NEWS & VIEWS

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

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Nutrient Management Research… Foundation for the Future

THE Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR) provide financial and technical support for many agronomic research and education projects. These projects provide science-based answers for today and lay the foundation for tomorrow. This issue is a summary of the 1999 nutrient management research supported by PPI and FAR in the Midsouth Region. Please contact us or the project leaders if you would like more information on the research.

Arkansas

Foliar Fertilization of Cotton (Evaluation of the Double Petiole Sampling Technique for Detecting a Pending Potassium Deficiency in Cotton)

Project Leader: Dr. Derrick M. Oosterhuis, 115 Plant Science Bldg., Crop, Soil and Environmental Sciences Department, University of Arkansas, Fayetteville, AR 72701 (501-575-3979), oosterhu@sysb.uark.edu

Cooperating Scientists: Don Plunkett and Dennis Coker.

Petiole samples from the main-stem nodes 4 and 8 were sampled weekly beginning at pinhead square and continuing for some time after first flower in three irrigated fields, one dryland field, and in a replicated study at the Southeast Branch Experiment Station near Rohwer, Arkansas in 1999. Mehlich 3 potassium (K) levels on these silt loam soils ranged from 219 to 311 lb/A. Potash was applied according to soil test recommendations at four of the five sites.

In 1998 research, petiole K levels at node 8 decreased more rapidly with time than petiole K levels at node 4. In the 1999 research, this same tendency occurred with the irrigated fields and the replicated, irrigated field experiment. In the replicated field experiment, petiole K levels were lower from the node 8 sampling position compared to the node 4 position under well-watered, high soil K conditions up to three weeks after first flowering. A similar relationship was found for the well-watered, lower soil K treatment up to two weeks after first flowering. A consistent relationship between petiole K concentrations at the two sampling positions (among sampling dates) and lint yield has not been observed.

Opportunities for Precision Nutrient Management in an On-Going Southern Regional Soybean Technology Transfer Program

Project Leader: Dr. Lanny O. Ashlock, Extension Agronomist-Soybeans, University of Arkansas, Cooperative Extension Service, P.O. Box 391, Little Rock, AR 72203 (501-671-2278), lashlock@uaex.edu

In cooperation with industry and farmers, Extension and research teams from Arkansas, Louisiana and Mississippi applied precision ag technology in managing nine fields in 1997, 12 fields in 1998, and nine fields in 1999. Average yields were 39.1 bu/A in 1997 and 47.5 bu/A in 1998. Data from the three 1999 Arkansas full-season, irrigated fields showed yields averaged 68.4 bu/A, which was greater than the 52.4 bu/A yield average for other full-season, irrigated fields enrolled in the 1999 Arkansas Soybean Research Verification Program. Elevation and soil drainage were identified as factors affecting yield the most in several fields, while cation exchange capacity or texture, as reflected by different soil profile electrical conductivity measurements, seemed to explain much of the yield variability in several Louisiana fields. Opportunities for variable rate lime application were identified on several Arkansas fields where rice rotates in the cropping system. Soybean fertilizer recommendations in Arkansas were modified to accommodate variable rate applications as a result of this project. Interest in high yield management has increased because of the opportunities made available by precision ag tools when using timely agronomic management.

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Influence of Nitrogen Application Rate, Time and Source on Rice Yields

Project Leader: Dr. Rick Norman, 115 Plant Science Bldg., Crop, Soil and Environmental Sciences Department, University of Arkansas, Fayetteville, AR 72701 rnorman@comp.uark.edu

Cooperating Scientists: N.A. Slaton and C.E. Wilson, Jr.

Cypress rice was grown at Colt, Arkansas on a Calloway silt loam (pH 7.3 to 8.3) to compare urea and ammonium sulfate [$(NH_4)_2SO_4$] at five fertilizer nitrogen (N) rates (0, 60, 90, 120, and 150 lb/A) applied at four different timings (all N 20 days before flooding, all N 10 days before flooding, all N pre-flood the day of flooding, and one-third of the N pre-plant plus two-thirds pre-flood). There was no three-way interaction among N source, rate, and timing, but all two-way interactions were significant. When all the N was applied the day of flooding (all pre-flood), grain yields were maximized at 90 lb N/A. Maximum yield was observed at 120 lb N/A with the other three application timings. Yields were similar between the urea and $(NH_4)_2SO_4$ when applied all pre-flood, or using the one-third plus two-thirds split. Urea applied longer than 10 days before flooding resulted in significant yield loss. The $(NH_4)_2SO_4$ provided consistently higher yields (20 bu/A higher) than urea at N rates above 60 lb/A, under conditions favorable for N losses via ammonia (NH_3) volatilization (i.e. 10 or 20 days before flooding).

Louisiana

Improving the Profitability of Production through Precision Farming Technology

Project Leader: Dr. Steve Moore, Dean Lee Research Station, LSU Agricultural Center, Route 2, Box 20, 8105 E. Campus Ave., Alexandria, LA 71302 (318-473-6520), smoorealex@aol.com

A precision farming research program was initiated in 1997 to compare uniform and site-specific fertilizer...phosphorus (P), K, and sulfur (S)...on soybeans. The results indicated no economic advantage of variable rate fertilization over uniform rate fertilization at this site, which did not respond to fertilization. Soil fertility, soil electrical conductivity, tissue nutrient concentration, micro-topography, and soil compaction data layers were developed. Yield was spatially stable from year to year. Research comparing a weigh wagon and a yield monitor identified clear patterns of error in time with the yield monitor. Work with a statistician has begun, to develop a yield model from spatially-measured parameters. Soil profile electrical conductivity, measured on-the-go, was the best single indicator of soil productivity and yield. In separate efforts, soil compaction (estimated by penetration resistance) was measured with the cooperation of the National Soil Dynamics laboratory at Auburn University. The ultimate goal of this project is to publish a bulletin that will assist consultants and farmers in conducting good, on-farm research.

Effect of Copper and Potassium Fertilization on Yield and Plant Nutrient Status of Sugarcane

Project Leader: Dr. W.B. Hallmark, Iberia Research Station, LSU Agricultural Center, P.O. Box 466, Jeanerette, LA 70544 (318-276-5527), whallmark@agctr.lsu.edu

To address high-yield K requirements and the potential interaction of copper (Cu) and K, a three-year experiment is being initiated in the spring of 2000. Drought and constraints with farmer management prevented study establishment in 1999. Four K rates (0, 80, 160, 240 lb K_2O/A) and three foliar copper sulfate ($CuSO_4$) rates (0, 1 and 2 quarts/A) will be applied in all possible combinations. Cane and sugar yields will be measured at annual harvests and plant leaf samples will be collected for complete nutrient analysis at the first visible dewlap leaves at the end of July each year.

Missouri

Boron in Plant Nutrition and Crop Production

Project Leader: Dr. Dale G. Blevins, Agronomy Department, 1-87 Agriculture Building, University of Missouri, Columbia, MO 65211 (573-882-4819), blevinsD@missouri.edu

The metabolic effects of boron (B) deficiency on mineral nutrition and hormone action in plants have not been explained. A sophisticated test system was developed, using genetically-modified *Arabidopsis thaliana*, to evaluate the effect of B nutrition on plant enzymes involved in auxin oxidation. Auxins affect cell expansion and division, apical dominance, and certain other metabolic functions. This novel research has resulted in the ability to localize the sites of enzyme (beta-Glucoronidase) activity by using a tissue staining technique and a synthetic auxin response element (DR5 - fused to the enzyme reporter gene). Reduced levels of plant auxin were associated with B deficiency. It was also discovered that the decline in enzyme activity, caused by B deficiency, was almost completely reversed with supplemental ascorbate (Vitamin C). This basic research has shown that plant ascorbate levels may control plant auxin concentrations, depending on B nutrition.

Phosphorus-Magnesium Interactions in Plants

Project Leader: Dr. Dale G. Blevins, Agronomy Department, 1-87 Agriculture Building, University of Missouri, Columbia, MO 65211 (573-882-4819), blevinsD@missouri.edu

Tall fescue plots were developed at the Southwest Center near Mt. Vernon, Missouri with different soil P (26, 51, and 91 lb/A Bray 1 P) and magnesium (Mg) levels (202, 254, 328 lb/A ammonium acetate extractable Mg) to study the soil P and Mg interaction with spring P fertilization (0 vs. 57 lb P_2O_5/A). Spring P fertilization increased plant Mg and calcium (Ca) concentrations at both soil P levels across all soil Mg levels. With no fertilizer P, at low soil P and Mg levels, plant Ca and Mg levels were borderline in causing grass tetany. Fescue hay yield was increased 3,000 lb/A with 57 lb P_2O_5/A in the low P soil and increased 1,000 lb/A on the higher P soil. Spring P fertilization increased hay Mg level above the threshold value (0.20 percent) likely to cause grass tetany. There was little effect of soil Mg level on hay Mg concentration. The mechanism of Mg uptake was more dependent on plant P status than on additional Mg.

Development of Electromagnetic Induction Applications for Improved Crop Nutrient Management on Mississippi Delta Soils

Project Leader: Dr. Newell R. Kitchen, USDA/ARS, Midwest Area Cropping Systems, Water Quality Research Unit, 240 Agricultural Engineering Building, University of Missouri, Columbia, MO 65211 (573-882-1138), kitchenn@missouri.edu

The relationships between apparent soil electrical conductivity (EC_a) and several physical and chemical properties were investigated on Mississippi River Delta soils in three fields near Oran, Missouri. The soils were cropped in a corn-wheat-soybean rotation. EC_a was a poor estimator of percent sand and silt in the top six inches of the soil, but did predict the depth-weighted average of percent sand and percent clay to 24 inches deep in the Delta soils. Soil EC_a could be used to accurately estimate soil texture variations in the Mississippi River alluvial soils and may show promise in estimating available K in the soil profile. Ground-truthing EC_a measurements for each soil type and location will be needed to better understand the potential precision agriculture applications.

Site-Specific Fertilizer Recommendations for Improved Nutrient Utilization on Corn-Soybean, Claypan-Soil Fields

Project Leader: Dr. Newell R. Kitchen, USDA/ARS, Midwest Area Cropping Systems, Water Quality Research Unit, 240 Agricultural Engineering Building, University of Missouri, Columbia, MO 65211 (573-882-1138), kitchenn@missouri.edu

Cooperating Scientists: Dr. Ken Sudduth and Dr. J. Glen Davis.

This study was conducted in several fields on claypan soils farmed to corn and soybean to: (1) develop a method for integrating soil, landscape, yield, and sensor-mapped information for interpretation of field-scale variability dynamics in crop production, (2) develop site-specific management (SSM) plans, (3) compare agronomics and economics between SSM and conventional management systems (CMS) using one-pass, at-planting banded fertilization of N-P_2O_5-K_2O, (4) create a user-friendly decision support guide, (5) evaluate variability in grain P and K removal and (6) to characterize soil properties influencing in-field changes in soil test P and K. An unsupervised, continuous clustering algorithm was determined for delineation of field management zones based on soil and field characteristics. Yield data were kriged to a 33-ft. grid cell size, using an appropriate semivariogram model.

Differences between SSM and CMS were small and attributed to N management differences in one N-P_2O_5-K_2O study. SSM tended to outperform the CMS when depth to the claypan was greater than 20 inches. Environmentally, N uptake efficiencies and rootzone soil NO_3-N levels were similar between SSM and CMS. Use of a constant nutrient concentration for grain often overestimated nutrient removal. Topsoil thickness within fields, pH, elevation, and soil test Ca were the measurements that explained most of the variability in grain P and K removal.

Fertilizing Tall Fescue Pasture with Phosphorus to Prevent Grass Tetany in Grazing Beef Cows

Project Leader: Dr. Rob Kallenbach, State Extension Forage Specialist, Department of Agronomy, 214 Waters Hall, University of Missouri, Columbia, MO 65211 (573-882-2002), kallenbachr@missouri.edu

Cooperating scientists: Dr. Dale Blevins, Tim Reinbott, Richard Crawford, and James Williams.

A three-year study was initiated to determine if P fertilization: (1) influences fescue P, K, Ca, and Mg concentrations, (2) increases blood serum Mg levels of cows grazing tall fescue on low P soils (< 7 lb/A Bray 1 P),

and (3) influences fescue yield and animal condition in the spring. There were three replicates of three treatments on the fescue pasture: a control (no P fertilization and no Mg supplementation), 12 percent Mg oxide (MgO) mineral block offered free-choice (with no P fertilization), and 60 lb P_2O_5/A applied in the spring. Three Angus-cross cows grazed each fescue paddock for 41 days in April 1999. Phosphorus fertilization resulted in lowered Mg, raised P, and lowered K concentrations in the tall fescue, but a lowered grass tetany risk [lower (K/(Ca + Mg) equivalent ratio]. Magnesium concentrations in the cattle blood serum were: 20.3, 20.0, and 19.0 parts per million (ppm) with P fertilizer, the mineral block, and the control, respectively.

Phosphorus Response of Intensively Grazed Fescue Pastures

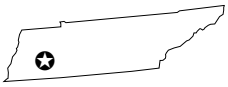
Project Leader: Dr. John Lory, Environmental Nutrient Management Specialist, 210 Waters Hall, University of Missouri, Columbia, MO 65211 (573-884-7815), LoryJ@missouri.edu

Cooperating scientists: Wayne Bailey and Jim Gerrish.

A grazing study was conducted at the University of Missouri Wurdack Farm in Crawford County to determine if raising soil test P levels could eliminate N application by improving legume growth and persistence and to evaluate increases in forage yield and quality independent of fertilizer N or legume N sources. Initial soil (0 to 6 inch) pH_{salt} was 5.6, Bray 1 P was 7 lb/A, ammonium acetate extractable K was 271 lb/A, Ca was 1,445 lb/A, and Mg was 402 lb/A. Phosphorus was broadcast as triple superphosphate (TSP, 0-46-0) August 18, 1997, on duplicate plots at 0, 20, 60, 115, 225, 300, and 400 lb/A of P_2O_5. (There were three replicates of the control and the 20 lb/A treatment). The legume treatment was red clover and lespedeza overseeded on the fescue and included 40 lb N/A in April 1998. The grass-only N treatment received the same April 1998 N rate plus 30 lb N/A in May and 50 lb N/A in August as NH_4NO_3.

Phosphorus increased yields of the legume and grass-only treatments equally, but legumes did not grow well in 1998. Relying on the legume N reduced dry matter yields about 0.8 ton/A. The P fertilizer response curves showed that for a one ton/A dry matter response, an application of 290 lb P_2O_5/A was required on this soil. Forage Mg concentration was not increased by P fertilizer, likely because the soil test Mg level was high initially. Three harvests were made in 1999, but yields were limited because of severe drought.

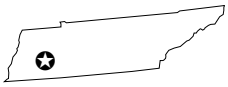
Tennessee



Evaluation of Potassium Source and Rate of Starter Fertilizer on No-Till Corn and Cotton

Project Leader: Dr. Donald H. Howard, West Tennessee Experiment Station, 605 Airways Boulevard, University of Tennessee, Jackson, TN 38301-3200 (901-425-4748), ddhoward@agmail.ag.utk.edu

Application of 10-10-10 IF on a Memphis silt loam soil, using K_2SO_4 as the K source, increased 1997 corn yields 18 bu/A over the 108 bu/A check and 24 bu/A over the IF starter which included K as KCl. Reducing the starters to 5-5-5 solutions resulted in comparable yields with both K sources, which were not different from the 10-10-10 solution made with K_2SO_4. No significant differences in corn yield were measured among starter treatments in 1998, possibly because of very high temperatures during silking through maturation. No-till corn yields (102 to129 bu/A) were not significantly affected by IF starter in 1999. No differences in cotton yield among treatments were detected in either 1997 or 1998. In-furrow application of 4-4-4 using K_2SO_4 resulted in 75 lb/A more lint cotton (848 lb/A) compared to the next closest yield and 100 lb/A more lint than the control in 1999. Cotton leaf and petiole P and K analyses failed to show any differences among treatments in 1999.



Evaluation of Nitrogen Sources, Rates and Timing of UAN Application on Wheat

Project Leader: Dr. Donald H. Howard, West Tennessee Experiment Station, 605 Airways Boulevard, University of Tennessee, Jackson, TN 38301-3200 (901-425-4748), ddhoward@agmail.ag.utk.edu

Comparisons were made among NH_4NO_3, urea, urea plus $(NH_4)_2SO_4$ and UAN solution at 0, 30, 60, 90, 120, and 150 lb/A of spring-applied N in 1997-98. In 1998-99, an UAN-calcium nitrate [$Ca(NO_3)_2$] treatment was added. Treatments were applied on March 1. There was a significant N source by N rate interaction in 1999. Wheat yields increased with N rates up to 120 lb/A (91 bu/A) in 1999, a trend consistent with the 1998 yields. A separate study compared five different application times (from mid-February to mid-April) of NH_4NO_3 and UAN at 90 lb/A. The highest yields in 1999 were observed with N applications made between March 1 and 30. Across N timings, NH_4NO_3 resulted in significantly greater yields compared to UAN: 80 vs. 74 bu/A. After two years of research, NH_4NO_3 appears agronomically superior to UAN on wheat, at 90 to 120 lb N/A, in this part of the Midsouth region. ■

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