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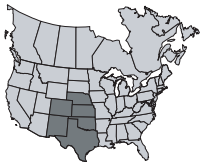
Southern and Central Great Plains Region Research Report



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CONTINUING investigation into new technologies and improved efficiency is vital to any industry. 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**<.

Colorado

Spatial Management of Nutrients in 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 strategies on irrigated corn production efficiency. Among these efforts has been an evaluation of the two most prominently used and accepted active NDVI (normalized difference vegetative index) remote sensors. On-going work has shown that both sensors perform equally well in the determination of N variability in irrigated corn in Colorado, and that the V12 to V14 growth stage range is best for the most accurate determination of N variability. The next logical step and current aim of the work is to develop an N recommendation algorithm for the two active crop canopy sensors.

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Each sensor's NDVI N recommendation algorithm calculated unbiased N recommendations, suggesting that the means of algorithm development was valid, as was the estimate of required N at maize growth stage V12. The algorithm developed for each sensor calculated very similar N recommendations. The integration of ground-based sensors and the appropriate N application algorithms into an on-the-go fertilizer application system have the potential to increase the spatial accuracy of N application on fields with sufficient variability, assuming that the algorithms are shown to be stable over time and space. *CO-12F*

Contribution of Animal Feeding Operations and Synthetic Fertilizers to Ammonia Deposition in Rocky Mountain National Park

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Project Cooperators: Thomas Borch and Jeffrey L. Collett, Jr.

Ammonia (NH_3) deposition has been identified as a concern from both human health and environmental protection standpoints and has recently been targeted by Colorado as a primary contributor to atmospheric and ecosystem changes in Rocky Mountain National Park (RMNP). Ecological ramifications, including increased forest and grassland productivity, eutrophication and acidification of fresh waters, hypoxia, and loss of biodiversity have been documented in terrestrial, freshwater, and coastal ecosystems. The Colorado Department of Public Health and Environment has estimated that 60% of the NH_3 deposition in RMNP comes from agricultural activities with 40% from animal feeding operations and 20% from fertilizer. However, these estimates have not been verified by scientific measurement, and verification is especially important if future regulations require that agriculture be held accountable for NH_3-related ecosystem damage. One promising way to track N to its original source is via N isotopic signatures (ä15N) since the ratio between the ^{14}N and ^{15}N isotopes is influenced by source. A major goal of this project is to assess the ability of isotopes as tracers, and in turn, to determine sources of NH_3 contributing to N deposition in RMNP. To ensure that agricultural producers are being treated fairly, this study seeks to 1) determine the major sources of NH_3 deposition in RMNP based on N isotopic signatures of different NH_3

sources (i.e., agricultural, natural, and industrial), and 2) quantify the relative contribution of NH_3 to RMNP from animal feeding operations, synthetic fertilizers, and other sources.

The first year of this study was spent determining the best approach to isotope analysis. After laboratory methods were established, construction of appropriate equipment was initiated. Progress over the past year includes completion of laboratory apparatuses and preliminary field sampling. To enhance simultaneous site sampling capabilities, three stationary samplers are being assembled for future NH_3 studies with anticipated sampling to begin this winter. Once construction of the field samplers is completed, sampling in earnest is anticipated at sites involving fertilized soils, waste water remediation plants, vehicle emissions, etc. As with any novel and large-scale effort, considerable background work and evaluation is required. *CO-13F*

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 2009 results of this project continue to demonstrate that fertilizer inputs are important to the production of irrigated corn and grain sorghum in western Kansas. Corn yield in the no fertilizer control was 85 bu/A in 2009. Nitrogen alone increased corn yield by as much as 70 bu/A, while co-application of N and P increased yield by over 150 bu/A. Averaged across the past 9 years, co-application of N and P increased irrigated corn yield by 139 bu/A. Application of 120 lb N/A (with P) was sufficient to produce >90% of maximum yield in 2009, which was similar to the 9-year average. Phosphorus fertilizer at the lowest P rate increased corn yield by over 85 bu/A with 120 lb N/A, and application of the highest P rate increased yield by an additional 13 bu/A. The no fertilizer treatment in the sorghum study produced 64 bu/A. Nitrogen fertilizer alone increased sorghum yield by as much as 51 bu/A, while N plus P increased yield by 75 bu/A. Application of 40 lb N/A (with P) was sufficient to produce about 85% of maximum yield in 2009, although yields continued to increase with higher N rates. Potassium fertilization 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. *KS-23F*

Nitrogen Management for No-tillage Corn and Grain Sorghum Production

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No-tillage is being adopted by an increasing number of producers in the Great Plains. Its advantages include soil erosion reduction, increased water storage and efficiency, and improved soil quality. However, surface residue can create N fertilizer management challenges. Surface applications of urea containing fertilizer in these systems may be subject to volatilization losses, and leaching can also be an issue on coarse textured soils when N is applied in a single, preplant application. Several fertilizer technologies have the potential to address challenges in N management in no-till systems. For example, polymer-coated urea products have become increasingly available for agricultural use. The polymer coating allows the urea to be released at a slower rate than uncoated urea. Urease inhibitors and other additive technologies can be applied with urea-containing fertilizers to help reduce the potential for volatilization losses and improve performance. The objective of this study is to evaluate the effectiveness of specific enhanced efficiency fertilizer technologies for no-tillage irrigated corn production.

This 3-year irrigated corn study in north central Kansas compared urea, urea ammonium nitrate (UAN), Environmentally Smart Nitrogen or ESN® (a controlled-release polymer-coated urea), UAN treated with Agrotain® (a urease enzyme inhibitor), UAN treated with Agrotain Plus+® (including both urease and nitrification inhibitors), UAN treated with Nutrisphere® (a polymer additive designed to impact N transformations and loss), and ammonium nitrate at 80, 160, and 240 lb N/A. Nitrogen fertilizer was applied either broadcast or banded just prior to planting. A zero N check plot was also included. Corn was planted without tillage into residue from the previous year's corn crop.

Treated urea products out-yielded untreated urea, and were similar to ammonium nitrate. No significant differences in corn yield were found between N treated with ESN®, Agrotain®, or Nutrisphere-N®. UAN treated with Agrotain Plus+® or Nutrisphere-N® out-performed untreated UAN. A 2-year study was also conducted to compare banding and broadcasting of urea-containing fertilizers. With both urea and UAN, banding resulted in greater yields than surface broadcast application. The use of fertilizer additives resulted in yield increases even when banded. The results of this work show that if producers wish to apply urea-containing fertilizer on the soil surface in no-tillage production, banding is more effective than broadcasting. This research also confirms that several products are currently available to

improve the performance of N fertilizer, whether broadcast or banded. *KS-38F*

Improving Nitrogen Fertilization of Manured Fields in Kansas

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The appropriate application rate of inorganic N fertilizer for manure-amended fields is sometimes difficult to determine for several reasons. The goals of this study were to determine N response of winter wheat on manure-amended soil, evaluate N availability calculations recommended by Kansas State University (KSU), and examine application of optical sensors for making in-season N recommendations. Field experiments were conducted at three sites (Blaine, Manhattan, and Hays) during the 2008-2009 winter wheat growing season. Whole plot treatments were pre-plant N source (manure or fertilizer) and sub-plot treatments were in-season top-dress N rates (urea ammonium nitrate at 0 to 80 lb N/A). A reference treatment of 120 lb N/A was also applied at planting. A GreenSeeker RT 200 (NTech Industries, Inc., Ukiah, California) was used to measure normalized difference vegetation index (NDVI) in winter wheat on whole-plot treatments.

At all three sites, there was no interaction between pre-plant N source and top-dress N rate, indicating that both manure and fertilizer treatments responded similarly to top-dressed N application. Results of the evaluation of in-season N recommendation tools showed that KSU recommendations performed well at the Blaine site and the Greenseeker performed well at the Manhattan site, but neither recommendation tool performed well at the Hays site. This suggests that both the KSU and GreenSeeker methods have the potential to produce appropriate recommendations on manure-amended fields, but more work is needed for further clarity. *KS-39F*

Nebraska

Ecological Intensification of Irrigated Corn and Soybean Cropping Systems

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Project Cooperators: T. Setiyono, A. Dobermann, H. Young, J.E. Specht, and K.G. Cassman

An interdisciplinary research program on ecological intensification of irrigated maize-based cropping systems was established at the University of Nebraska in 1999 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 an integrated assessment of productivity, profitability, input use efficiency, energy balance, and environmental consequences of intensified cropping, and (iv) develop scientific bases and decision support tools for extrapolation to other locations. Among the items this work has generated are the "Hybrid-Maize" growth simulation model, and several scholarly journal publications and *Better Crops with Plant Food* articles. The project is in its final stage with the development of a state-to-the-art, widely applicable tool for recommending N fertilizer rates for corn.

Instead of developing two separate models (systematic and generic) as was previously planned, it was decided that two models be combined into a single improved model (*Maize-N*) that relies on the robustness of a yield-based approach and mechanistic features of an uptake-based approach. The *Maize-N* model seeks to provide a means of analysis for the factors (biophysical, climatic, etc.) that govern N supply, N use efficiency, and N uptake in corn production systems. It is composed of three major modules: (i) a yield module for estimating corn yield potential and its variation under differing climatic regimes, (ii) a carbon (C) and N mineralization module for estimating soil indigenous N supply, and (iii) a yield response module for estimating the economically optimal N rate (EONR). The *Maize-N* tool has performed well in estimating EONR as was indicated by its comparison against measured EONR in sites in the U.S., Asia, and Brazil. In the majority of site years (39 out of 46), the estimation of EONR was reasonably close to (≤ 22 lb/A) the observed or measured EONR. *Maize-N* was relatively robust in estimating EONR considering that the observed EONR and attainable yield both varied considerably... from 54 to 247 lb/A and 99 to 295 bu/A, respectively. The development of this model is in the final fine-tuning stages. *NE-11F*

Texas

Nutrient Uptake and Removal Dynamics in Muskmelon Grown in South Texas

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Project Cooperator: Gene Lester

Fertilizer requirements for optimum yields may differ from the requirements for quality traits such as taste, flavor, texture, and shelf-life for certain high-value horticultural crops. Timing of fertilizer application, as well as soil and plant factors, are also critical in quality considerations. Currently, there are no nutrient management guidelines for optimizing produce quality even though certain nutrient elements such as K are known to influence quality development. Information on nutrient uptake and removal amounts may be useful in developing fertility recommendations for crops with different nutrient requirements and quality standards. The objective of this work is to evaluate nutrient removal and uptake dynamics of cantaloupe (muskmelon) in the Rio Grande Valley of Texas, and to ultimately improve the

understanding and implementation of nutrient recommendations.

Leaf, stem, and fruit tissues of muskmelons were sampled from fields with different soil types and analyzed to calculate nutrient removal amounts. There were little differences in the concentration of major nutrients (N, P, K) in plant tissues during vegetative development. However, after fruit set the concentration of major nutrients was significantly reduced as developing fruits became sinks for these nutrient. Differences were also observed in tissue nutrient concentrations among the sampling sites and this was coincident with soil type – tissues sampled from sites with heavy soils tended to have higher nutrient concentrations than those from sites with light textured soils. Estimates of nutrient removal amounts ranged from 18 to 38 lb N/A, 3 to 6 lb P/A, and 35 to 80 lb K/A and varied significantly among sites. Exceptionally dry weather during the 2009 growing season affected uptake and accumulation patterns of nutrients and fruit yields were lower than average. Data collected over multiple years under different weather conditions, soil types, and yield scenarios will be needed to establish realistic nutrient removal values that can be used to further develop fertilizer guidelines. *TX-52F*

Potassium Fertilizer Management in Irrigated Cotton in West Texas

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Project Cooperator: Randal Boman

The majority of soils in the western part of Texas test high in extractable K, and this abundant soil K is often taken for granted. Over the last several years, cotton fields

in some parts of this region have been exhibiting pre-mature leaf senescence, which may be linked to soil K supply issues. There is also some concern among growers and others that traditional soil K testing methods do not accurately reflect actual soil K availability to cotton. The typical practice of not applying K fertilizer, combined with higher cotton lint yields, leads to some degree of K mining in these soils. Fertilizer source and rate trials were initiated in two west Texas locations (Lubbock and Reeves counties) in 2009. Specific objectives were to: i) assess lint yield response to K fertilizer rates (0, 40, 80, 120, 160, 200 lb K_2O/A) in irrigated cotton production, ii) assess lint yield response to K fertilizer source (KCl and K thiosulfate), iii) assess soil test procedures for soil K availability, and iv) monitor leaf K between early bloom and first open boll as a function of K fertilizer rate. Both sites were irrigated...one with subsurface drip (Reeves) and the other with in-furrow flood irrigation (Lubbock). Both sites tested high in soil K by traditional measures. The soil test K procedures evaluated included traditional ammonium acetate extraction, water extraction, and a cation exchange resin method designed to measure dynamic K availability.

There was no response to K fertilizer nor were there source differences among the cotton parameters measured (lint and seed yield, plant biomass, leaf K concentration) at either site in 2009. However, the cation exchange resin test did show that there was net K fixation at the Reeves site and net release at the Lubbock site. Early results also suggest that water soluble K bears further investigation as a useful K fertility tool in these environments. The questions and issues that brought about this work are not straight forward since the leaf drop problem is not consistent from year-to-year. Thus, more investigation is warranted. *TX-54F* ■