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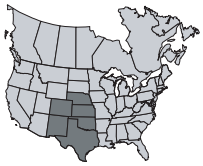
Research in the Southern and Central Great Plains Region



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CONTINUING investigation into new technologies and improved efficiency is vital to any and all industries. Accordingly, IPNI continues a tradition of supporting agronomic research for the future of our industry.

This 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 has for several years been evaluating the impact of precision nutrient and pesticide strategies on environmental quality and production efficiency. Quantifying the N requirements of maize is an important component of this research. Previous work has shown that Normalized Difference Vegetation Index (NDVI) sensor technology is effective in determining in-field maize leaf N concentrations and spatial variability. This technology can also be used to predict maize grain yield early in the season, resulting in the potential for improved N management decisions. The main objective of this project is to use crop and soil variables in conjunction with NDVI to accurately predict the grain yield of irrigated maize.

Sensor NDVI readings were collected using two active hand-held remote sensors (NTech's Red GreenSeeker©, and Holland Scientific's Crop Circle©) at two northern Colorado field sites over maize growth stages V8, V10, V12, and V14. Ancillary crop and soil data was also collected including maize leaf N content, soil N content, plant height, and chlorophyll (SPAD) readings. Preliminary results indicate that at growth stages V8 and V10, leaf N and NDVI were highly correlated, and leaf N content was the most important variable in predicting grain yield. At the later growth stages (V12 and V14), NDVI, leaf N content, and plant height were comparable predictors of grain yield. However, using multiple variables rarely increased the correlation with grain yield at any of the growth stages evaluated. *CO-12F*

Kansas

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

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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.

The 2007 results of this project continue 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 110 bu/A, while N and P applied together increased yield by up to 180 bu/A. Application of 120 lb N/A (with P) was sufficient to produce >90% of maximum yield in 2007,

which was slightly less than the 10-year average. Phosphorus fertilizer increased yield by 80 bu/A at 120 lb N/A. Application of 80 instead of 40 lb P_2O_5/A increased yields 8 bu/A. Nitrogen fertilizer alone increased sorghum yield by as much as 70 bu/A, while N plus P increased yield by as much as 90 bu/A. Application of 40 lb N/A (with P) was sufficient to produce >85% of maximum yield, although yields continued to increase up to 120 lb N/A in 2007. Potassium fertilization has had no effect on sorghum yield over the course of the study. This is one of the few continuous, long-term crop nutrition studies in the U.S.A. Support will continue in 2008. *KS-23F*

Maximizing Irrigated Crop Yields in the Great Plains

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Several years of irrigated field research in north central Kansas clearly demonstrated the importance of complete and balanced nutrition in the production of high-yield corn. However, 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 study was started in 2004 as an expansion of the original corn research 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 glyphosate-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. In 2007, the low P and K rates increased yield over the control by 33 bu/A, from 49 to 82 bu/A. The maximum yield response in 2007 was with the complete N-P-K-Mn treatment where yield was 90 bu/A...41 bu higher than the zero fertilizer check. The addition of Mn resulted in a 5 bu/A yield increase and N fertilization provided no yield advantage in 2007. This work has demonstrated the importance of direct fertilization of soybeans in high-yield environments. It has continued for 4 years with relatively consistent results and will not be continued in 2008. *KS-33F*

Effect of Nitrogen and Phosphorus Starters on Yield, Yield Components, and Nutrient Uptake of Short-Season Corn Grown in Conservation Tillage Systems

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Project Cooperator: David Mengel

Corn acreage has been on the rise in southeastern Kansas in recent years because of the introduction of short-season hybrids. These hybrids reach reproductive stages earlier than full-season hybrids and thus enable avoidance of mid-summer droughts that are often severe on the upland, claypan soils of the region. However, soil fertility and other management options have not been well defined for short-season corn production in southeastern Kansas. The objective of this project is to determine the effect of N and P rates applied as starter fertilizers on yield, yield components, and nutrient uptake of short-season, rain-fed 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_5O_5 in order to isolate starter effects.

Yields in the first year of this project (2006) were low due to dry conditions. In contrast, the spring of 2007 was unusually wet, with rainfall frequent enough to interfere with timely planting. By the time conditions at the study site were dry enough to allow planting, the optimal window had passed. So the decision was made not to plant. Therefore, there are no results to present from this study for the 2007 season. The study will resume in 2008. *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. Therefore, Mn additions may help overcome the apparent yield disadvantage of GR soybeans. 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 at five locations (Scandia, Manhattan, Ashland Bottoms, Rossville, and Ottawa) in North Central and Eastern Kansas in 2006 and 2007 to compare conventional and GR soybean response to three rates of soil applied and two rates of foliar Mn. Response variables include yield, biomass, plant height, Mn uptake, and leaf, and grain Mn concentrations.

Application of Mn increased GR soybean yields between 6 and 14 bu/A at the Scandia site, but results were inconsistent at the other sites. Conventional soybeans were not responsive to Mn at any of the locations in 2006, but were responsive at the Scandia site in 2007. Over all, soybean yields were greater at the Scandia location compared to the other locations for both years, suggesting that the yield increase from Mn application to GR soybeans may only occur in high yielding environments (>60 bu/A). Trends indicated a yield response to both soil-applied and foliar-applied Mn, but the results were inconsistent across locations. Preliminary plant analyses show that there was no significant difference in Mn uptake between the GR and non-GR varieties. There were some differences in nutrient partitioning, where the non-GR soybeans had more K remaining in the leaves at R6 growth stage. Further analysis of 2007 data will be conducted to confirm these observations. *KS-36F*

Nitrous Oxide Emissions from Bermudagrass Turf Fertilized with Slow Release and Soluble N Sources

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Project Cooperators: Jack Fry and Jason Lewis

The majority of nitrous oxide (N_2O), an important greenhouse gas (GHG), emissions in the USA are from agriculture. Most of these emissions come from the soil and are linked to soil management and nutrient use. Although most attention given to this issue has been focused on production agriculture, an important component that is often overlooked is the contributions from turfgrass areas. One estimate indicates that there are about 40 to 50 million acres of urbanized land covered with turfgrasses (e.g., golf courses, lawns, parks, sport fields). Because turfgrasses often receive fertilizer N, these urban areas have the potential for significant contribution to overall N_2O emissions. One best management practice that may help achieve the goal of reduced GHG emissions from turf is the use of controlled release N fertilizers. The objective of this work is to quantify N_2O emissions from bermudagrass turf fertilized with a conventional soluble N fertilizer (urea), a slow-release polymer coated N fertilizer, and an organic (manure) source of N.

Emissions of N_2O increased after application of each of the N fertilizer sources in 2007. Emissions from urea were sometimes higher than either of the controlled-release sources. In general, N_2O emissions among treatments returned to pre-fertilization levels after 7 to 10 days. Cumulative emissions of N_2O during the first year were not statistically different among N sources. Emissions tended to increase after irrigation or precipitation. The relationship between soil temperature and N_2O emissions was weaker than between soil moisture and emissions, although emissions were lower during winter when soils were colder. There were no significant correlations between N_2O emissions and soil ammonium and nitrate levels.

Strict interpretation of the data indicates that fertilizer source did not affect overall N_2O emissions from turfgrass. However, variability is high in this type of data collection, which complicates statistical detection of differences among treatments. The study will be repeated in 2008. *KS-37F*

Nebraska

Ecological Intensification of Irrigated Corn and Soybean Cropping Systems

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An interdisciplinary research program on ecological intensification of irrigated maize-based cropping systems was established in 1999 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.

The work in this reporting period was aimed at modeling nutrient uptake and removal requirements of maize and designing a framework for estimating N fertilizer requirements in maize grown with best management practices (BMPs). A database of maize nutrient uptake was assembled using field studies conducted in Nebraska and in Southeast Asia. Different modeling approaches were used to estimate balanced N, P, and K uptake requirements for specific yield targets in specific climates. The same approach was also used to develop generic models for estimating grain nutrient removal. The framework for estimating N fertilizer requirements for maize was designed to be flexible in terms of user input availability so as to provide maximum utility. Key parameters were identified, including agronomic efficiency, recovery efficiency, yield without fertilizer,

and expected yield response from added fertilizer. Readily available variables that are potentially linked, either directly or indirectly, to these key parameters were identified and will be evaluated. This project is part of a greater effort to develop a global maize nutrient decision support system. *NE-11F*

Texas

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

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Project Cooperator: Gene Lester

Cantaloupe (muskmelon) fruit quality attributes such as sugar content, 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 has evaluated the effects of six foliar K sources [potassium chloride (KCl), potassium nitrate (KNO_3), monopotassium phosphate (MKP), potassium sulfate (K_2SO_4), potassium thiosulfate (KTS), and potassium metalosate (KM)] on fruit quality parameters of field-grown muskmelon 'Cruiser'. Experiments were conducted in 2006 and 2007 at Weslaco, Texas. Weekly foliar K applications were established starting at fruit set and continued to fruit maturity. Although soil K levels were very high, supplemental foliar K treatments resulted in generally higher K concentrations in plant tissues, suggesting that K uptake from the soil solution was not sufficient to optimize tissue K accumulation. Fruit from plots receiving supplemental foliar K had higher external and internal fruit firmness, and higher soluble solids concentrations (SSC) than the zero K control fruit. All the foliar K sources studied had positive effects on fruit quality parameters except for KNO_3, which tended to result in less firm fruit with lower SSC values. Fruit yields in 2006 were not affected by supplemental foliar K spray, but in 2007 yields differed significantly among the foliar K sources with treated plots generally having higher yields than the control plots.

These results demonstrate that the apparent K deficiency caused by inadequate uptake can be alleviated by supplemental foliar K applications and that the effectiveness of foliar K fertilization depends not only on source of fertilizer K, but also on environmental conditions affecting plant growth and development. The results are consistent with previous controlled environment findings that supplementing soil K supply with foliar K applications during fruit development and maturation can improve muskmelon fruit quality by increasing SSC, firmness, and sugar contents. *TX-52F*

Evaluation of Potassium Magnesium Sulfate and Potassium Magnesium Sulfate + Phosphorus Compared to Potassium Chloride for Production of Tifton 85 Bermudagrass on Coastal Plain Soils

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Coastal bermudagrass has been the standard against which other hybrid forage bermudagrasses are evaluated. However, Tifton 85, a recently-introduced hybrid bermudagrass, has better nutritive value, is more digestible, and has greater yield potential than does Coastal. Data on response of Tifton 85 bermudagrass to applied plant nutrients is limited. Scientists at Texas A&M at Overton (east Texas) are addressing this need. A 6-year study was completed in 2006 where responses to N, K, S, and chloride (Cl^-) were evaluated. The current study was adapted from the 2006 effort. The objectives of this work are to determine the effects of N, K, and magnesium (Mg) rates, and K source...i.e., potassium magnesium sulfate or K-Mag® ($K_2SO_4 \cdot 2MgSO_4$), potassium chloride (KCl), and a specialty fertilizer called ACT 62D (6-26-8-14S-7Mg-1Zn) on Tifton 85 bermudagrass production, nutrient uptake, and changes in extractable nutrient content in a Darco loamy fine sand.

Five harvests were made in 2007, a year with above normal rainfall. The 120 lb N/A rate applied for each harvest did not significantly increase bermudagrass dry matter (DM) yield compared to the 60 lb N/A rate. Increasing the K rate to 134 lb K_2O/A significantly increased yield in the first harvest. In the second and fifth harvests, DM production was significantly increased by 268 lb K_2O/A. In the third and fourth harvests made following above-normal rainfall in July and August, DM yield was optimized at the 402 lb K_2O/A treatment. There was no statistical advantage to applying more than 268 lb K_2O/A for total 2007 production. Source comparisons indicate that dry matter yield was significantly increased by application of Potassium magnesium sulfate+KCl in the second harvest, indicating a response to S or Mg, and by ACT 62D+KCl in the third harvest. Total yield in 2007 was significantly greater with ACT 62D+KCl than any other K source. Statistically significant interactions of N and K on DM yield occurred in all except the second harvest, and this interaction was significant in total DM yield as well. This was the first year of this study. It is scheduled to continue in 2008. *TX-53F* ■