Program 9R-2

▸ Development And Validation Of The Nitrogen-Soil Test For Rice: N-ST*R

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In recent years production agriculture has experienced a wide array of price fluctuations influenced by the instability of the world economy. This extreme market volatility was experienced firsthand by rice producers as the price of urea quadrupled in less than a year's time. Increasing nitrogen (N) fertilizer prices threaten the long-term sustainability of US rice production and the implementation of a soil-based N test will result in better management of N fertilizer and more profitable rice production, while lowering the potential environmental impact of rice production. Soil fertility has searched for a soil-based testing method to manage N fertilization in crop production for decades. Current practices rely on soil type, residual inorganic-N (NO3- and NH4+), yield goal and/or previous crop to determine N fertilizer recommendations (Blackmer et al. 1997). Many crops, such as corn and rice, require large amounts of N fertilizer when utilizing either a yield based or soil texture based fertilizer recommendation. These methods do not take into account the soil N that may become mineralized during the growing season and have no predictive value (Mulvaney et al. 2006). Conventional rice production has relied on yield goal estimates for determining N fertilizer needs, which can often lead to over-fertilization of crops and potentially higher impacts on the surrounding environment. Understanding the amount of N that can be supplied by the soil may significantly reduce the amount of N fertilizer required in many fields to obtain maximum rice yields. Implementation of a soil-based N test for rice production will allow N fertilizer recommendations on a field specific basis and ensure more profitable rice yields while lowering environmental impact due to excess N.

Researchers at the University of Arkansas have successfully correlated and calibrated a soil-based N test for rice using 27 site-years of data collected from N rate trials on experiment stations and producer fields from 2004 to 2008 (Roberts et al. 2010). The new N-Soil Test for Rice (N-ST*R) measures the alkaline hydrolyzable N fraction of the soil using direct steam distillation. The coefficients of determination for N-ST*R increased for percent relative grain yield (RGY) and N rate to give 95% RGY as sampling depth increased from 0-15 cm until 0-45 cm, but then dropped significantly when increased to the 0-60 cm depth. Coefficients of determination for N-ST*R were greatest for percent RGY at the 0-45 cm depth (r2=0.73). Calibration of the fertilizer N rate to achieve 95% RGY resulted in similar trends as the correlation of rice response parameters, but with a much higher r2 value of 0.89. The successful calibration can be attributed to the N dynamics that exist in the direct-seeded, delayed-flood rice production system, the consistency of direct steam distillation, and identification of the proper sampling depth.

Research with N-ST*R has shown that in most situations the standard N recommendation results in over-fertilization and some producers planting rice after continuous soybean, catfish or fallow may be able to eliminate or at least drastically reduce the N fertilizer rate while maximizing yields. Work on the N-ST*R recommendations has lead to the development of three calibration curves which will prescribe the N fertilizer rate required to achieve 90, 95 and 100% RGY. Utilization of the three N-ST*R calibration curves will allow producers to make management decisions based on their production philosophy and current production costs. Implementation of a soil-based N test will allow site-specific N fertilizer recommendations, thereby avoiding excess N applications and lowering potential environmental impacts, while decreasing the incidence of lodging and disease. Prior to the implementation of this soil-based N test for rice fertilizer recommendations in Arkansas there are a series of issues that must be addressed and include the validation of the test from a production standpoint, field variability and the timeframe in which samples must be taken relative to N fertilizer application.

A series of small-plot to field-scale experiments are being conducted to validate the N-ST*R calibration and soil sampling protocol. Field validation studies included five N fertilizer rate treatments and four replications. Nitrogen rate treatments included a check (0 kg N ha-1), standard recommendation for silt loam soils in Arkansas (168 kg N ha-1) and prescription N rates for each field based on the N-ST*R value and the three calibration curves. Using N-ST*R for the 95% RGY goal resulted in N rate recommendations ranging from 20 to 258 kg N ha-1. Yields were compared for the 90, 95 and 100% RGY treatments to the standard N fertilizer rate recommendation to evaluate the ability of N-ST*R to predict site-specific N rates that would maximize yield. Initial results show that maximal yields could be obtained using the 95 and 100% RGY curves for each of the 20 sites investigated. In many cases, the yield obtained using the N rate from the 90% RGY calibration curve was not significantly different from the maximal yield for a given location. Success of the N-ST*R program will lead to further validation studies and implementation of strip verification trials in producer fields to gain more data on the ability of N-ST*R to prescribe site-specific N rates and provide a field-scale demonstration of this exciting new management tool.

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Program 13R-2

▸ Trends In Reduced Tillage In Louisiana Rice Production

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Interest in reduced tillage rice production began in the late 1980's at a time when the predominant method of seeding in south Louisiana was water seeding. The driving force behind water seeding was red rice. Red rice is a weedy form of rice and belongs to the same genus and species of cultivated rice. Thus any herbicides that would kill red rice would also kill cultivated rice. By water seeding red rice germination and emergence could be suppressed. It was and is the most effective cultural control method available.

In other crops planter manufacturers were modifying existing equipment or designing entirely new planters to meet the challenges of good seed placement in no-till or reduced tillage seed beds. Because none of these planters work in water seeded situations one of the most difficult challenges to reduced tillage rice production was establishing good seed to soil contact. Broadcasting seed by air into standing water presents its own set of problems such as seed midge, water mold, seed drift and bird depredation. Sowing seed into stubble in standing water on firm soil compounds the problem.

Early attempts were met with frustration and disappointment. Only the most determined adopted reduced tillage in rice production while acreage devoted to reduced tillage in other crops took off. In northeast Louisiana where drill seeding was already in practice rice farmers slowly applied lessons learned in their other crops to rice.

In Louisiana reduced tillage acreage is broken down into no-till and stale seedbed. True no-till includes planting into existing crop residue, planting into a fallow field, and planting into crawfish ponds without seedbed preparation. Stale seedbeds are seedbeds prepared either in the fall or late winter then left undisturbed until planting. In Louisiana even a seedbed prepared in late winter will likely be covered by native vegetation by planting time only a few months later. Land prepared in the fall remains bare only a very short period of time before