IPNI INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

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Northcentral Research Update Report

AGRICULTURE is being asked to solve monumental problems — global warming, hypoxia, eutrophication, food security, and sustainable energy to name a few. The research of soil fertility and plant nutrition is as important as ever as we strive to better understand the elements of sustainable nutrient management. The studies contained in this publication are efforts to that end, and represent continued efforts to help agriculture meet the growing number of demands placed upon it.

This issue of *INSIGHTS* features the brief Interpretive Summaries related to research projects partially supported by IPNI and the Foundation for Agronomic Research (FAR) in the Northcentral Region. This information and more detail on each project can be found at the research database at our website: >**www.ipni.net/research**<.

Indiana

Impact of Potassium and Phosphorus Nutrition Biomass Yield and Herbage Composition of Switchgrass Grown for Biofuels

Project Leader: Dr. Jeffrey Volenec, Purdue University, Department of Agronomy, 915 West State Street, West Lafayette, IN 47907. Telephone: 765-494-8071. Fax: 765-496-2926. E-mail: jvolenec@purdue.edu

Project Cooperators: Sylvie Brouder, Keith Johnson, and Brad Joern

Current U.S. plans for energy security rely on the conversion of large acreages from food crop production to the production of cellulosic biomass in order to produce 86 billion gallons of biofuels, thereby reducing U.S. dependence on imported oil by 25% by 2025. Additionally, lands currently considered too marginal for intensive food production may be considered suitable for biofuel production, bringing highly erodible, nutrient-poor soils currently in conservation reserve programs back into intensive agriculture. In the U.S. Midwest, cropping systems may shift from the predominant corn-soybean base to a more varied array of species, including novel perennial grasses for which little agronomic and environmental impact data exist. Sustainable biofuels production with the concomitant protection and improvement of air, soil, and water resources requires a concerted effort by the scientific community to gain knowledge regarding the comparative production potentials and environmental impacts of candidate biofuel systems.

This multi-disciplinary team has initiated a study of the most promising biofuel crop species and management systems at Purdue University's Water Quality Field Station (WQFS). Project team expertise combined with the unique WQFS capabilities for quantifying agro-ecosystem carbon, N, and water balance are permitting a quantitative assessment of candidate system net energy balance. Our overall goal is to develop a cropping system-level analysis of the potential for miscanthus, switchgrass, maize-based, and native prairie production systems to provide renewable fuel while protecting natural resources. Our hypothesis is that biofuel cropping systems differ in total yield and yield of structural and non-structural carbohydrate pools relevant to system profitability. In addition, we hypothesize that tangible differences in the water, N, and C economies of candidate systems exist and these differences will drive changes in soil and water quality. *IN-25*

Global Maize Project in the United States: West Lafayette, Indiana

Project Leader: Dr. Jeffrey Volenec, Purdue University, Department of Agronomy, 915 West State Street, West Lafayette, IN 47907. Telephone: +1 765 494-8071. Fax: +1 765 496-2926. E-mail: jvolenec@purdue.edu

Project Cooperators: Sylvie Brouder and Tony Vyn

A new model of research is desperately needed to meet the increased global demand for food, feed, and fuel. In 2009, IPNI assisted Purdue University in writing a proposal that was funded by the United States Department of Agriculture to plan Purdue's Long-Term Agroecology Program (LTAP). This project will address major research questions related to management impacts on interactions among soil N, carbon, water use efficiency, and the resultant ecosystem services from U.S. corn-based production. The overarch-

Dr. T. Scott Murrell
Northcentral Director
International Plant Nutrition Institute (IPNI)
1851 Secretariat Drive
West Lafayette, IN 47906
Phone: 765-413-3343

E-mail: smurrell@ipni.net
Website: www.ipni.net

ing theme is ecological intensification. The program is multi-disciplinary and will include integration of research conducted at different locations with systematic data aggregation and curation, thereby permitting on-going data accessibility and re-purposing.

Existing resources provide the foundational elements of the field research. The resources being considered for inclusion are IPNI's Global Maize Centers and Purdue University's Water Quality Field Station, Long-Term Tillage Research Facility, Long-Term Drainage Research Facility, the Purdue Agricultural Centers, and the Crop Diagnostic Training and Research Center. *IPNI-27*

Iowa

Variability in Soil Test Potassium and Crop Yield in Iowa

Project Leader: Dr. Antonio Mallarino, Iowa State University, Department of Agronomy, 3216 Agronomy Hall, Ames, IA 50011-0001. Telephone: 515-294-6200. Fax: 515-294-2458. E-mail: apmallar@iastate.edu

This project studied early growth, early K uptake, and corn grain yield response to in-furrow fluid starter K and broadcast K across the landscape using eight replicated strip trials and precision agriculture technologies. A low-salt liquid starter fertilizer (0-0-30) was applied at 15 to 22 lb K_2O/A alone and after broadcasting 120 lb K_2O/A (a common removal-based rate used by farmers for corn of corn-soybean rotations). Soils were sampled using a dense grid sampling approach and harvesting was performed with yield monitors. Two trials were managed with no-till and the others used chisel-plow/disk tillage.

Mean field soil test K ranged from 102 (low) to 223 ppm (very high), but each field had values ranging from very low or low to high or very high. Averages from the entire length of the strips showed that K applied as either source: (1) did not affect early plant dry weight or K uptake consistently; (2) often increased early plant K concentration; and (3) increased grain yield at three sites. At two sites, broadcast K increased yield more than starter K and at one site both fertilizers increased yield similarly. Analyses of data for within-field areas with different soil series or with soil test K in different interpretation classes showed no consistent differences in response to starter or broadcast K. An interesting result was that a yield response to K sometimes was observed for soil test K levels higher than those for which K application is recommended in Iowa and neighboring states. The few instances with an early plant growth or K uptake response did not show a yield response. Starter K applied in addition to broadcast K never increased yield further.

Comparisons of these results with others using N-P or N-P-K starters indicate that application of in-furrow K has little or no true starter effect, which confirms previous Iowa research conducted with granulated fertilizer applied beside and below the seed row. However, the low liquid starter K rate applied often increased corn yield as much as the higher broadcast rate, which shows that farmers have management options concerning use of these K fertilizers sources for production of corn. *IA-09F*

Evaluation of Corn Response to Sulfur Fertilization in Iowa

Project Leader: Dr. John Sawyer, Iowa State University, Department of Agronomy, 2104 Ag Hall, Ames, IA 50011. Telephone: 515-294-7078. E-mail: jsawyer@iastate.edu

Project Cooperator: Brian Lang

In 2009, a series of on-farm strip trials was established to survey the frequency of corn response to S fertilization. At each field location, one rate of S was compared to no S applied. The S source was calcium sulfate (gypsum). Within-field replicates ranged from 3 to 9 across locations. Fifteen sites were established and 11 had useable data.

Seven different counties were represented and ranged from the middle of Iowa to the far northeastern part of the state. Sulfur rates across locations ranged from 15 to 40 lb S/A. A significant increase in corn yield to S fertilization occurred at 6 of the 11 sites, for a relative frequency of 55%. This frequency is similar to that of other recent small plot research conducted in northeast Iowa. Yield increases at the responsive sites ranged from 5 to 13 bu/A and were large enough to more than pay for S application. *IA-18F*

Evaluation of Sulfur Response by Corn

Project Leader: Dr. John Sawyer, Iowa State University, Department of Agronomy, 2104 Ag Hall, Ames, IA 50011. Telephone: 515-294-7078. E-mail: jsawyer@iastate.edu

Project Cooperator: Daniel Barker

The main objective of this study was to evaluate the 12-40-0-10S product (MicroEssentials MES10®), comprised of monoammonium phosphate (MAP) plus ammonium sulfate (AMS) and elemental S in equal proportions, as a S and P fertilizer source for corn production. A second objective was to provide additional data on the potential for corn response to S fertilization in Iowa. In addition, a second MicroEssentials product (MESZ® 12-40-0-10S-1Zn) was evaluated as a Zn fertilizer source. Sites were chosen in Mason City and Madrid, Iowa, based on their potential for soil S deficiency.

Results indicated a similar plant S uptake response to all S fertilizer products, but no yield response to S application at either site in 2009. A plant P uptake response was observed with all P fertilizer products, and a yield increase to applied P was found at the Madrid site and when analyzed across sites. A yield increase from P application was present for each product. However, for an unknown reason, the yield with the MES10® product when applied at the 30 lb S/A rate resulted in no yield response at both sites compared to the control. This also occurred for the MAP product at the Madrid site. The products were surface-applied at both sites, with one difference being the Madrid site was tilled and the Mason City site was under no-tillage. However, other P and S applications (either as different products or

at a lower rate of MES10®) did not generate such low yields as all of these combinations produced a yield increase from P application.

Based on the results in 2009, no real difference was noted between the S or P fertilizer products. There was no yield increase with application of Zn as MESZ®. The MESZ® product also appeared to supply equivalent S and P compared to the AMS and MES10® products. The MESZ® product did not have the yield issue noted with the high rate of MES10®. This lends further evidence that the lower yield with the 30 lb S/A rate of MES10® and MAP treatments was due to something besides product application, although that is unconfirmed. *IA-19F*

Global Maize Project in the United States: Ames, Iowa

Project Leader: Dr. Roger Elmore, Iowa State University, Agronomy Department, 2101 Agronomy Hall, Ames, IA 50011-1010. Telephone: +1 515 2946655. Fax: +1 515 2943163. E-mail: relmore@iastate.edu

Project Cooperator: John Sawyer

Iowa has the largest area planted to maize of all corn producing states in the U.S. and it also has yields that are among the highest in the country. Iowa is within the Mississippi River Basin, which is an area of intense environmental scrutiny due to issues related to hypoxia in the Gulf of Mexico. Examining the gap between average and potential yields provides important information about future production growth in this state as well as other areas in the U.S. Midwest. Attaining greater production requires the identification of combinations of management practices that allow corn hybrids to fully express their genetic potential while limiting nutrient losses. These management practices are conceptualized by the term "ecological intensification (EI)." Field experiments are being planned for the 2010 cropping season that compare current farmer practices to what scientists at this center currently believe comprises EI practices. Within this study, N use efficiency will be measured to determine if EI practices can achieve both higher production levels as well as greater N use efficiency. *IPNI-26*

Illinois

Assessing Nutrient Profiles in Illinois Soils

Figure 1. Counties sampled in the late 1960s soil test survey.

In the late 1960s, a University of Illinois project coordinated by Sam Aldrich, Ted Peck, and Bill Walker collected soil and plant samples from fields throughout Illinois to establish a baseline of soil profile nutrient levels and crop uptake for corn and soybeans. This report summarizes results from samples collected in 1967, 1968, and 1969, from about 20 corn and soybean fields in each of 75 Illinois counties. An earlier project, outlined in University of Illinois Agricultural Experiment Station Bulletin No. 123, reported on a similar statewide survey conducted about 100 years ago. These surveys provide important benchmarks of the nutrient status of Illinois soils and help track the impact of nutrient removals in crop production and additions in fertilizer and livestock manure. FREC Project #313 was designed to provide a checkpoint to determine whether there has been significant change in soil nutrient profiles in the past 4 decades since the last survey was completed. *IL-35F* ■

Figure 2. Counties from which samples were collected for FREC #313 in 2006.

IPNI Introduces "Nutrient Source Specifics" Series

The International Plant Nutrition Institute (IPNI) is introducing a series of one-page, condensed fact sheets highlighting common fertilizers and nutrient sources in modern agriculture. The series is called "Nutrient Source Specifics".

"These topics offer brief information about the production, agricultural use, management practices, and chemical properties of common fertilizer materials," said IPNI President Dr. Terry L. Roberts. "One of our thematic work groups saw the need for this kind of information and we believe the series format will be useful in providing a quick reference library as we add to it. However, we also encourage individuals to consult with local experts regarding specific nutrient use."

One of the goals of IPNI is to provide science-based plant nutrient and fertilizer information to a wide range of audiences. Written by IPNI scientific staff, Nutrient Source Specifics topics are primarily for educational use by a non-technical audience. The list of topics will include all the major nutrient sources, but currently consists of: 1) urea; 2) polyphosphate; 3) potassium chloride; 4) compound fertilizer; 5) potassium sulfate; 6) potassium magnesium sulfate: langbeinite; 7) urea ammonium nitrate; 8) thiosulfate; 9) monoammonium phosphate (MAP); and 10) ammonia. The entire series is available as individual PDF files at the IPNI website: >www.ipni.net/specifics<.

COMING EVENT

40th Annual
North Central Extension-Industry Soil Fertility Conference

November 17-18, 2010

Holiday Inn Airport, Des Moines, Iowa

An excellent program is being planned for 2010 featuring invited talks by industry and university presenters.

http://www.ipni.net/ipniweb/conference/ncsfc2010.nsf/