NEWS & VIEWS

A regional newsletter published by the Potash & Phosphate Institute (PPI) and the Potash & Phosphate Institute of Canada (PPIC)

Dr. C.S. (Cliff) Snyder, Southeast Director

July 2004
Part 1 of 2

2003 Research Program Summaries—Southeast Region: Soybeans, Site-Specific Management, and Rice

THE Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR) provide financial and technical support for agronomic research and education projects across North America. These studies are designed to answer production agriculture questions and to provide guidance for site-specific, sustainable, high-yield management.

The summaries that follow provide a brief overview of each project. For more details, please consider contacting the research project leader. You can also view the full annual reports of each project (current and past), when available, at the website:

>**http://www.ppi-far.org/research**<.

Once at this website, click on "Continue" then click on "Expand" under North American Programs and look for projects by state abbreviation and title.

Arkansas

Influence of Nitrogen Fertilizer Source, Application Rate, and Timing on Grain Yields of Delayed-Flood Rice

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Project Cooperators: N.A. Slaton, C.E. Wilson, Jr., D.L. Boothe and B.R. Griggs

Drill-seeded rice (Wells variety) yield and ammonia volatilization response to urea, ammonium sulfate (AS), and a 50:50 mixture of urea and AS were evaluated with and without Agrotain®, on a silt loam soil with 7.6 pH . The nitrogen (N) was applied pre-flood and compared under 1, 5, and 10 day delayed-flood management after surface broadcast application of the N. The N rates were 0, 60, and 120 lb/A for yield comparisons. Ammonia loss (volatilization) of the different N sources was evaluated using the 120 lb rate applied 10 days prior to flooding. Within 5 days of application, urea lost almost 15% of the applied N while the AS and Agrotain® lost only about 3% and 1%. By 10 days after application and the time of flooding, the ammonia losses of the applied N had leveled off at about 17% for the urea and about 4% for the Agrotain®, respectively. Ammonia volatilization losses of N from AS with flooding delayed until 10 days after N application were not significantly different from those measured at 5, 15, or 20 days after application. Rice grain yields reflected the pattern of N loss with the different sources, rates, and delayed flooding. Agrotain®, AS, and AS + Agrotain® had the highest grain yields and least ammonia volatilized when application was made 5 and 10 days prior to flooding. Rice grain yields were intermediate when AS + urea was applied at 5 and 10 days before flooding. Ammonium sulfate + urea also had intermediate ammonia volatilization losses at these times compared to the other N sources. Most of the yield decrease measured when the flood was delayed from 5 to 10 days was probably due to nitrification of the N sources and denitrification after flooding. *AR-18F*

Rice Response to Phosphorus Fertilizer Application Time and Rate

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Project Cooperators: Chuck Wilson, Jr., Russ DeLong, Richard Norman

The objectives of multiple studies conducted since 2001 (two in 2003) were to evaluate phosphorus (P) application time and rate on the P nutrition and grain yield of rice grown on silt loam soils in Arkansas. Phosphorus fertilizer was broadcast applied before rice emergence, preflood (5-leaf stage), at panicle differentiation, and at the late boot

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stages at rates of 0, 25, 50, and 100 lb P_2O_5/A. Whole plant samples were collected at 14-day intervals after the 5-leaf stage to evaluate rate and timing effects on rice P nutrition and grain yield. In 2003, both silt loam soils had relatively high Mehlich 3 extractable soil P concentrations (42 and 49 parts per million [ppm]) and neutral to alkaline soil pH (6.8 to 8.4). Rice tissue P concentrations were not affected by P fertilizer rate, time of application, or their interaction at any sample date. Grain yields were high and showed no response to P fertilization on these two soils. The 2003 results indicate that rice does not need supplemental P when Mehlich 3 soil P is high. When considered alone, soil pH and Mehlich 3 P were poor predictors of potential response to P fertilization, but the accuracy improves when both parameters are considered together. The need for P fertilization of rice increases as soil pH increases and soil-test P decreases. Seedling P nutrition was not accurately predicted when the Mehlich 3 soil P was greater than 5 ppm and the pH was less than 6.6, or up to 40 ppm Mehlich 3 soil P when the pH was less than 8.5. Identification of soils with limited P availability during early-season rice growth will improve P fertilization recommendations for flood-irrigated rice. *AR-22F*

Soybean Response to Boron Fertilizer Application Time and Rate in Arkansas

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Project Cooperators: Leo Espinoza, Morteza Mozaffari

Four studies were conducted in 2003 on alkaline silt loams to evaluate boron (B) application time and rate effects on the seed yield of soybean. Boron fertilizer (Solubor) was foliar-applied at early vegetative (V1 to V4) and late vegetative to early flowering (V10 to R2) growth stages at 0, 0.25, 0.50, 1.0, and 2.0 lb B/A. Boron significantly increased soybean seed yields at all four sites. Averaged across the two application times, 0.5 to 1.0 lb B/A increased soybean seed yields from 7 to 129% (3 to 19 bu/A). The optimum B rates generally ranged from 0.5 to 1.0 lb B/A, while the optimum application time depended upon location, which may have been related to the severity of B deficiency. At the most responsive site, B applied during early vegetative growth produced consistently higher yields (5 bu/A) than B applied at the R2 stage, regardless of application rate, and despite the absence of B deficiency symptoms until mid-to-late reproductive growth.

Application time had little influence on soybean yields at the other three sites. Although quite severe B deficiency symptoms occurred during vegetative growth at one of the three other sites, yields were similar among application times, but increased as application rate increased. These results indicate that when B deficiency is diagnosed early during vegetative growth and followed by appropriate B application, seed yield losses may be small. We also observed that soybean plants receiving no B or very low B rates (i.e., 0.25 lb B/A) matured up to two weeks later than plants receiving 0.5 lb B/A. Delayed maturity, as indicated by delayed leaf senescence, was observed at three of the four sites and was the only B deficiency symptom observed at one site. Foliar application above 0.5 lb B/A usually resulted in significant leaf injury, which was quickly outgrown. *AR-23F*

Application of Precision Agriculture Technology to Define and Manage Nematodes and Diseases of Soybeans

Project Leader: Dr. John Rupe, University of Arkansas, PTSC 212, Fayetteville, AR 72701. Telephone: 479-575-2778, E-mail: jrupe@uark.edu.

Project Cooperator: Rick Cartwright

A soybean study was initiated in 2003 to detect the onset and map the development of soybean cyst nematode (SCN) using aerial remote sensing, and to determine the effectiveness and practicality of applying site-specific measures to control SCN. Two sites were established: one at the Pine Tree Research Station and the other in a grower's field in Prairie County in eastern Arkansas. Treatments were replicated strips of a SCN-susceptible cultivar (Hutcheson) and a SCN-resistant cultivar (Anand) at the Prairie County field, and replicated strips of Hutcheson, Hutcheson + nematicide (aldicarb), and Anand at the Pine Tree site. Nematode densities at planting and harvest, soil nutrient levels, soil texture, and aerial images will be compared to yield and plant height measurements. Some of these data are still being compiled. Yields at both locations were high and fairly uniform. The 2003 season was a very favorable growing season and, in these fields, SCN densities at planting were much lower than expected from the previous year's levels and may have resulted in minimal nematode damage to the plant. These conditions may have also resulted in high nematode densities in the fall. Since SCN has been damaging in these fields in the past, we expect a closer link between SCN densities and yield in future years. We also expect to be able to relate SCN densities to soil factors like texture that will help predict where problems may occur. We are also conducting a hyperspectral analysis of nematode infested and uninfested microplots that should determine the best approach to identifying damage from SCN using remote sensing. *AR-24F*

Louisiana

Boron Studies with Rice in Southwest Louisiana

Project Leader: Dr. Pat Bollich, Louisiana State University, Rice Research Station, PO Box 1429, Crowley, LA 70527-1429. Telephone: 318-788-7531, Fax: 318-788-7553, E-mail: pbollich@agctr.lsu.edu.

A nutrition study was conducted at the Rice Research Station in Louisiana to determine the effect of B applied to rice at different rates and application timings. This research was a continuation of a study conducted in 2002. Boron rates included 0, 0.33, 0.67, and 1.0 lb B/A. Application timings included preplant, preflood, and at panicle initiation. The variety, Wells, was drill-seeded into a Crowley silt loam soil, typical of the rice soils of southwest Louisiana. Unlike 2002 results which indicated very little response to B timing or rate, in 2003 the results were positive. Rice yield increased with a preplant B application and yield was significantly higher with a preplant application than with a midseason application. Preplant and preflood B applications resulted in similar yields. A significant yield increase of 6% occurred with a B application of 0.33 lb/A. Yield increased slightly at 0.67 lb B/A, but decreased at the 1.0 lb B/A rate. Similarly, leaf B content was significantly increased with the preplant application when compared with the midseason application. Research sites were very similar in 2002 and 2003, yet a yield increase from B application occurred in only one year. When observing significant differences or trends, especially in 2003, the preplant application timing of B seems to be the most appropriate. The optimum rate of application for rice on silt loam soils in southwest Louisiana appears to range from 1/3 to 2/3 lb B/A. *LA-21F*

Mississippi

Rice Phosphorus and Potassium Nutrition Research in Mississippi

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Project Cooperators: J.E. Street, W.L. Kingery, M.S. Cox, J.L. Oldham

In an effort to validate current Mississippi State University Extension Service (MSU-ES) soil test recommendations for rice, two similar studies were conducted in 2003 with P and potassium (K). A small plot study was conducted in a commercial field (pH 8.1), that was suspected to be responsive to fertilizer P, using three P rates (25, 50, and 100 lb P_2O_5/A) at each of four different growth stages: delayed preemergence (DPRE), preflood (PF), panicle differentiation (PD), and boot (BT). Whole plant tissue samples were taken at 14-day intervals beginning 14 days after flooding (DAF), and analyzed for total P. Yield and milling quality were also measured. Both P-rate and application timing affected rice grain yield. When averaged across application timings, rice grain yields were 5,830, 4,539, and 3,966 lb/A, for 100, 50, and 25 lb P_2O_5/A, respectively. When averaged across P rates, rice grain yields were 7,964, 5,745, 3,355, and 2,048 lb/A for DPRE, PF, PD, and BT timings, respectively. The untreated control yielded only 509 lb/A. When averaged across application rates, total/whole milling percentages were 61/73, 60/73, 58/70, and 59/71 for DPRE, PF, PD, and BT timings of P, respectively. A delay in maturity is one factor that contributes to the lower milling observed when the P application was delayed past the PF stage. This study will be conducted again in 2004. A small plot K study was also conducted in a commercial field that had a medium soil test K level. Four K rates (30, 60, 90, and 120 lb K_2O/A) were applied at DPRE and PF rice growth stages. No treatment combination produced significantly greater yields than the untreated check (8,870 lb/A). *MS-10F*

Evaluating Site-Specific Soybean Management within the Mississippi Soybean Verification Program (SMART – Soybean Management through Application of Research and Technology)

Project Leader: Dr. Alan Blaine, Mississippi State University, Dorman Hall Rm 153 Box 9555, Mississippi State, MS 39762. Telephone: (662) 325-2311, E-Mail: ablaine@pss.msstate.edu.

Eleven fungicide and 14 insecticide tests were conducted in 14 Mississippi counties in 2003, using precision ag tools: aerial imagery, global positioning systems (GPS) and geographic information systems (GIS). Each foliar fungicide test included varying rates of Dimilin, Quadris, and other fungicides with applications beginning at R3 (beginning pod) and R5 (beginning seed) growth stages. Based on these tests and additional field experience, we have made some firm conclusions. Varieties that possess a poor foliar disease tolerance/resistance package exhibit a good response to fungicides. Long-term yield data indicate where a significant yield increase is achieved from a fungicide application, the yield increase will more than pay for the material and application costs. More consistent response has occurred with applications at the R3 growth stage. Two fungicide treatments that showed the most consistent response in 2003 were a Quadris/Dimilin combination and a Quadris/Topsin M combination. Frogeye leafspot has been one of the prevalent diseases. Soybean insects in no-till

cropping systems have increased in the last several years. Velvetbean caterpillars, saltmarsh caterpillars, green cloverworms, cabbage looper, soybean looper, podworms, and armyworms have been active in many fields. Dimilin has been an effective insecticide on these pests and it also provides excellent control of grasshoppers. However, it must be applied as a preventative before insect populations reach damaging levels. Our most consistent fungicide/insecticide combination this year was a one-half rate of Quadris (3 oz.) plus Dimilin (2 oz.) applied at the R3 growth stage. This combination was applied by ground and air at various spray volumes...all applications yielded more than the untreated check. Yield benefits can exceed 13 bu/A and result in total net returns for the soybean crop above $270/A. Bean leaf beetles, three-cornered alfalfa hoppers, and stinkbugs are insect pests that are becoming more damaging in soybeans. Fungicides, insecticides, or a combination will be required to produce high yielding soybeans consistently. *MS-11F*

Missouri

The Impact of Potassium Fertilizer Source on Crop Response and Weed Control in a No-till "Weed and Feed" Glyphosate-Resistant Soybean Production System

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Project Cooperators: Kelly Nelson, Manjula Nathan

Potassium sources that have minimal effects on spray solution pH controlled weeds similar to glyphosate plus diammonium sulfate, except 3-18-18. Soybean response to K applications appeared to be greater on early-planted soybean than late-planted soybean. Compatibility of K-sources with glyphosate formulations need to be evaluated as there were no interactions with the TD KPMG (a glyphosate formulation), but two of the K-sources formed precipitates with Roundup WeatherMAX. Potassium chloride, nitrate, and sulfate had good crop safety and weed control when tank mixed with Roundup WeatherMAX. The fertilizer 3-18-18 probably needs additional evaluations as there was good weed control, but crop injury was greater than 10% at one site. Soybean yield was increased in a weed-free environment with 0-0-30; however, the greatest soybean injury and poor weed control were observed when this treatment was tank mixed with Roundup WeatherMAX. *MO-22F*

Multi-State Evaluation of Boron Fertilization of Rice: Missouri Component

Project Leader: Mr. David Dunn, University of Missouri, Delta Center, PO Box 160, Portageville, MO 63873 Telephone: 573-379-5431 E-mail: dunnd@missouri.edu

The primary objective of this study was to validate the University of Missouri soil test recommendations for B fertilization of rice. The recommendation is to apply 0.5 lb B/A to soils containing less than 0.25 ppm B (hot water extraction). Both rates (0. 0.33, 0.66, and 1.00 lb B/A) and timing of applications (preplant, preflood, and internode elongation) were investigated. All treatments were applied using a carbon dioxide backpack sprayer with the appropriate amount of Solubor dissolved in 10 gallons of water/A. A secondary objective was to establish critical levels for B tissue concentrations. All B treatments resulted in yields (182 to 191 bu/A) that were numerically greater than the untreated check (181 bu/A). When averaged over all application times, the 1.0 lb B/A rate had the highest yields (189 bu/A). Pre-plant treatments tended to have higher yields, compared to later applications. Boron tissue levels for the same treatment declined as the season progressed. Tissue levels of B generally reflected application rates, but a critical tissue B level was not determined from this work. *MO-23F*

Site-Specific Management of Phosphorus, Potassium, and Lime Using Nutrient Dynamics Information

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Project Cooperators: Newell Kitchen, Ken Sudduth, Brent Myers

Management zones have been shown to aid in the interpretation and use of spatial data for precision agriculture. Management strategies that take into account the specific combination of yield-limiting factors present in each subfield zone might then be more easily developed than for an entire field. The process of developing management zones for a field includes choosing the information to be used for classification, selecting and applying appropriate classification technique(s), and evaluating the usefulness of the resulting potential management zones. Automated techniques that can improve the speed and efficiency of this process are needed. Geographic information system (GIS) packages contain many of the functions necessary for developing potential management zones, but they can be

cumbersome and expensive to use. We previously developed a software tool, Management Zone Analyst (MZA), to simplify this process.

The following are enhancements we have identified for MZA: (1) graphing of change in variance within cluster groups as cluster number increases; (2) including other performance indices such as the "separation index"; (3) allowing for pre-clustering start points in order to prevent generating different outcomes with multiple runs of the same dataset; (4) output a record of clustering options (i.e., settings used for a particular run); and (5) an improved help section, especially to help the user to choose an appropriate measure of similarity. The next phase will be the actual programming. The first version of MZA was tested on a 10-year yield data set to evaluate whether soil electrical conductivity might provide a suitable surrogate of yield potential for claypan soils. The results showed that with this procedure there was about 50 to 70% agreement between yield-map productivity zones and soil EC-mapped management zones. *MO-24F*

Development and Evaluation of a Producer Decision-Aid for Delineating Productivity Management Zones for Precision Agriculture

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Over the last eight years a study has been conducted on a claypan soil field near Centralia, Missouri, investigating potential interactions of surface soil P and K fertility and topsoil depth. The P and K response plots have been set up in four unique topsoil depth/landscape position areas of the large field. Yield, grain nutrient, surface soil fertility, and subsoil fertility have been monitored. This study has shown that crop response to fertility depends on much more than the surface-sampled soil-test levels. Subsoil fertility is highly variable and a driving force in responsiveness to fertilizer additions. Characteristic of these soils is a subsoil clay horizon with between 55 and 65% clay and a topsoil with only 25 to 30% clay. Generally, crop productivity increases as a function of increasing topsoil thickness. Results to date have shown that response to P and K fertilization has been greatest with increasing topsoil thickness.

Research for this project built on previous successes. Part of the objective was to further evaluate MZA, software developed at the University of Missouri that is intended to aid in management zone delineation. *MO-25F*

Sulfur Fertilization of Rice in Missouri

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This study was conducted to evaluate the validity of the University of Missouri's soil testing recommendations for sulfur (S) fertilization of rice. The current recommendation is to apply S only when the soil cation exchange capacity (CEC) is less than 7.5 cmol(+)/kg (sandy to coarse silt loam soils). Previous research dated to the 1970s. Since that time, the deposition of sulfate-S by rainfall has decreased. Sulfate-S rates of 0, 12, and 24 lb/A were applied at four times (preplant, preflood, internode elongation, and heading) using AS. An additional treatment of 24 lb/A of 90% elemental S/A was also tested. The N rate was constant across treatments at 150 lb N/A. Preplant and 10% heading urea treatments were included to verify if yield differences in the AS treatment were due to a S or N effect. The average yield of all S treatments was 183 bu/A compared to the zero S control of 176 bu/A. Preplant S treatments resulted in generally higher yields than with later S applications. *MO-26F*

North Carolina

Using LIDAR-Based Digital Elevation Maps to Identify Soil Drainage Problems in Eastern North Carolina

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Project Cooperators: J.A. Thompson, R.W. Heiniger

The objectives of this work were to evaluate the usefulness of GIS in crop problem diagnosis on a farm-scale and to rank the frequency with which different GIS data layers appear to explain yield variability. This work began in November of 2002 and should continue through October 2004. The approach was to investigate several GIS data layers from a sufficiently large number of farmer fields to permit assessment of the frequency of usefulness of each layer and principal component analysis. Due to the unusually wet weather during the past year, the recently available digital elevation data (LIDAR Digital Elevation) has attracted considerable attention in northeastern North Carolina. We have mapped 16,560 acres at the request of Extension agents, producers, or other researchers interested in visualizing the extent of soil drainage limitations.

A training module was developed, which has been

offered three times to a total of 13 agronomic professionals (Cooperative Extension, NRCS, North Carolina Dept. of Agriculture and Consumer Services). This has led to the identification of 14 suitable farms with both LIDAR digital elevation map coverage and global positioning system (GPS) yield monitors. This is the target group of farms from which fields will be selected during the quantitative phase of this project. We expect to complete the GIS data analysis and highlight this technology during two field days: the biannual Precision Farming Field Day and the annual Blackland Farm Managers' Tour. Identification and correction of soil drainage problems using these precision ag tools can improve crop yields, farmer profits, and the potential response to fertilizer inputs. *NC-19F*

Tennessee

Soybean Cyst Nematode Management Zone Identification Using Soil Characteristics and Yield Data

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Project Cooperator: Pat Donald

The objectives of the study were to determine if we could find correlation of soil factors and SCN that would allow establishment of soybean management zones. The study was initiated in June of 2003 with a proposed length of two years. Two fields were soil sampled near planting time. One field had been previously grid sampled and sample points marked using GPS technology. Nematode samples were collected based on the pH of the soil. Two groups of samples were collected in the first field for a total of 50 samples. The two SCN groupings of soil samples were based on whether the soil pH was 4.0 to 4.9 or 6.0 to 6.9. The level of SCN present in the first field was too low to make any conclusions. In the second field, random soil samples were collected, sample points marked using GPS, and the soil samples split for nematode and standard soil fertility analyses. We found that there were significantly lower numbers of SCN when the soil pH was in the range of pH 4.0 to 4.9 than in the 6.0 to 6.9 range. The pattern in the field indicated that different management practices were probably present at a prior time for the different portions of the field. Low levels of sudden death syndrome were present in the field at pod fill. *TN-18F* ■

*Note: Additional summaries with information on various other crops in the Southeast Region appear in a separate issue of *News & Views: 2003 Research Summaries—Southeast Region Cotton, Forages, Forestry, Citrus, and More.*

RN 04076
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NEWS & VIEWS

Southeast Region
July 2004

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Permit No. 1355