NEWS & VIEWS

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Dr. C.S. (Cliff) Snyder, Midsouth Director
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Summary of the 2000 Research Programs — Midsouth Region

The Potash & Phosphate Institute (PPI) and the Foundation for Agronomic Research (FAR) provide both financial and technical support for many agronomic research and education programs. These programs seek to provide science-based answers for today and lay the foundation for tomorrow's management plans. This issue is a summary of the Midsouth nutrient management research supported by PPI and FAR in 2000. Please contact us or the project leaders if you would like more information on the research.

Arkansas

Yield Response to Soil and Foliar Potassium Fertilization of Water Deficit Stressed Cotton

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Cooperating Scientist: Dennis Coker

High (with recommended soil-applied K) and low K regimes (without recommended K), were compared under well-watered and dryland conditions, with and without foliar-applied K treatments at Clarkedale (250 lb/A Mehlich 3 soil K) and Rohwer, Arkansas (> 300 lb/A Mehlich 3 soil K). Foliar potassium nitrate (KNO_3) was applied for four consecutive weeks starting at first flower using 10 lb of KNO_3 in 10 gallons of water/A. Soil water status, growth, photosynthesis rate, and K concentration in organ tissues were monitored at pinhead square, first flower, three weeks after first flower, and five weeks after first flower. Lint yield and components of yield were also measured. Under the extreme hot and dry conditions in 2000, there was no significant lint yield response to foliar K at Rohwer. Lint yield increased significantly by 128 lb/A with recommended soil-applied K under well-watered conditions, but tended to decrease under dryland conditions at Rohwer. Averaged across soil K treatments at Clarkedale, foliar K increased lint yield by 51 lb/A under well-watered conditions and 56 lb/A under dryland conditions. On soils in the marginal range of medium soil test K, foliar K may increase lint yield, but response may differ under well-watered and dryland conditions.

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

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

Drew 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 N rates (0, 60, 90, 120, and 150 lb/A) applied at four different timings (all N 14 days before flooding, all N seven days before flooding, all N pre-flood the day of flooding, and half of the N pre-plant plus half pre-flood). There was a three-way interaction among N source, rate, and timing. When all the N was applied at pre-flood the day of flooding, there was no yield difference between N sources at any N rate. Yields (154 to 160 bu/A) did not increase from either source with this pre-flood timing at rates above 90 lb N/A. When either source was applied one week before flooding, 120 to 150 lb N/A were required to maximize grain yields. Ammonium sulfate was superior to urea if applied two weeks before flooding on this high pH soil, but required 120 to 150 lb N/A to achieve the same yield as 90 lb N/A of either urea or $(NH_4)_2SO_4$ applied pre-flood, the day of flooding. If a farmer cannot flood a field within 10 to 14 days of N application, it would be prudent to use $(NH_4)_2SO_4$ instead of urea on high pH soils.

Agronomic market development information provided by:
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Evaluation of Precision Agriculture Technology Incorporated into an On-Going Statewide Technology Transfer Program

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**See note on page 6.*

Global positioning, yield monitors, remote sensing, and other technology tools were used to identify factors restricting efficient production in an ongoing, state-wide soybean research verification program (SRVP). Variable rate or grid based (2.5-acre grid) fertilizer applications were made in four fields in 2000. In spite of the heat and drought, irrigated soybean yields exceeded 50 bu/A in three of the fields, but reached only 38 bu/A in the fourth field. Four-fold spatial variation in soil test P and K levels was identified for corrective management. Remote sensing images and yield monitor data identified areas in this field which did not receive adequate irrigation (flood irrigated), even though the field had been precision leveled. Corrective action by the land leveler was identified for the winter. Approximately 24 selected Extension specialists, County Extension agents, and Extension associates from Arkansas, Louisiana and Mississippi received instruction on the use of the Farm Research Analyst program in research verification programs. Precision agriculture technologies and implementation experiences in the SRVP were transferred to producers, county agents, the agricultural industry, Extension specialists, and researchers at a Mid-South Precision Agriculture Tour on August 30-31, 2000, an Arkansas tour on September 19-20, and at the Southern Soybean Conference in Tunica, MS in February 2001.

Fertilizing Rice-Based Cropping Systems to Achieve Maximum Yields while Maintaining the Natural Resource Base

Project Leader: Dr. Merle Anders, University of Arkansas, Rice Research and Extension Center, P.O. Box 351, Stuttgart, AR 72160 (870-673-2661), rrec_manders@futura.net

A long-term cropping systems study was initiated in 1999 on a silt loam soil near Stuttgart, Arkansas. The field was leveled, and 10 cropping systems (rice, corn, soybean, wheat in different combinations/rotations) were established using conventional tillage practices with four replications. In 2000, the plots within each cropping system were split into conventional tillage and no-tillage treatments. Each tillage treatment was split into two fertilizer treatments: 1) standard recommended fertilizer according to soil tests and 2) an enhanced treatment, consisting of approximately 20 percent more N-P_2O_5-K_2O than the standard. Soil and plant samples were collected from each treatment in 2000 to evaluate effects on soil fertility, soil C and N levels, plant nutrition, and soil physical properties. There were visual differences between the two fertility treatments in 2000, but no significant effects on yield. Crop rotation scheme, tillage treatment, and crop variety explained most of the yield differences observed among the systems. Differences between fertility treatments may not be manifested until later years.

Rice Response to Rate of Granular Fertilizer Sources Differing in Water Soluble Zinc Content

Project Leader: Dr. Nathan A. Slaton, 115 Plant Science Building, Crop, Soil and Environmental Sciences Department, University of Arkansas, Fayetteville, AR 72701 (501-575-3910), nslaton@uark.edu

Identical field studies were established near Stuttgart and Colt, Arkansas. Soil pH was raised to 7.4 with ag lime, and excessive P (300 lb P_2O_5/A.) was applied to silt loam soils (Mehlich 3 Zn < 1.5 ppm) at both sites to increase the likelihood of Zn deficiency. Four Zn sources [CoZinco 31 percent Zn, RSA Microtech 10 percent Zn, Frit 20 percent Zn (F20), and Frit 36 percent Zn (F36)] were compared at 0, 2, 4, 8, 12, and 16 lb Zn/A. Post-harvest Mehlich 3 soil Zn increased incrementally with Zn rate. All Zn rates and sources produced yields numerically greater than the control (6,179 to 6,592 > 5176 lb/A). Rice yield was not significantly correlated with Zn rate, water-soluble Zn (WSZn) rate, or number of fertilizer granules per square foot (FD) at Stuttgart. An unknown cause of floret sterility occurred at Stuttgart, which masked detection of potential yield differences among rates and sources.

At Colt, yield was significantly increased with 2 lb Zn/A (7,636 vs. 6,794 lb/A). Zinc rates of 4 lb/A or more produced yields equal to one another (8,397 to 8,891 lb/A), but greater than with 2 lb Zn/A. The WSZn rate and FD showed poor correlation with yield. Correlations of Zn rate, WSZn rate, and FD with vegetative dry matter, tissue Zn concentration, and vegetative Zn uptake were highly significant at both locations. The WSZn rate and FD had the highest correlations (r >0 .82 to 0.89) with vegetative Zn uptake. Zinc rate was also important, but had a lower correlation (r > 0.60 to 0.81) with vegetative Zn uptake. Rice growth and Zn uptake were similar among all sources except the F36 product. The F36 fertilizer consistently showed the least rice response. These studies emphasize the importance of Zn fertilizer granule distribution in the soil as well as water-soluble Zn rate. In 2001, Zn fertilizer will be recommended for rice by the University of Arkansas on silt loam soils having a pH > 6.0 and a Mehlich 3 soil Zn < 7 ppm.

Louisiana

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

A three-year experiment was planted in the high-yielding sugarcane variety LCP 85-384 in the fall of 1999 on a Jeanerette silt loam soil (144 ppm extractable K) near Lafayette, Louisiana. The objectives were to evaluate KCl at 0, 80, 160, and 240 lb K_2O/A with foliar applications of copper sulfate ($CuSO_4$) at 0, 0.1, and 0.2 lb Cu/A. All plots received a blanket application of 120 lb N/A as NH_4NO_3, 60 lb P_2O_5/A as polyphosphate, and 24 lb S/A as gypsum. Because of severe drought and the farmer's concern about potential leaf burn, the $CuSO_4$was not applied. Potassium rate did not significantly affect stalk weight, cane yield, or sugar yield in 2000. Plant leaf samples are being evaluated for nutrient concentrations.

Incorporating Precision Agriculture Technologies in a Soybean Research Verification Program

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Cooperating Scientists: Darryl Rester, Maurice Wolcott, and Curt Riche

**See note on page 6.*

The SRVP concept has been in existence for approximately 16 years in Arkansas, seven years in Mississippi and five years in Louisiana. In an effort to enhance the production efficiency, three fields were selected from the SRVP in Louisiana in 2000 to evaluate the factors contributing to yield differences within each field, using weekly scouting and precision agriculture tools [yield mapping, grid soil sampling, and soil electrical conductivity (EC) maps]. Old rice levees and differences in soil texture were identified using soil EC maps made with a Veris 3100 meter in one field. Differences in soil texture and nutrient levels were also mapped. Yields were 39, 56, and 55 bu/A in the three fields – compared to the 23 bu/A state average in 2000. Yield differences in the fields could not be readily correlated with measured parameters. Difficulties were experienced in getting fertilizer precision-applied because so few fertilizer dealers in Louisiana have variable rate or global positioning system (GPS) capabilities. In the future, greater effort will be made to work with farmers who have yield monitors and yield records. Such data can help refine soil sampling strategies and field management decisions.

Effect of Potassium Sulfate vs. Potassium Chloride on Sugarcane Yields

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

In September of 1999, sugarcane variety HoCP 85-845 was planted on a Baldwin silt clay loam soil near Lafayette, Louisiana. The soil has a pH of 5.9, 0.67 percent organic matter, 23, 42, 113, 406, and 1,865 ppm of extractable P, sodium (Na), K, Mg, and Ca, respectively. In May of 2000, K rates of 0, 84, 168, and 252 lb K_2O/A were established to compare K_2SO_4 and KCl as K sources in a Latin square design with eight replications. The crop was harvested in late December. Sugarcane yield and sugar yield were not affected by K sources or rates in 2000. Plant tissue analysis and soil test results are pending.

Missouri

Using Microarray Technology to Probe Boron Effects on 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

Boron (B) is important in cell wall structure, and deficient plants stop growing rapidly. Other physiological roles of B and its role in gene expression are not understood. Sophisticated molecular techniques were used to investigate the secondary and tertiary role of B in gene expression in plants. Ribonucleic acid (RNA) levels in B sufficient and deficient hydroponically-grown *Arabidopsis thaliana* were studied because RNA is an indicator of gene expression. Arabidopsis is the only plant that has had its genome completely mapped. All 20,000 genes were evaluated for sensitivity to B deficiency. Extracted RNA was sent to the Arabidopsis Functional Genomics Consortium for microarray analysis. Results are pending. Microarray identification of B sensitive genes and their function may provide direct information for determining why plants need B. It may also help identify genes involved in the channel or transporter functions of cell membranes and phosphorylation sites. The expression of B sensitive genes will be evaluated under shorter and shorter durations of B deficiency to isolate components that are responsible for rapid plant responses. Nutrient interactions, like the influence of B deficiency on decreased Mg uptake by roots, may be better understood and managed using the information generated from this research.

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

The cattle industry in Missouri is based largely on 12 million acres of tall fescue pasture and hay. Tall fescue plots were developed in 1996 at the Southwest Center near Mt. Vernon, Missouri, with different soil P (26, 51, and 91 lb/A Bray 1 P) and Mg levels (202, 254 and 328 lb/A NH_4OAc extractable Mg), to study the soil P and Mg interaction with spring P fertilization (0 vs. 57 lb P_2O_5/A). High Mg, Ca and P concentrations in fescue leaves in April resulted from the application of 57 lb P_2O_5/A in early March. The highest leaf Mg concentrations were observed throughout April in the plots which had the highest soil Mg levels and which also received P. This same trend was observed in May hay samples, although Mg levels were low compared to leaf tissue levels in April. Phosphorus fertilization increased May hay yields by one ton/A compared to untreated control plots. These results are consistent with data from previous years, showing that P fertilization on low P soils increases forage and hay yield, improves plant P, Ca, and Mg concentrations, increases the grazing and feed value of tall fescue, and decreases the potential for grass tetany.

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

With the advent of site-specific management strategies, interest has intensified to cost-effectively measure spatially-variable soil physical and chemical characteristics affecting crop growth and yield. This research was conducted to investigate the relationship of apparent electrical soil conductivity (EC_a measured using an EM38 conductivity sensor) in the soil to a depth of 5 feet to various soil physical and chemical properties, especially properties associated with soil fertility. Other work has been conducted on claypan soils of central and northeast Missouri and loess soils in central and northwestern Missouri. This work was conducted on Mississippi River alluvial soils in southeast Missouri to refine nutrient management for corn, especially N management.

Single rate N strips 15 feet wide were established the entire length of fields, and the average yield in each 60-foot length was measured. Families of N response curves were generated for each 60-foot section and compared to average EC_a measurements for the same areas. A significant relationship existed between EC_a values and soil basic cations (Ca, Mg and K). The optimal N rate in both years has varied from as little as 25 to 225 lb N/A, indicative of the soil variability. Areas requiring high N rates were characterized by either one of two soil conditions: (1) very sandy soil profile and high potential for nitrate leaching, as identified with low EC_a values, or (2) high clay content areas as identified by high EC_a values which reflect a high potential for denitrification. Soil EC_a also shows promise in estimating K in the soil profile.

Influence of Claypan Soil Topsoil Thickness and Fertility Factors on Corn and Soybean Yield

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Cooperating Scientists: Kenneth A. Sudduth and Jon J. Fridgen

**See note on page 6.*

The objective of this research was to assess the potential interaction between claypan soil topsoil thickness (i.e., depth to the claypan) and soil test P and K on corn and soybean crop response. Plots were established in 1996 on a corn-soybean field near Centralia, Missouri with varying topsoil thickness (2 to 48 inches). A range of soil test P and K values was achieved with fertilization in the springs of 1996 and 1999. Both soil test P and K decreased dramatically over the 1997 and 1998 cropping period, indicating minimal buffering capacity of the surface soil for fertilizer additions. Erosion classes based on topsoil depth explained the majority of corn yield variation in 1997 and 1999. In three crop years, yield response to higher soil test values was best in areas of enhanced topsoil thickness. Generally, subsoil P and K were negatively correlated with topsoil thickness, an explanation for why researchers observed a recurring crop response to surface soil test P and K in areas with greater topsoil thickness. Direct calibration of EC_a using an EM-38 conductivity sensor to estimate topsoil depth worked well on the claypan soils of central Missouri. Response to soil fertility was found to vary by erosion class for three out of the four crop years investigated. Generally, crop response was to either soil test P or K, but not to both within a year. Crop yield was most sensitive to soil test levels in areas of deeper topsoil (i.e., areas of erosional deposition).

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: Dale Blevins, Tim Reinbott, Richard Crawford, and James Williams

A three-year study was initiated near Mt. Vernon, Missouri in 1999 to determine if P fertilization on low P soils (< 7 lb/A Bray P-1): 1) influences fescue P, K, Ca, and Mg concentrations under grazing conditions, 2) increases blood serum and cerebrospinal fluid Mg levels of cows grazing these pastures, and 3) provides the same protection against grass tetany as feeding a Mg supplement free-choice on grazed tall fescue. There were three replications of three treatments on the fescue pasture: a control [no P fertilization and no magnesium oxide (MgO) supplementation], 12 percent MgO mineral block offered free-choice (with no P fertilization), and 100 lb/A of P_2O_5 applied in early February. Each paddock received 120 lb N/A and 300 lb K_2O/A in early February. Three Angus-cross cows grazed each 2-acre fescue paddock for 56 days from February 15 to April 1, 2000. By the end of the trial, the P fertilized tall fescue had greater Mg levels than the two other treatments: 0.17, 0.13, and 0.15 percent Mg for the P fertilized, Mg supplement, and control treatments, respectively. Blood serum from cows showed Mg levels were 19 ppm initially and by the end of the trial were 20, 19, and 15 ppm for the P fertilized, Mg supplement, and control, respectively. There were no differences in cerebrospinal fluid Mg concentrations. Based on blood serum Mg levels after two years of study, it is clear that P fertilization provides the same protection against grass tetany as offering Mg supplement free-choice to cows. Cattlemen should maintain Bray P-1 soil test levels above 30 lb/A in tall fescue pastures.

Mississippi

Variability of Soil Chemical and Physical Properties and Their Influence on Soybean Yield in Mississippi

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Cooperating Scientists: Jim Thomas and Mitt Wardlaw

**See note on page 6.*

Three fields were selected near Hernando, Leland and Shaw in western Mississippi for EC_a mapping (using a Veris 3100 meter), soil fertility sampling on a 2.5-acre grid, determination of elevation, and topography. These fields were involved in an on-going SMART program, intended to demonstrate implementation of research-based technology to improve production efficiency and farm profitability. Soil textures ranged from silt loam to clay. Measured physical and chemical soil properties were related to yield data generated from GPS-referenced yield monitors on farmer combines. Yields averaged 37, 55, and 57 bu/A in the fields near Hernando (nonirrigated), Leland (irrigated), and Shaw (irrigated), respectively. The standard deviations in yields were 6.5, 13.3, and 13.8 bu/A, respectively. Variability in soil properties among the fields ranged from low to very high. Soil pH exhibited the least spatial variability while P and Ca tended to have the most. Relationships between soil fertility and EC_a varied among the fields. Regression analyses indicated yield variability tended to be explained best by topography, soil clay content, and general soil fertility, although the influences were not straightforward. Factors associated with good soil drainage (surface and internal) and plant-available soil water showed the strongest relationships with yield. Use of soil mapping units was not helpful in defining soil management zones or in explaining yield variability.

On-Farm Rice Research 2000 – Phosphorus Rate Studies

Project Leader: Dr. William L. Kingery, Department of Plant and Soil Sciences, Box 9555, Mississippi State University, Mississippi State, Mississippi 39762 (662-325-2748), wkingery@PSS.MsState.edu

Cooperating Scientists: T.W. Walker and J.E. Street

Arkansas, Louisiana and Mississippi have all reported possible inadequacies in soil tests for making P recommendations for rice. Each state laboratory uses a different soil test extractant. This study was initiated in 2000 on clayey soils in the Mississippi River Delta of western Mississippi to determine if rice responds to P fertilization at high to very high (60 to 120 lb/A) Lancaster soil test P. Tests were established in leveled fields in both cut areas and filled areas, using a range of pre-flood P rates: 0, 20, 40, 60, and 80 lb P_2O_5/A. The soil pH in plot areas ranged from 5.0 to 6.2. No differences in rice yield or Y-leaf tissue P concentration were observed among the P treatments at any of the eight sites. The Y-leaf tissue P concentrations at ½-inch internode elongation were all in the sufficiency range of 0.18 to 0.29 percent P.

Tennessee

Evaluation of Nitrogen Sources and Rates and Timing of UAN Application for Winter Wheat

Project Leader: Dr. Donald D. 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-$(NH_4)_2SO_4$, and urea-NH_4NO_3 (UAN) solution at 0, 30, 60, 90, 120, and 150 lb/A of spring-applied N in 1997-98. In 1998-99, a 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 N/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.

The study was repeated in 1999-2000, but the urea-$(NH_4)_2SO_4$ treatment was replaced by $(NH_4)_2SO_4$. Broadcasting NH_4NO_3 at 90 lb N/A (62 bu/A) or 150 lb N/A as $(NH_4)_2SO_4$ (59 bu/A) provided the highest yields. Plots were heavily infested with take-all disease in 2000, and yields were lower compared to previous years. Increasing the N rate did not affect wheat test weights in 2000 as it had previously. The test weights were significantly greater with $(NH_4)_2SO_4$, NH_4NO_3, and UAN-$Ca(NO_3)_2$ compared to urea and UAN sources. These results indicate NH_4NO_3 tends to provide higher wheat yields at 90 to 120 lb N/A in this part of the Midsouth region compared to the other N sources studied on wheat.

Potassium, Nitrogen and Tillage Effects on Bronze Wilt of Cotton

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Cooperating Scientists: D.D. Howard, C.E. Michaud, and E.F. Robinson

This study was superimposed on plots that had been used for no-till K research at Ames Plantation and Jackson, Tennessee in former years. The objective was to evaluate the effects of tillage and fertilization on the incidence of bronze wilt (BW) in a susceptible variety (Paymaster 1218 BG/RR). Bronze wilt is a disorder in cotton characterized by bronze discoloration and wilting of the leaves, no discoloration of the vascular system, but excessive square and boll abortion, and yield reduction. Potassium rates at Ames Plantation ranged from 0 to 240 lb K_2O/A, with 80 or 160 lb N/A broadcast prior to planting. The higher N rate was applied only to plots receiving 60 or 120 lb K_2O/A, but all K_2O rates were tested with 80 lb N/A.

The main plot treatments at Ames Plantation were no-till and conventional tillage. The K rates at Jackson ranged from 0 to 180 lb K_2O/A; P treatments were 30 and 90 lb P_2O_5/A. The N and P rates were not applied to all K rates, but all K rates were tested with 80 lb N/A and 30 lb P_2O_5/A. A few plants with BW symptoms appeared each week from first flower to late bloom at both locations. Neither fertility nor tillage affected BW incidence or severity. The incidence of BW was not sufficient to affect the plot yields, but yields of individual plants were markedly reduced. The fruit loss ranged from about 90 percent in plants developing BW symptoms at early bloom and from 20 to 30 percent when symptoms appeared later. ■

*Note: More information can be obtained via the website (**http:www.farmresearch.com**) on four projects which were coordinated through FAR and funded by the United Soybean Board (USB) . To learn more about the Midsouth projects in Arkansas, Louisiana, and Mississippi, track to:

http://www.farmresearch.com/Midsouth/midsouth.asp.

Details on the Midwest research project in Missouri can be found at:

http://www.farmresearch.com/Midwest/Midwest.asp.