yields significantly lower than rice fertilized with 75 to 149 kg K ha^{-1}. Maximal numeric rice yields have been produced by rice fertilized with 149 kg K ha^{-1}, but the predicted yields have been greater than the yields of rice fertilized with 75 and 112 kg K ha^{-1} rates in four (112 kg K ha^{-1}) or six (75 kg K ha^{-1}) of the nine rice crops. Numerical relative yield differences among the 75 to 149 kg K ha^{-1} $year^{-1}$ rates have ranged from 0 to 8%. Mehlich 3 extractable K was dependent on annual K rate and responded linearly across time. Soil test K values were 91, 94, 96, 103, and 101 ppm in 0 to 149 kg K ha^{-1} plots after the first year of rice production. The 2017 soil test K results showed mean soil-test K values of 43, 54, 65, 78, and 92 ppm for the five annual K rates in increasing order, respectively, with all treatments being significantly different from each other for the past 10 years. This trial shows that on the loamy soils used for rice and soybean production in Arkansas, long-term omission or application of below optimal K rates results in reduced rice yields and low soil-test K values. It should be noted that for soil receiving the greatest annual K rate, soil-test K has remained nearly constant across time despite a large positive K balance (input greater than removal).

Does Moist Soil Analysis Improve Soil-Test Based Potassium Fertilizer Recommendations for Rice?

Slaton, N.A., Norman, R.J., Roberts, T.L., DeLong, R.E., and Jones, G.T.

Mehlich-3 extractable potassium (K) has been shown to be a relatively good predictor of soil K availability for flood-irrigated rice (*Oryza sativa* L.) produced in Arkansas. The standard method for processing soil for routine soil testing is oven drying so that soil samples can be mixed and subsampled for extraction without having to account for differences in water content. Research has shown that oven drying soil influences the amount of K extracted and that K extracted from field-moist soil is a better predictor of corn (*Zea mays* L.) and soybean [*Glycine max* (L) Merr.] response to K fertilization. Our research objective was to evaluate whether Mehlich-3 K extracted from field-moist