NEWS & VIEWS

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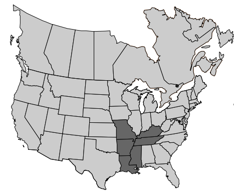

Dr. C.S. (Cliff) Snyder, Midsouth Director
May 1999

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 1998 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

Characterization of Boron Use and Distribution in the Cotton Plant: Evaluation of Foliar Boron Feeding

Project Leaders: Dr. Derrick M. Oosterhuis and Adele Steger, Agronomy Department, 113 Plant Sciences, University of Arkansas, Fayetteville, AR 72701 (501-575-3979).

A site low in Mehlich 3 soil boron (B) (0.04 lb/A) was used to evaluate: 1) the uptake and partitioning of B, 2) potential benefits of B applied a) at 2 lb B/A to the soil at planting, b) as three 0.2 lb B/A foliar applications (one, two, and four weeks after first flower), or c) as a combination of soil plus foliar applications during flowering, and 3) nitrogen (N) and B interactions under both high (100 lb N/A) and low soil-applied N (50 lb N/A). Soil plus foliar B in the high N treatment resulted in the highest total B in plants at 3 weeks after bloom. Yields were greater in the control treatment (1,580 lb/A lint) in the high N plots compared with the B treatments (1,310 to 1,520 lb/A lint). In the low N plots, the soil-applied plus foliar B and the foliar B treatments resulted in the greatest yields (1,460 lb/A lint). The interactions of N and B fertilization on cotton plant physiology remain unclear and deserve continued study.

Statewide Evaluation of the Double Petiole Sampling Technique for Detecting a Pending Potassium Deficiency

Project Leaders: Dr. Derrick M. Oosterhuis and Adele Steger, Agronomy Department, 113 Plant Sciences, University of Arkansas, Fayetteville, AR 72701 (501-575-3979). Mr. Don Plunkett and Dr. Bill Robertson, University of Arkansas, Cooperative Extension Service, P.O. Box 391, Little Rock, AR 72203 (501-671-2186).

Preliminary work has indicated that sampling petioles at the 4th nodal position from the plant terminal and the position 4 nodes below may improve prediction of pending potassium (K) deficiency. Petioles were collected from main stem nodes 4 and 8 weekly, beginning at pinhead square and continuing through the 5th week of flowering, in four quadrants in each of six irrigated and one non-irrigated cotton fields enrolled in the University of Arkansas Cotton Research Verification Program. Soil textures varied from silt loam to clay, Mehlich 3 soil test K ranged from 235 to 481 lb/A at 0 to 6 inches, and N rates varied from 60 to 100 lb/A. After first flower, K was consistently lower in petioles at node 8 compared to node 4. There was a strong negative correlation of K levels at main stem node 8 with time after first flower, reflecting the natural decline in petiole K levels with maturity. The correlation of petiole K with yield was strongest at 4 weeks after first flower, with a trend toward higher yields with higher petiole K levels at nodes 4 and 8. Petiole K levels at node 8 decreased more rapidly with time than petiole K levels at node 4. Yet, the petiole K level at node 4 appeared to be more strongly associated with yields in 1998. This study should be repeated on soils testing low in K where replicated soil and /or foliar K applications can be evaluated in contrast with untreated controls.

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Opportunities for Precision Nutrient Management in an On-Going 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).

Six Soybean Research Verification fields were managed using precision ag concepts in 1998 to evaluate their potential benefits using an integrated crop production system approach and to expand the transfer of the technologies to more producers. A problem field in Prairie county having a Mehlich 3 soil phosphorus (P) level of 10 lb/A and K of 100 lb/A was also studied. Soil was sampled on 2.5-acre grids, and lime and/or fertilizer were applied either with a variable rate applicator (where available) or by grouping closely related areas and using conventional application equipment. Fields were also sampled for plant population, nematodes, weeds, and plant tissue nutrient levels on a grid basis, and electrical conductivity maps were also made in each field using the Veris machine. Yield monitors recorded yields ranging from 38 to 62 bu/A. In the Lincoln county field, a replicated study resulted in higher yields with variable rate P and K compared to a uniform rate (62 vs. 60 bu/A). At the problem field in Prairie county, where replicated comparisons of P_2O_5 (0, 45, 90 lb/A) and poultry litter (0,1, 2 tons/A) were made, the control yield was 34.8 bu/A. The top yield of 58.8 bu/A resulted from the 90 lb P_2O_5/A rate plus 2 tons/A poultry litter. Seed P concentrations increased with P fertilization and ranged from 0.32 to 0.39 percent. Low P fertility may result in significantly reduced soybean yields in many Arkansas fields commonly rotated with rice.

Louisiana

Interaction of Starter Fertilizer, Row Spacing, and Plant Population on Performance of Corn and Weed Competition

Project Leaders: Dr. H.J. "Rick" Mascagni and B.J. Williams, Northeast Research Station, LSU Agricultural Center, P.O. Box 348, St. Joseph, LA 71366 (318-766-3769).

Row spacings of 30 and 40 inches, plant populations of 25,000 and 30,000 plants/A, starter fertilizer at 0 and 5 gallons/A of 10-34-0 applied in-furrow, and four herbicide treatments were compared on a Commerce silt loam soil at St. Joseph. Starter fertilizer increased yields in 30-inch rows (147.9 vs. 142 bu/A), but not in the 40-inch rows (141.9 vs. 143.9). Broadleaf signalgrass pressure (BSP) was significantly affected by the interaction of starter fertilizer, row spacing, corn plant population, and herbicide, but the pressure was low and highly variable. Starter fertilizer improved corn's ability to compete with broadleaf signalgrass. The BSP increased two-fold with starter fertilizer in 40-inch row corn at 25,000 seed/A. When corn was seeded at 30,000 seeds/A in 30-inch and 40-inch rows, starter fertilizer reduced weed pressure approximately 25 and 35 percent, respectively. Starter fertilizer can significantly increase corn yields on productive Mississippi Delta soils with high soil test P levels when row spacing, weed control, and plant populations are managed correctly.

Improving Efficient Use of Soil Applied Fertilizers Using 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).

A 165-acre field was sampled on 1 and 2.5-acre grids and a composite sample was collected in 1997, to evaluate the agronomic and economic benefits of variable rate fertilization vs. uniform rate fertilization of soybeans. Phosphorus, K and sulfur (S) were found to be deficient, and these three nutrients were applied simultaneously at uniform and variable rates in 1997. Residual fertilizer effects were evaluated in 1998. The two-year average yields were: 41.5, 40.8, and 39.8 bu/A for the uniform application, 1-A grid application, and the 2.5-A grid application. Economic analyses of sampling, fertilizer, and application costs showed the lowest cost of $30.20/A for the whole field sampling and uniform rate application. The costs for the 2.5-A grid approach and the 1-A grid approach were $32.03 and $34.51/A. The highest correlation found between soil test levels and yield was with initial soil test K. Yield was also strongly, negatively correlated with plant tissue K levels at R5 (beginning seed) and K DRIS indices: -0.33 and -0.33. The results indicate there is no advantage of variable rate fertilization over uniform rate fertilization at this site, but there may be a need to reevaluate the K nutrition of soybeans.

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).

To address high-yield K requirements and the potential interaction of copper (Cu) and K, a three-year experiment was planned for 1998, but delayed until the spring of 1999 because of drought and other factors. Four K rates (0, 80, 160, 240 lb K_2O/A) and three 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 Effects on 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).

This project continues to address the basic physiological role of B in ion uptake mechanisms and the effects of B deficiency. Plants receiving supplemental B in hydroponics and in the soil can overcome Al toxicity. It was also discovered that B is involved in the reduction of iron (Fe) in roots to a form that dicots can use. The role of B in root uptake of calcium (Ca), magnesium (Mg) and K was investigated in 1998. Deficiency of B was found to decrease Mg concentration in actively growing root tips of squash plants. Calcium levels in cells at the root apex, and 3 to 10 mm back, were also affected by B nutrition. These results indicate that B may play a role in both uptake and efflux of Ca and Mg from roots. Boron also affected the uptake of K, but differently compared to the effects on Ca and Mg.

Phosphorus and Magnesium Interaction in Plants

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

Tall fescue plots were developed at the Southwest Center near Mt. Vernon with different soil P (26, 51, 91 lb/A Bray P-1) and Mg (202, 254, 328 lb/A ammonium acetate extractable Mg) levels, to study the interaction with Mg fertilization…0, 15 lb/ A Mg as $MgCl_2$. Raising soil Mg levels and using Mg fertilization to increase tall fescue yields and quality and to reduce the grass tetany risk were of little benefit unless soil test P levels are maintained above 40 to 50 lb/A with adequate P fertilization. Raising soil test P to this level or higher has increased hay yields by 2,000 lb/A compared to lower soil test P levels. A separate test evaluated tall fescue response to the rate (0, 28, 56 lb P_2O_5/A) and timing of P (spring or late summer) on a low P soil (26 lb/A Bray P-1). The optimum rate and time of P application in this 1998 test were found to be 28 lb P_2O_5/A in the spring, but summer drought may have influenced the results. Additional tests were conducted to evaluate the use of the herbicide Select (0, 1.28, 2.56 oz./A) to suppress seed heads and its interaction with P fertilization (0, 28, 56 lb P_2O_5/A). Spring application of Select at low rates suppressed the number of stems produced by tall fescue. Phosphorus fertilization increased the fescue leaf numbers, potentially increasing forage quality.

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).

This research is evaluating the use of electromagnetic induction (EM) sensing for soil electrical conductivity as a surrogate measure of subsoil fertility. In 1997, three fields were EM-surveyed in the Mississippi Delta region of Missouri. Available K, Ca, and Mg in the rootzone were related to soil conductivity. There was little relationship between EM readings and soil P availability. The mass of clay plus fine silt-sized particles in the top 4 feet was strongly correlated with soil electrical conductivity readings. Average clay content of the top 2 feet of soil was also correlated to soil electrical conductivity readings. Preliminary results indicate that EM sensing and precision ag technologies may improve management and economic returns to fertilizer inputs (N and possibly K) on some soils in the Mississippi Delta.

Site-Specific Fertilizer Based Recommendations for Improved Nutrient Utilization on Corn-Soybean, Claypan-Soil Fields (Multi-Regional Project)

Project Leaders: Dr. Newell R. Kitchen, Soil Scientist, Dr. Ken Sudduth, Agricultural Engineer, 240 and 269 Agricultural Engineering Building, USDA-ARS, Midwest Area Cropping Systems, Water Quality Research Unit; and Dr. J. Glen Davis, Extension Assistant Professor, 241 Agricultural Engineering Building, University of Missouri, Columbia, MO 65211 (573-882-1138).

The objective of this study is to develop and validate a method for site-specific fertilizer recommendations to improve the agronomic, economic, and environmental benefits from fertilization of the corn-soybean rotation system, using EM and precision ag technologies integrated with soil-landscape characteristics. This study is part of a larger regional cooperative effort in coordination with the PPI Midwest Director and the United Soybean Board.

Variable-rate N, P, and K were applied with the corn planting operation in a 70-acre field. Leaf chlorophyll, total biomass at harvest, N uptake and fertilizer-use efficiency, yields via a combine monitor, grid-sampled grain nutrient content, and nutrient variability were measured. Preliminary yield data indicate that the two application methods performed similarly. Post-harvest soil sampling is being conducted to measure residual soil nitrate levels.

Tennessee

Site-Specific Management of Cotton

Project Leaders: Dr. Mike E. Essington, Department of Plant and Soil Sciences, P.O. Box 1071, University of Tennessee, Knoxville, TN 37901-1071 (423-974-7101); and Dr. Donald H. Howard, West Tennessee Experiment Station.

In 1996, a 5-acre area within a larger field with a long history of cotton production on the Milan Experiment Station was selected to study soil chemical and physical variability and its association with cotton lint yields. The study area was expanded to 16 acres in 1997 and to 27 acres in 1998 and divided into 240 monitoring units measuring 53 by 90 feet. Cotton yields were determined using an instrumented 4-row Case 2155 cotton picker in conjunction with a GPS satellite receiver. A 0.25-acre grid appeared to provide a realistic estimate of soil fertility in the field. Spatial variability in soil fertility was relatively consistent from year to year for nutrients other than P and K. Build-up in soil P and K was observed. In 1996 and 1997, individual soil fertility parameters failed to correlate significantly with yield. Lint yield in 1997 was significantly correlated with multiple parameters [e.g. Mehlich 3 K and Fe, Fe and manganese (Mn)]. Yield variability at this site may be better related to soil physical characteristics than to fertility, since 92 percent of the monitored units tested high in soil P, and 86 percent of the units tested high in soil K. Yield data from 1998 are being converted and formatted for statistical analysis.

Evaluation of Potassium Sulfate as a Starter Material for 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).

Research was initiated in 1997 and continued in 1998 at Milan on a Memphis silt loam soil to determine the no-till (NT) corn and cotton response to fertilizer solutions made from K_2SO_4 or KCl, with and without 11-37-0 plus urea-ammonium nitrate solutions as in-furrow (IF) starters. Application of 10-10-10 IF, 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 no different from the 10-10-10 solution made with K_2SO_4. No significant differences were measured among starter treatments in 1998, possibly because of very high temperatures during silking through maturation. Corn yields (104 to 113 bu/A) were 25 percent lower than yields in 1997. In contrast to the NT corn, NT cotton yields (984 to 1,175 lb/A lint) were unaffected by the IF starter treatments either year. Preliminary results indicate that no-till corn may significantly benefit from K included in the in-furrow starter, and K_2SO_4 may be the preferred in-furrow source compared to KCl.

Evaluation of Nitrogen Sources and Application Timing for Wheat

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

Research was initiated in the fall of 1997 to compare ammonium nitrate (AN), urea (U), urea plus ammonium sulfate (UAS), and urea-ammonium nitrate (UAN) solution at 0, 30, 60, 90, 120, and 150 lb/A of spring-applied N. The UAN was applied with flat fan nozzles from a CO_2 pressurized sprayer and the other N sources were applied with a 12-foot Gandy drop-type spreader. Yield, disease severity, flag leaf N concentration, N uptake, grain moisture, and test weight were measured. Yields increased incrementally with N rates up to a maximum of 63.4 bu/A with 120 lb/A of spring-applied N. Across N rates, AN yielded the most (58.6 bu/A) while the other N sources did not differ (55.5 to 56.4 bu/A). There was a significant rate by source effect on yield, grain moisture, test weight, flag leaf N concentration, and plant N uptake. A separate study compared application timing of AN and UAN at 90 lb/A of spring-applied N. Five different application times were evaluated. The first N application was made in mid-February, and the other four times were spaced at two week intervals thereafter. Application timing did not affect yields. Ammonium nitrate produced higher yields than the UAN treatment (57.1 vs. 52.2 bu/A). These early results indicate that N sources for wheat may differ in effectiveness in this part of the Midsouth region. ■