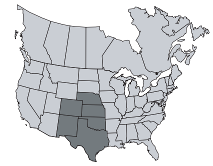
INSIGHTS
IPNI
INTERNATIONAL PLANT NUTRITION INSTITUTE

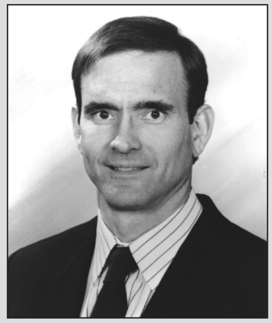
Research in the Southern and Central Great Plains Region



September 2007

CHANGE is the theme of this issue of *INSIGHTS*, both in name and staff. Effective January 1, 2007, the Potash & Phosphate Institute changed its name to the International Plant Nutrition Institute (IPNI) and we change the name of this publication from *News & Views* to *INSIGHTS*.

The issue of *INSIGHTS* features the brief Interpretive Summaries related to research projects supported by IPNI in the Southern and Central Great Plains Region. This information and even more detail on each project can be found at the research database at our website: >**www.ipni.net/research**<.



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Colorado

Spatial Removal of Nutrients by Corn

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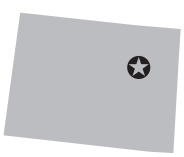
Project Cooperators: Dwayne Westfall, Kim Fleming, and Tim Shaver



Research at Colorado State University is quantifying the impact of precision nutrient and pesticide strategies on environmental quality and corn production. Since the inception of this project in 2004, significant progress has been made in data collection, analysis, and extension-outreach. The project is currently evaluating a suite of active remote-sensing devices to quantify in-season N variability in corn production for better N management.

A Ph.D. level graduate student is conducting both greenhouse and field studies. In this process, a significant number of soil and plant tissue samples are being analyzed for nitrates. IPNI/FAR is providing support in plant and soil sample analysis through a cooperating laboratory. The 2006 results so far indicate that each of three commercially available active hand-held sensors (i.e., Green Green-Seeker, Red Green-Seeker and the Crop Circle Sensor) have the ability to distinguish in-season N variability (dependent on growth stage) in corn. Each sensor yielded different levels of NDVI (Normalized Difference Vegetation Index). However, the overall trend of the NDVI readings among sensors generally increased with increasing corn growth stage. This project is furthering the understanding and development of advanced technologies that have the potential to improve N fertilizer management. *CO-12F*

Kansas

Effect of Long-Term Nitrogen, Phosphorus, and Potassium Fertilization of Irrigated Corn and Grain Sorghum

Project Leader: Dr. Alan Schlegel, Kansas State University, Southwest Kansas Research and Extension Center, Rt 1, Box 148, Tribune, KS 67879. Telephone: 316-376-4761. e-mail: schlegel@ksu.edu

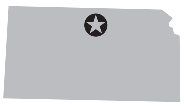
This long-term western Kansas study was initiated in 1961 to evaluate responses of irrigated continuous corn and grain sorghum to N, P, and K fertilization. Furrow irrigation was used through 2000, and sprinkler irrigation since 2001. No yield benefit to corn from K fertilization was observed in the first 30 years and soil K levels remained high, thus the K treatment in the corn study was discontinued in 1992 and replaced with a higher P rate. Nitrogen treatments for corn and grain sorghum were 0, 40, 80, 120, 160, and 200 lb N/A. Phosphorus treatments for corn and grain sorghum were 0, 40, and 80 lb P_2O_5/A, and 0 and 40 lb P_2O_5/A, respectively. The K treatments for grain sorghum were 0 and 40 lb K_2O/A.

This project continues to show that P and N fertilizer inputs are critical to the optimization of irrigated corn and grain sorghum production in western Kansas. Nitrogen alone increased corn yield by as much as 70 bu/A, while N and P applied together increased yield by up to 160 bu/A. Historically, 160 lb N/A has been the economic optimum N rate for corn. However, 120 lb N/A was required to obtain maximum yield in 2006. Phosphorus fertilizer increased yield by 134 bu/A at 120 lb N/A... from 68 bu/A with the zero P control to 202 bu/A with the application of 80 lb P_2O_5/A. Corn yield was higher (26 bu/A) with 80 compared to 40 lb P_2O_5/A. Nitrogen fertilizer alone increased sorghum yield by as much as 50 bu/A, while N plus P increased yield by as much as 65 bu/A. Potassium fertilization has had no effect on sorghum yield over the course of the study.

This is one of the few long-term crop nutrition studies in the U.S. Support will continue in 2007. *KS-23F*

Maximizing Irrigated Crop Yields in the Great Plains

Project Leader: Dr. Barney Gordon, Kansas State University, North Central Kansas Experiment Fields, Route 1 Box 43, Courtland, KS 66939. Telephone: 785-335-2836. Fax: 785-335-2239. e-mail: bgordon@oznet.ksu.edu



Recent research in north central Kansas has demonstrated the importance of complete and balanced nutrition in the production of high-yield corn. Fertilization of soybeans in a common corn/soybean rotation has traditionally been secondary to corn fertilization, as the crop is usually left to scavenge nutrients remaining after corn. This work was expanded in 2004 to determine the benefit of direct fertilizer application to sprinkler-irrigated soybeans.

Treatments in this study were row spacing (30 in. and 7.5 in.), plant population (150,000 and 225,000 plants/A), and seven fertility treatments. The N, P, and K fertility treatments consisted of a low P application, low P-low K, low P-high K, high P-high K, NPK, and an unfertilized check. Phosphorus application rates were 30 (low) or 80 (high) lb P_2O_5/A, and K treatments were 80 (low) or 120 lb (high) K_2O/A. The NPK treatment consisted of 20-80-120 lb N-P_2O_5-K_2O/A. In 2005, manganese (Mn) at 5 lb Mn/A was applied along with the NPK treatment to evaluate the effect of Mn on Roundup Ready® soybeans. Initial (2004) soil test values were: pH 6.5; 23 ppm Bray-1 P (very high); and 236 ppm exchangeable K (very high). All fertilizer was broadcast in mid-March.

Soybean yield has not been affected by row spacing or plant population in any year of this study. However, fertilization has had a significant impact on soybean yield every year. In the first 2 years, the high P-low K treatment produced a maximum yield increase over the unfertilized check, with a 2-year average increase of 33 bu/A. Applying additional K or adding N did not increase yields over the high P-low K treatment. Adding Mn to the NPK treatment increased yield by 5 bu/A in 2005. However, in 2006 yield was maximized by the low P rate, with additional P, K, and Mn showing no advantage. The low P rate in 2006 increased yield by about 30 bu/A over the unfertilized control. This work is demonstrating significant response to direct fertilization of soybeans in high-yield environments and will continue in 2007. *KS-33F*

Effect of Nitrogen and Phosphorus Starters on Short-Season Corn Grown in Conservation Tillage Systems

Project Leader: Dr. Daniel Sweeney, Kansas State University, Southeast Agricultural Research Center, PO Box 316, Parsons, KS 67357. Telephone: 316-421-4826. e-mail: dsweeney@oznet.ksu.edu

Project Cooperator: David Mengel

The objective of this southeastern Kansas project was to determine the effect of N and P rates in starter fertilizers on yield, yield components, and nutrient uptake of short-season corn planted with reduced or no-tillage. Starter N rates were 20, 40, and 60 lb/A and P rates were 0, 25, and 50 lb P_2O_5/A. Total N and P rates, in all cases except the control, were balanced to 120 lb N and 50 lb P_2O_5 in order to isolate starter effects. Corn yield was low in the first year (2006) because of dry growing conditions. Overall yields averaged less than 80 bu/A, with no differences due to starter or starter rates. All starter treatments averaged 80 bu/A compared with 77 bu/A when all the fertilizer was broadcast before planting. The control treatment receiving no N or P fertilizer yielded 62 bu/A. Additionally, there were no differences in yield between tillage systems, nor were there any significant interactions between tillage and starter fertilizer treatments. This project is to be continued for 2 more years to provide data under different environmental conditions. *KS-35F*

Manganese Response of Conventional and Glyphosate-Resistant Soybean

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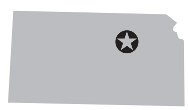

Weed control benefits of glyphosate resistant (GR) soybeans have resulted in nearly complete adoption of GR soybean varieties by U.S. producers, despite an apparent yield decrease that accompanies this decision. Although the reasons for the yield decrease are not known, there is some evidence that GR soybeans have reduced manganese (Mn) uptake compared to conventional soybeans and, therefore, Mn additions may help overcome the apparent yield disadvantage. The objectives of this study are to i) evaluate nutrient uptake, distribution, and biomass accumulation in a GR soybean cultivar compared to a non-GR sister line, and ii) determine the response of a GR and non-GR soybean cultivar to soil and foliar Mn applications.

Field plots were established in four locations in north central and eastern Kansas to compare conventional and GR soybean response to three rates of soil-applied Mn and two rates of foliar Mn. Response variables include plant height, biomass, leaf Mn concentration, Mn uptake, yield, and grain Mn concentration. Manganese additions to GR soybeans increased soybean yields by 5 bu/A at one (Scandia, Kansas) of the four locations, whereas conventional soybeans were not responsive to Mn at any of the research locations. Over all, soybean yields were greater at the Scandia location compared to the other three locations, suggesting that yield increases from Mn additions to GR soybeans may occur only in high-yielding environments (> 60 bu/A). The GR soybeans were also taller than conventional soybeans at two of the four locations (Scandia and Ashland Bottoms). The difference in plant height was 4 in. at Scandia and only 2 in. at Ashland Bottoms, suggesting that genetic differences are also magnified in high yielding environments. Tissue analyses are not yet completed, but will be reported in future summaries. *KS-36F*

Nebraska

Ecological Intensification of Irrigated Corn and Soybean Cropping Systems

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Project Cooperators: K.G. Cassman, T.J. Arkebauer, R.M. Caldwell, R.A. Drijber, J.L. Lindquist, J.P. Markwell, L.A. Nelson, W.L. Powers, W.K. Russell, J.E. Specht, M. Soundararajan, and D.T. Walters

In 1999, an interdisciplinary research program on ecological intensification of irrigated maize-based cropping systems was established at the University of Nebraska to: (i) improve understanding of the yield potential of corn and soybean and how it is affected by climate and management; (ii) develop approaches for managing continuous corn and corn/soybean systems at 80 to 95% of the yield potential; (iii) conduct integrated assessment of productivity, profitability, input use efficiency, energy balance, and environmental consequences of intensified cropping; and (iv) develop a scientific basis and decision support tools for extrapolation to other locations.

Crop yields of 90 to 95% of the yield potential have been consistently achieved in this project, in both continuous corn and corn-soybean systems. Better exploitation of the available growing season, high levels of soil fertility, and fine-tuned crop management practices contributed most to the achievement of high yields. In the intensive continuous corn systems, incorporation of large amounts of residue carbon (C) and N has led to a significant build-up of soil organic matter over a few years, which most likely has contributed to the increased system-level N use efficiency observed and also resulted in a lower overall global warming potential than that of a corn/soybean system. Major accomplishments in 2006 include an updated release of the Hybrid-Maize software (www.hybridmaize.unl.edu) and publication of an article in *Agronomy Journal* describing it; improved understanding of soil organic matter changes and greenhouse gas emissions in continuous corn and corn-soybean systems; discovery that arbuscular mycorrhizal fungi may play a significant role in P nutrition during reproductive stages of high-yielding corn; improved understanding of soybean phenology and yield response to management and climate; guidelines for high-yield soybean management; a new soybean phenology simulation approach; evidence that high-yielding corn systems can increase net energy yield from ethanol production by several fold compared to the current averages. All of these items are currently in some stage of publication.

Many of the management system differences in soil properties and crop productivity are becoming clearer through this work, which will allow a final agro-ecological evaluation of the different cropping systems in 2007. *NE-11F*

Texas

Effect of Potassium Fertilizers on Hybrid Bermudagrass Yields and Stand Decline

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This field experiment was initiated in 2001 with the specific objectives of: 1) determining the effect of K, chloride (Cl^-), and sulfur (S) fertilizer application on production, stand decline, and disease suppression in Tifton 85 bermudagrass; 2) evaluating the effect of K fertilizers on soil and forage nutrient content; and 3) investigating the effect of K and N fertilizer on bermudagrass production. Fertilizer treatments include K and S sources including potassium chloride (KCl), potassium sulfate (K_2SO_4) and KCl+elemental S at rates of 134, 268 and 402 lb K_2O/A/yr. Split applications consisting of one-third the yearly rate were applied throughout the growing season. Nitrogen rates were 80 and 160 lb N/A, and were applied for each forage growth period (i.e., between harvests). Phosphorus fertilizer was applied at 180 lb P_2O_5/A in the first year of study, and 120 lb P_2O_5/A was applied each spring thereafter.

Yields in 2006 were low as drought conditions allowed a total of only three harvests. Potassium fertilization had a significant impact on total yield. The total seasonal response to K ranged from about 1 t of dry matter (DM) at the 134 lb K_2O/A rate, to almost 2 t DM at 402 lb K_2O/A. This amounted to yield increases over the no K control of 48% and 86%, respectively. There was no significant difference between K sources in 2006. This is inconsistent with past years' results where source differences were observed and both S and Cl- contributed to yield. The higher rate of N (160 lb/A) produced approximately 0.9 t/A more total DM than did the 80 lb/A rate. *TX-47F*

Using Supplemental Foliar Potassium Fertilization to Improve the Nutritional Quality and Stress Tolerance of Muskmelon

Project Leader: Dr. John L. Jifon, Texas A&M University, Texas Agricultural Experiment Station, 2415 E Hwy 83, Weslaco, TX 78596. Telephone: (956)968-5585. Fax: (956)969-5620. e-mail: jljifon@agprg.tamu.edu

Project Cooperator: Gene Lester

Cantaloupe (muskmelon) fruit quality attributes such as sweetness, aroma, and texture are directly related to K-mediated processes. However, during fruit growth and maturation, soil K supply alone may be inadequate to satisfy K requirements. A previous south Texas glasshouse study has demonstrated that supplemental foliar K applications can overcome this apparent deficiency; however, the suitability of K sources for foliar application was not investigated.

This study is evaluating the effects of six foliar K sources including: potassium chloride (KCl), potassium nitrate (KNO_3), monopotassium phosphate (MKP), potassium sulfate (K_2SO_4), potassium thiosulfate (KTS), and potassium metalosate (KM) — a glycine amino acid-complexed K source — on fruit quality parameters of field-grown muskmelon 'Cruiser'. Experiments were conducted during the spring of 2005 and 2006 at Weslaco and Santa Ana in south Texas. Weekly foliar K applications were established starting at fruit set and continued to fruit maturity. Although preplant soil K concentrations were very high, supplemental foliar K treatments resulted in generally higher K concentrations in plant tissues, suggesting that plant K uptake from the soil solution was not sufficient to optimize tissue K accumulation. Fruit from plots receiving supplemental foliar K generally had higher soluble solids concentrations (SSC), sugars, and human wellness compounds (ascorbic acid and beta-carotene) than control fruit. However, this trend was more evident at the Weslaco site and there were no consistent trends among K sources, except for KNO_3 which tended to result in lower fruit firmness. Fruit yields were not affected by supplemental foliar K applications.

These results generally support our previous controlled-environment (glasshouse) findings that supplementing soil K supply with foliar K during fruit development and maturation can improve muskmelon fruit quality by increasing firmness, sugars, ascorbic acid, and beta-carotene. The study also provides additional evidence of differences among foliar K sources, with KNO_3 consistently emerging as a less desirable source of foliar K during fruit development and maturation. *TX-52* ■

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