# NEWS & VIEWS

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



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*Part 1 of 2*


# 2004 Research Program Summaries—Southeast Region: Soybeans, Site-Specific Management, and Rice

**THE** Potash & Phosphate Institute (PPI) and Foundation for Agronomic Research (FAR) program in the Southeast Region continues to investigate and expand the knowledge of optimum plant nutrient management practices. This *News & Views* includes reports from a portion of the twenty-nine projects supported in the region in 2004. **Please refer to the second *News & Views* (part 2) for a report from other studies conducted in the Southeast region in 2004.**

The summaries that follow provide only 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, research project information can be viewed by state abbreviation and project title, or by a topic area.

## Arkansas

### Rice Response to Phosphorus Fertilizer Application Time and Rate

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

Five phosphorus (P) studies were conducted in 2004 to evaluate P application time and/or rate effects on the P nutrition and grain yield of rice grown on silt loam soils in Arkansas. Phosphorus fertilizer was broadcast-applied before rice emergence or preflood (5-leaf stage) at rates of 0, 25, 50, and 100 lb $P_2O_5$/A. Rice grain yield was not significantly affected by P fertilization at any of the sites, possibly because only one of the sites had soil pH >6.9, and it had Mehlich 3-extractable P at 17 mg P/kg of soil. Whole-plant P concentrations at the midtillering stage were generally not affected by P application time, but were influenced by P application rate. The 2004 data indicate that rice is not likely to respond to P fertilization when the pH of undisturbed soils is <7.0.

Rice response to potassium (K, muriate of potash) rate (0, 40, 80, 120, and 160 lb $K_2O$/A applied before flooding) was also evaluated at six sites on silt loam soils in northeast and central Arkansas, with Mehlich 3-extractable soil K ranging from 64 to 132 mg K/kg. Significant grain yield increases with increasing K rate occurred at two sites. Potassium fertilization increased rice grain yields from 183 to 206 bu/A at the Murphy site and from 197 to 213 bu/A at Lake Hogue. Grain yields increased numerically as K rate increased to the maximum amount applied. Symptoms associated with K deficiency were present at all K rates to some degree, and the Mehlich 3-extractable soil K did not always predict site responsiveness to K fertilization. Rates of 60 to 90 lb $K_2O$/A are usually adequate to produce maximum rice yields. Other soil extractants are being evaluated to determine if they may be more accurate in predicting rice response to K fertilization. *AR-22F*

### Soybean and Rice Response to Boron Fertilization in Arkansas

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Four studies were conducted on alkaline silt loam soils in northeast Arkansas in 2004 to evaluate boron (B) fertilization timing (V1 to V4 and V10 to R2 growth stages) and rate (0, 0.50, 1.0, and 2.0 lb B/A) effects on the seed


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yield of soybeans. Boron fertilization significantly increased soybean seed yield by 2 to 3 bu/A (regardless of application time or rate) at one site where the trifoliate leaf B concentration at R2 averaged about 10 mg B/kg. When soil pH is >7.0, small to large positive soybean yield responses are likely to occur on silt loam soils in northeast Arkansas with no history of B application. The residual influence of a single application of B (0 to 8 lb B/A applied in 2002) on soybean B uptake was also evaluated at two sites. A single B application made in 2002 significantly affected the B nutritional status of rice in 2003 and soybean in 2004, but had no influence on crop yields. A single application of the recommended B rate (<1 lb B/A) may provide sufficient B to soybeans grown in a soybean-rice rotation for several years. Higher than recommended rates of B, which simulate numerous years of B application, did not have a detrimental influence on the following rice or soybean crop yields. The influence of B fertilization (0.33 lb B/A) time on rice yields was also evaluated in 2004 at three fields in northeast Arkansas, which had no history of B fertilization and were near fields where B deficiency of soybean had been documented. Each test evaluated preflood, late-tillering, and boot stage application times, with an unfertilized control. Neither positive nor negative rice yield responses to B fertilization time were found at any of the three sites. *AR-23F*

**Application of Precision Agriculture Technology to Define and Manage Nematodes and Diseases of Soybean**

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*Project Cooperator: Rick Cartwright*

Soybean cyst nematode (SCN) is a difficult-to-detect threat to Arkansas soybean production. The objectives of this project were to detect the onset and map the development of SCN in soybean fields using remote sensing and to determine the practicality and effectiveness of applying site-specific control measures for SCN. Samples for SCN counts at planting and harvest were collected in 2003 and at planting and flowering in 2004. Airborne color-infrared images were also acquired for both years. Geographically weighted regression (GWR) analysis was performed for the 2003 data. Ground-level, canopy multi-spectral data were recorded for 2004 and critical wavelengths, responsive for SCN counts, were found by statistical procedures (Max. $R^2$).

In 2003, soybean yield reflected a negative trend with nematode levels, showing higher yield at lower cyst densities and lower yield corresponding to high cyst densities for the susceptible variety (Hutcheson). A significant spatial relationship was found which explained 59% of the variability between pre-planting SCN counts and yield for Hutcheson. A GWR model on SCN population densities at planting, where nematodes appeared, explained 37% of the variability in soybean yield. Four critical wavelengths (777.0, 779.5, 809.5, and 839.5 nm) in the near infrared and one wavelength (269.5 nm) in the ultraviolet region were selected for the model because they explained 87% of the variability in SCN counts. The 2003 treatments had a significant impact on 2004 yield, with the resistant cultivar (Anand) producing the highest yield, followed by nematicide treatment (aldicarb) and susceptible cultivar (Hutcheson). Remote sensing may be an effective tool to detect the SCN in fields, but additional experiments are recommended to confirm these initial results. *AR-24F*

**Influence of Dicyandiamide Treated Ammonium Sulfate, Application Rate, and Timing on Grain Yields of Drill-Seeded, Delayed Flood Rice**

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*Project Cooperators: C.E. Wilson, Jr., D.L. Boothe, N.A. Slaton*

A study was conducted with Wells rice on a DeWitt silt loam (pH 6.1) to determine if ammonium sulfate (AS) coupled with the nitrification inhibitor DCD (Dicyandiamide) could be applied to a dry soil 21 days prior to flooding of drill-seeded, delayed flood rice and produce grain yields similar to those produced when urea was applied to a dry soil immediately prior to flooding. Fertilizer nitrogen (N, 60 and 120 lb/A) sources/application time/% DCD-N were: i) urea applied 1 day prior to flooding (PTF); ii) urea applied 20 days PTF; iii) AS applied 20 days PTF; iv) AS + 5% DCD-N applied 20 days PTF; v) AS + 7% DCD-N applied 21 days PTF; and iv) AS + 10% DCD-N applied 20 days PTF. All N fertilizer treatments were applied to a dry soil surface and a 1 in. rainfall event occurred the same day, after the N applications, which incorporated the sources and limited volatilization losses. Plant samples were collected for dry matter and N analyses at heading and yield was measured at maturity. The 60 lb N/A rate was used to make comparisons between treatments because 120 lb N/A was excessive on this site. The highest grain yields (~200 bu/A) were recorded when AS + DCD were applied 20 days PTF. All rates of DCD utilized (5 to 10% DCD-N) appeared equally effective in slowing nitrification and enabling sufficient N uptake to maximize rice grain yield with 60 lb N/A. Ammonium sulfate and urea applied 20 days PTF without DCD had yields of only around 165 bu/A. This indicates that DCD was effective in sufficiently slowing nitrification of the AS to minimize denitrification losses after flooding. It was unusual that urea applied immediately PTF did not also maximize grain yields. *AR-25F*

### Assessment of Soybean Response to Boron Fertilization in Growers' Fields

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*Project Cooperators: Lanny Ashlock, Rick Wimberley, Richard Klerk*

Yield-limiting B deficiency symptoms were documented in several soybean-producing regions of Arkansas during the 2001 season. The objective of this study was to assess the yield response of popular soybean varieties (maturity group V) to 0, 1, and 2 lb/A of soil-applied B, and to foliar-applied rates equivalent to 0, 0.5, and 1 lb B/A at vegetative (V4) and reproductive (R1) growth stages. The test was located in a grower's field where a B deficiency was documented in 2002. An additional test was established in a grower's field with no previous history of deficiency symptoms. This test consisted of a single application of B at a rate equivalent to 1 lb B/A at the R1 growth stage. At the deficient site, initial soil samples (Mehlich 3 analysis) showed average B levels of 0.4 parts per million (ppm). Boron levels in leaf tissue collected at R1 showed increased B with increased rates of application, but no yield effects from the soil-applied rate and timing combinations. The response to foliar-applied B appeared to vary according to soybean variety, and was more obvious with B applications at the V4 stage, as compared to applications at the R1 stage. *AR-26F*

## Louisiana

### Boron Studies with Rice in Southwest Louisiana

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A nutrition study was conducted at the Rice Research Station in Crowley to determine the effect of B applied to rice at different application timings. This research was a continuation of a study conducted in 2002 and 2003 examining the effect of B applied to rice at different rates and times. Results from 2002 indicated very little response to rate or application timing; however, a preplant application of 0.33 lb B/A produced highest rice grain yields in 2003. In 2004, B was applied at 0.33 lb/A preplant, late-tillering, and at booting. A nontreated check was included for comparison. Wells variety was drill-seeded into a Crowley silt loam soil, typical of the rice soils of southwest Louisiana. No differences in the number of days to 50% heading or plant height were observed among the three application timings. Also, main, ratoon, and total rice grain yields were equivalent following application of B at 0.33 lb/A preplant, late-tillering, and at booting. Total rice grain yields ranged from 11,178 lb/A for the nontreated check to 11,448 lb/A following B application at late-tillering. *LA-21F*

## Missouri

### Rice Response to Soil and Foliar Boron Applications

*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*

This study is part of a larger study initiated in 2002, including the states of Arkansas, Louisiana, Mississippi, and Missouri. It investigated the response of rice grain yields to two B fertilization rates (0 and 0.33 lb B/A) and three application times (first tiller, late tillering, and early boot). In 2004, research plots were established at the Missouri Rice Research Farm (MRRF), located near Qulin, on a Crowley silt loam in an area which has been in a rice/soybean rotation for over 15 years. Before planting, composite soil samples were collected at a 0 to 6 in. depth and analyzed for hot water extractable-B as well as basic soil fertility. The average B concentration of these samples was 0.14 ppm B. All B applications were made using a $CO_2$ sprayer calibrated to deliver 10 gal of liquid/A, with the appropriate amount of B as Solubor DF (17.5% B). The seedbed was prepared using conventional tillage and the rice cultivar *Cocodrie* was seeded at a rate of 90 lb/A using a 10 ft. John Deere no-till drill on May 1, 2004. In 2004, B application time failed to affect rice grain yields. No significant response has occurred in 12 of 16 site-years of data collected since 2002. When statistically significant yield increases did occur, yields were about 5 to 7% greater than the unfertilized control, but no single B-application rate or time consistently increased rice yields. Soil, irrigation water, or both may provide sufficient B for rice grown in the upper Midsouth. Perhaps the most significant finding of this research is that direct application of up to 1 lb B/A to flood-irrigated rice did not reduce growth and yield. The minimum critical tissue B concentration may be lower than published values. *MO-23F*

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

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Fertilizing crops more than needed may increase the risk of nutrient contamination of water resources. Because many crop production fields are spatially variable in both soil nutrients and crop nutrient need, conventional uniform fertilizer rates can exceed requirements for some field areas. To better match applications to needs, cost-effective and efficient methods are needed to delineate sub-field management zones within which crop fertilizer needs are more uniform. In response to requests from farmers and consultants, we developed a software decision aid to help them quickly process map information (such as elevation and soil electrical conductivity) into management zones for variable-rate nutrient applications. This software, Management Zone Analyst (MZA), uses georeferenced field information to mathematically divide a field into natural clusters or zones and also helps determine the optimum number of management zones for each field. The objectives of this project were to identify and make modifications to MZA to improve its utility and application, and evaluate this decision aid on datasets in the Midwest.

Using field-scale studies, we developed procedures to identify which information sources were most helpful in creating nutrient management zones. For claypan and claypan-like soils in the U.S. Midwest, densely-spaced georeferenced measurements of elevation and apparent soil electrical conductivity were the most useful data for creating management zones related to potential crop productivity and nutrient need. Zones created from MZA using these sources were much more strongly related to yield map data than were traditional soil surveys. Research findings have been widely distributed through public-sector and commodity organizations using various communication sources (e.g., invited presentations at workshops and conferences, guide sheets, and web sites).

The MZA software is available on the internet at >**http://www.fse.missouri.edu/ars/decision_aids.htm**< By December 2004, the software had been downloaded over 400 times. Users include researchers, commodity organization representatives, and agricultural consultants from 39 states and 35 foreign countries. *MO-25F*

## Sulfur Fertilization of Rice in Missouri

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The objective of this study was to evaluate the agronomic accuracy of the University of Missouri soil testing recommendations for S fertilization of rice. The University of Missouri recommends applying S only on soil with a cation exchange capacity (CEC) of less than 7.5 meq/100g. This would preclude S fertilization for most rice production fields. This recommendation was developed during the early 1970s and reflected S contributions from rainfall. Sulfur rates (0, 12, 24 lb S/A) and timing (preplant, preflood, internode elongation, and 10% heading) were investigated. Ammonium sulfate (AS) was the S source except for one treatment which received preplant S from 90% elemental S at 24 lb S/A. The total amount of N was held constant in each treatment at 150 lb/A. Preplant and 10% heading urea treatments were also included to determine if yield differences in the AS treatments were due to a S or a N effect. Sulfur numerically increased rice yields. The 2-year average yield for all S treatments was 194 bu/A compared to 185 bu/A for the control. Preplant and preflood S treatments (including elemental S) had generally higher yields than for later applications. Possible herbicide savings due to accelerated early plant growth are also possible with preplant and preflood S treatments. *MO-26F*

## Influence of Soil-Applied Magnesium on the Uptake and Partitioning of Potassium in Rice Plants

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A rice study was conducted at the Missouri Rice Research Farm (36˚N, 90˚W) in Dunklin County in 2004. Cocodrie rice was planted on a Crowley silt loam which has a thick, silty clay loam argillic horizon, typical for drill-seeded rice fields in southeast Missouri. The soil $pH_{water}$ of the surface horizon was 6.2. The ammonium acetate extractable fertility levels were: 55 mg potassium (K)/kg, 45 mg phosphorus (P)/kg, 147 mg magnesium (Mg)/kg, 1.9 mg zinc (Zn)/kg (1mg/kg=1 part per million) and the CEC was 17.9 meq/100g. The University of Missouri soil test K recommendation was to apply 50 lb $K_2O$/A. Rice was cultivated in 2003 and the field was conventionally tilled prior to seeding rice in 2004. Three preplant rates of K (0, 50, and 200 lb $K_2O$ /A) and two K sources...KCl and $K_2SO_4 \cdot 2MgSO_4$ (K-Mag®)...were applied by hand to this low-K

soil. Plant tissue samples were collected at first tiller, maximum tillering, internode elongation, and at harvest from each plot for determination of total dry matter and K and Mg concentration and content. Dry matter accumulation during reproductive growth stages tended to be reduced by Mg fertilization compared to KCl at the same K rates. The K-Mag treatments produced greater rates of Mg uptake than the KCl treatments at all growth stages studied. Only at first tiller did Mg rate affect Mg uptake. Magnesium fertilization did not affect total K uptake at harvest. Both KCl treatments produced grain yields significantly greater than the untreated check (190 to 192 vs. 168 bu/A). Both K-Mag treatments produced grain yields that were statistically equivalent to the untreated check (167 and 170 bu/A). However, grain moisture at harvest was statistically greater with K-Mag than the untreated check and both KCl treatments, which indicates a possible delay of maturity with K-Mag at this site. *MO-28F*

## Mississippi

**Rice Response to Phosphorus in Mississippi**

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

Starting in 2002, P response plots have taken a larger priority in the On-Farm Fertility Program in Mississippi. In 2004, four studies were conducted that investigated P rates and application timing. These studies were conducted on various soil textures ranging from silt loam to clay with a pH range of 6.0 to 8.0. The cooperators and respective soil types were as follows: 1) Mark Boone—Dundee silt loam; 2) Aguzzi Farms—Brittain silt loam; 3) Richard Farms—Sharkey clay (newly leveled); and 4) Gibb Steele—Sharkey clay. Yield responses to P were achieved at three of the four locations. Yields were increased by 7, 14, and 40% for the Boone, Richard, and Aguzzi locations, respectively. In two studies, the highest yield increases were obtained when 50 or 100 lb $P_2O_5$/A were applied. At the Richard location, the 25 lb $P_2O_5$/A treatment provided yields equal to those at the 50 and 100 lb $P_2O_5$/A rates. In all three studies, the highest yields were achieved when the fertilizer was applied at spiking (emerging) rice. This research is on-going with the goal of correlating and calibrating our current soil test method for determining optimum P-fertilizer rates for high yielding rice varieties and hybrids grown on different soil types with varying pH's. *MS-10F*

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

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The objectives of this work were to evaluate the use of the insecticide Dimilin, seed-applied fungicides, and foliar-applied fungicides as additional management strategies to be added to a total high-yield management approach. Over the course of this 2-year study, there have been 18 individual fungicide trials with 72 replications of each treatment. In 2003, 11 fungicide and 14 insecticide tests were conducted in 14 counties. In 2004, there were seven fungicide and three insecticide tests in nine different locations in Mississippi. The foliar fungicide tests each contained varying rates of Quadris, Tilt, Topsin, Bravo, and Dimilin. Each test had varying combinations and rates of fungicide applied at two different growth stages (R3 and R5). Treatments were rated during the growing season for severity of either frogeye leafspot, late season Cercospora, and/or green stem syndrome. The most consistent fungicide/insecticide combination was a half rate of Quadris (3 oz/A) plus Dimilin (2 oz/A) applied at the R3 growth stage. This combination was applied by ground and air at various spray volumes and all applications yielded more than the untreated check.

Through the cooperation of producers, county agents, and industry representatives, large replicated field plots were established across the state in 2003 and 2004 and useful fungicide data were collected. The results paralleled what has been observed in on-farm trials, in the soybean research verification fields for several years. The data have helped to identify the most cost effective treatments for various soybean pests. The evaluations of appropriate use of these crop protectants have shown the agronomic benefits in the Mississippi soybean production systems so producers can better position their soybean operations to decrease costs and maximize yields. With the recent discovery of Asian soybean rust in the southern U.S., this fungicide work has become more important. *MS-11F*

## North Carolina

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

*Project Leader: Dr. C.R. Crozier, North Carolina State University, Soil Science Department, 207 Research Station Rd., Plymouth, NC 27889.*

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

The objectives of this project are to evaluate the usefulness of geographic information systems (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. Work began in November 2002 and should continue through October 2005. The approach is to investigate several GIS layers from a sufficiently large number of fields to permit assessment of the frequency of usefulness of each layer and principal component analysis. GIS data are being compiled from 93 fields of six cooperating producers located in five counties in the eastern North Carolina Tidewater region. Fields include mineral, mineral-organic, and organic soils. A data analysis process has been developed permitting combine yield monitor data isolation from targeted swaths representing specific soil and field situations.

Preliminary results identified 4 and 8% lower yields adjacent to ditchbanks than along field crowns for two fields in the 2001 and 2003 corn seasons, and a 21% lower yield along field crowns than adjacent to ditchbanks for the 2004 corn crop on another farm. These results are being coupled with soil profile and digital elevation map analysis to pinpoint specific areas that could benefit from land reshaping, which is generally too expensive to consider for an entire farm. Farm data are still being compiled from numerous fields. Numerous data management concerns noted by farmers will be addressed in upcoming extension materials. Data archiving instructions are not understood by many producers, complicating use of data following computer, yield monitor, or software upgrades. This project demonstrates the usefulness of yield, soil test report, elevation, and soil GIS map layers in diagnosing drainage and other yield-limiting problems in these farmlands. It is also useful in defining data management themes to be addressed in future extension programs. Improved soil management is expected to result in improved crop yields and nutrient demand. *NC-19F*

**To be continued...in Part 2 of 2...**
***2004 Research Summaries—Southeast Region: Cotton, Forages, Forestry, Citrus, and More.***

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