IPNI INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

July 2010

Northern Great Plains Research Report

It is extremely valuable to have local, regional research results when evaluating new fertilizer technologies, whether these are newly developed forms of fertilizers, new additives, or new methods of placing fertilizers. Most research projects are conducted for at least 3 years. This is extremely important due to the natural variability of weather from one year to another. In parts of the Northern Great Plains in 2009, there were some areas that experienced dry and cool conditions. This made it hard to draw any conclusions as to the effectiveness of the new technologies as drought conditions rarely show any differences between experimental treatments. Fortunately these research projects will be conducted for more than one year. Areas that were droughty in 2009 are presently receiving ample rain in 2010.

This issue of *INSIGHTS* contains brief Interpretive Summaries of research projects supported or arranged by IPNI in the Northern Great Plains Region in 2009. More detail on these and projects from other IPNI regions can be found at the research database at our website: >**www.ipni.net/research**<.

Alberta

Evaluation of Phosphate and Nitrogen Fertilizers Treated with Polymer Additives to Increase Fertilizer Efficiency

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Project Cooperators: Claire Langlois, Guy Lafond, Brian Hellegards

Spring wheat was grown for the N experiment at Ellerslie, Alberta, but cool and dry conditions experienced from April to July affected yield potential in the region. This could not be compensated by more favorable moisture and temperatures that appeared later in the growing season. No significant differences in grain yield were observed between the selected N fertilizer forms [urea, urea treated with Nutrisphere-N® (a polymer coating), Super Urea (including both urease and nitrification inhibitors), and Environmentally Smart Nitrogen or ESN® (designed as a semi-permeable, polymer-coated urea source)]. Differences between fertilizer placement methods (banded at planting versus surface broadcast) or N rates (60 and 120 kg/ha) were also not observed.

In the P experiments, significantly higher yields were observed for dry granular monoammonium phosphate (MAP) compared to liquid ammonium polyphosphate (APP) at Ellerslie. In most years that are warmer and more moist, advantages for MAP over APP are not observed. Yields at Ellerslie responded to P rate as they increased from 3,659 to 4,839 kg/ha as P rate increased from 7.5 to 30 kg P_2O_5/ha. However, no significant difference was observed between regular P fertilizer compared to forms treated with the Avail® polymer additive. The Breton site was less responsive to P with no significant difference observed between the rates of P averaged for both form and with and without Avail®. However, a yield advantage was detected at the 30 kg/ha rate for MAP (3,350 kg/ha) compared to APP (2,728 kg/ha) and both forms resulted in greater yields with Avail® (3,664 kg/ha) than without Avail® (2,413 kg/ha). It is planned to repeat the experiments one more year at these two sites. *AB-26F*

Use of Large Urea Granules for Broadcast Application in No-till Cropping

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Research in Alberta and North Dakota has supported the use of urea granules larger than regular, ag-grade urea as a means of increasing crop yield and reducing the potential for denitrification losses. Thus, larger urea granules (up to 10 mm in diameter) commonly used in helicopter applications in replanted forest stands, and in agro-forestry plantations, could be used in broadcast applications for no-till cropping systems in the Northern Great Plains

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(NGP). The research noted above was largely done by hand application in small field research plots because existing spin-broadcast applicators could not achieve an even spread with larger urea granules. More recent pneumatic spreaders do have the capability to handle these larger granules. Past research has also investigated the addition of a nitrification inhibitor (dicyandiamide, DCD) with different-sized urea granules...although such treated granules were not commercially available at the time. Recent developments now allow the treatment of different-sized urea granules with both a urease and a nitrification inhibitor (i.e., Agrotain® and DCD).

This study investigates: two application timings (fall versus spring); two urea granule sizes (regular 3 mm and large 10 mm); four Inhibitors (regular untreated urea, urea+Agrotain®, and urea+Agrotain®+DCD, and Agrotain® plus N-Serve® (nitrapyrin); three incorporations (no incorporation, harrowing, and sweep chisel-plow tillage). The potential benefits to the agriculture industry are a low cost, low energy input method of applying N to no-till cropped fields in the NGP with reduced potential for ammonia volatilization losses. The fall 2009 treatments were applied as planned, and the spring applications were done in late April 2010. Barley were planted in early May 2010 and will be harvested in late August. *AB-27*

British Columbia

Evaluation of Phosphate and Nitrogen Fertilizers Treated with Polymer Additives to Increase Fertilizer Efficiency

Project Leader: Mr. Clair Langlois, BC Grain Producers Association, 400 116 Ave., Dawson Creek, BC V1G 3E2. Telephone: 250-782-2557. E-mail: bcgpa-r@pris.ca

Project Cooperators: Dick Puurveen, Guy Lafond, and Brian Hellegards

Unfortunately, this site experienced severe early growing season drought and no yield data were available for the

phosphate experiment involving the Avail® polymer coating, and only a minimum amount of samples were available for the N experiment involving urea treated with Nutrisphere-N® (a polymer coating) and Super Urea (including both urease and nitrification inhibitors). However, Nutrisphere-N® did perform better than regular urea, while Super Urea generated intermediate results. Yields of canola were 2,866, 2,689, and 2,397 kg/ha for Nutrisphere-N®, Super Urea, and regular urea, respectively. This was the second year of a 3-year study plan. *BC-17F*

Manitoba

Impact of Traditional and Enhanced Efficiency Phosphorus Fertilizers on Canola Emergence, Yield, Maturity, and Quality

Project Leader: Dr. Cynthia Grant, Agriculture & Agri-Food Canada, AAFC Brandon Research Centre, PO Box 1000A, Brandon, MB R7A 5Y3, Canada. E-mail: cgrant@agr.gc.ca

Project Cooperators: Gerhard Rakow and Jo-Anne Relf-Eckstein

An adequate supply of P is needed in the first 2 to 6 weeks of growth to optimize canola yield. Due to recent experiences with relatively high prices for P fertilizer products, many producers reduced their rates of application for seed-placed monoammonium phosphate (MAP), which may reduce crop yield potential. If regular rates are maintained, farmers also run the risk of some seedling damage. A number of enhanced efficiency P products have been developed that may improve the effectiveness of seed-placed P fertilizer, by reducing the risk of seedling damage and/or maintaining P in an available form for a longer period to enhance crop uptake. These products include a polymer-coated MAP that releases the phosphate slowly into the soil, Polyon® (a polymer-coated product), and Avail® (stabilized phosphate). Ammonium polyphosphate liquid fertilizer may also show improved performance compared to MAP, particularly on calcareous soils. While these enhanced efficiency fertilizers may have an advantage over traditional MAP, they have a higher cost. Therefore, it is important to determine if any increases in crop yield, quality, fertilizer use efficiency, or simplification of field operations are large enough to justify their use.

Results in 2009 indicated that the enhanced efficiency P products had little effect on any of the growth parameters assessed. Differences that did occur were mainly due to poor performance of the Polyon® product, although the reasons for the poor performance were not apparent. The second part of the research assessed whether a new yellow-seeded cultivar of canola has a similar tolerance to seed-row P fertilizer compared to a conventional dark-seeded canola cultivar. Results found the yellow-seeded canola cultivar to have very poor emergence compared to a conventional dark-seeded canola, leading to lower yields and limited competitive ability with weeds and volunteer barley. *MB-22*

Comparison of Phosphorus-Based Starter Fertilizer Products, Forms, and Rates Affecting Crop Yields

Project Leader: Dr. John Heard, Manitoba Agriculture, Food and Rural Initiatives, Box 1149, First Floor #65-3rdAve NE, Carman, MB R0G 0J0. Telephone: 204-745-5644. Fax: 24-745-5690. E-mail: john.heard@gov.mb.ca

High P fertilizer prices during the spring of 2009 resulted in numerous questions regarding the utility and practicality of applying low rates of fertilizer with the seed. This lesson/demonstration was designed for the 2009 Crop Diagnostic School in Carman, Manitoba. It was presented to 358 extension and retail agronomists over a 2-week period in July. Three sources of P were compared, including granular orthophosphate (mono-ammonium phosphate 11-52-0 or MAP), liquid orthophosphate (6-22-2), and liquid ammonium polyphosphate (10-34-0). A research planter was

equipped with a liquid fertilizer kit so that both dry granular and liquid starter products could be seed-row applied. The plots were used as a back-drop for discussion about the short-term and long-term efficacy of various starter P-based formulations and management strategies used in small grain and oilseed crops in Manitoba. In addition, a demonstration showed the distribution of starter liquid seed-row blend droplets compared to the distribution of MAP granules as the planter openers passed slightly above a plastic sheet.

It was interesting that the actual spread pattern comparing the dry granular and liquid formulations were not that much different. Some marketing information describes liquid starter blends as going down in a continuous stream along the bottom of the seed-row trench. However, it was shown that the liquid fertilizer actually falls down in droplets not that much closer than dry granules. The final yield samples from the four-replicate demonstration research project will be available in future project reporting. *MB-23*

Saskatchewan

Effects of Potassium and Chloride Nutrition on Seed Yield of Canaryseed

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Project Cooperators: Yantai Gan and Sukhdev Malhi

The objectives of this study are to determine the responsiveness of canaryseed seed yield to K and Cl- and provide better recommendations to producers on the use of potassium chloride (KCl) in canaryseed production. In 2007, five locations were established in Saskatchewan at Melfort, Stewart Valley, Regina, and two locations near Indian Head on Vale Farms. In 2008, another location on the Indian Head Research Farm was added. Only the Vale farm sites showed strong yield responses in 2007 to Cl^-, but a moderate yield response to Cl^- occurred at Regina. The yield components most affected were seeds per square meter and seeds per head, which indicates that the addition of Cl^- may prevent seed abortion from occurring. Grain yield was not affected by Cl^- or K applications at Melfort or Stewart Valley in 2007. In 2008, only the Vale Farm sites had a Cl^- response. One important difference was that the yield response at the Vale farm site occurred when yield conditions were quite good (40 to 50 bu/A). These preliminary results indicate that canaryseed growers need to measure Cl^- when doing soil tests. The response to Cl^- occurred when the crop was either under stress or under high yielding conditions.

The work was repeated in 2009 with strong Cl^- response at the farm site near Indian Head, and varied response at Stewart Valley and Regina. This research confirms that canaryseed responds to Cl^- and that the positive effect is observed through improved seed fill and seed yield. There can be sites that respond to Cl^-, but not to K, and other sites can respond to both Cl^- and K. Both responses can be predicted quite well by testing soils for plant available Cl^- and K. The final project report will be completed in early 2010 after grain sample quality tests are complete. *SK-38F*

Evaluation of Urea Nitrogen Fertilizer Treated with Nutrisphere® Polymer Additive to Increase Fertilizer Efficiency

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Project Cooperators: Clair Langlois, Dick Puurveen, and Brian Hellegards

This project consists of three experiments comparing regular granular urea, urea treated with Nutrisphere-N® (a polymer coating) and Super Urea (including both urease and nitrification inhibitors) at 45, 90, and 135 kg N/ha. The experiments were conducted on spring wheat, barley, and canola. This study was initiated in April 2008, repeated in 2009, and will be conducted for a third year in 2010.

In 2009, growing conditions were excellent at the Indian Head Research Farm. A significant response to N was observed for all three crops. All three forms of N did equally well as no differences in yield were observed between N forms for all three respective crops. *SK-40F*

Montana

A Micro-Meteorological Study to Quantify Ammonia Volatilization Losses from Surface Applied Urea in the Semi-Arid Northern Great Plains

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Ammonia (NH_3) losses from urea have ranged from 3 to 40% of the application rate (19.4% average) over eight gas sampling campaigns conducted to date in 2008 and 2009. In this semi-arid region, NH_3 losses are sometimes delayed by 2 weeks or more until sufficient precipitation falls to dissolve urea granules. Significant NH_3 losses may then occur over a three to six week period. Applying urea to frozen soils does not guarantee losses will be minimized. Surprisingly, some of the greatest NH_3 losses (e.g., 32, 36, and 40% of the application rate) occurred at three sites where urea was applied to moist surface soils near 0°C. Environmental conditions that result in prolonged damp conditions near the soil surface appear to promote volatilization losses. Ammonia fluxes as large as 22 kg N/ha/week have occurred under these conditions. Conversely, NH_3 losses from surface-applied urea are generally smaller (<16% of the application rate) if granules are applied to dry soils. Coating urea with an urease inhibitor like N-(n-butyl) thiophosphoric triamide (NBPT) at 4.2 ml/kg provides 2 weeks of protection against volatilization losses following fertilizer dissolution,

and has reduced NH_3 losses by 62% over untreated urea.

Results from this study indicate that significant NH_3 volatilization losses can occur from cold soils when urea is surface-applied. This study will be continued for one more year. *MT-17*

North Dakota

Agronomic Evaluation of New Sulfur Sources for Canola

Project Leader: Dr. John Lukach, North Dakota State University, Langdon Research Extension Center, 9280 107thAve NE, Langdon, ND 58249. Telephone: 701-256-2582. E-mail: jlukach@ndsuext.nodak.edu

Work on this project progressed well in 2009. Growing conditions were initially cool and moist, but with warmer growing conditions the crop yielded well and demand for S was high. The objective of this study is to evaluate the effectiveness of various commercially available and potentially available sources of S fertilizer for canola production in North Dakota. Research trials were carried out at two locations near Langdon. The S products included ammonium sulfate, elemental S, compound granules of N, P, and S, gypsum from coal power plant scrubbers, and a plant growth-promoting rhizobacteria (PGPR). All treatments were compared against a monoammonium phosphate check supplying N and P. Urea was added to certain treatments to balance N rates for all seed-row treatments.

Large canola yield responses to S were present at both sites. The 2009 data along with the previous 4 years will be combined, analyzed, and a final project report will be written with recommendations for S nutrition of canola in north-central North Dakota. *ND-14F*

Nitrogen Recommendation Recalibrations for Wheat in North Dakota

Project Leader: Dr. David Franzen, North Dakota State University, Department of Soil Science, Box 5758, Fargo, ND 58105-5758. Telephone: 701-231-8884. Fax: 701-231-6186. E-Mail: david.franzen@ndsu.edu

The objective of this project was to review current N recommendations for wheat to determine profitable N recommendations for spring wheat and durum in North Dakota. Over 100 site-years of data were collected during this project from archived studies and recent N-rate studies. Soil test nitrate improved the relationship between available N and yield. The Return to N approach was used to establish relationships between yield/protein response and economics of N application. This approach was modified for wheat by adding the criteria for the protein relationship. In the economic analysis, a 50% per point premium was provided between 14 to 15% protein, and a 50% per point dockage for any protein below 14%. The large number of sites made it possible to segregate different agri-climatic zones and determine whether the responses to available N were similar or different. The state was separated into the Langdon region, Eastern North Dakota, and Western North Dakota. When using the newly re-calibrated recommendations, a grower is asked to look exclusively at past field yield history and select productivity levels of low, medium, or high. The table values determined by region, productivity, wheat price and N cost are gross N requirements determined using return to N relationship equations. From this, the soil test nitrate will be subtracted. Other adjustments include previous crop N credits, additions due to short-term no-till adoption, credits due to long-term no-till adoption, and organic matter if greater than 5.9%.

The opening segment of the "North Dakota N Rate Calculator," is available on the web at this: www.soilsci.ndsu.nodak.edu/franzen/franzen.html. The final recommendation is usually plus/minus 30 lb N/A. Adjustments based on the common sense of the grower/consultant and their experience with the field area will dictate the final rate. Consideration due to protein property of the wheat variety, N application techniques that might not be 100% efficient, excessive previous year straw, and other considerations may play roles in defining the final rate. The recommendations were made available December 1, 2009, in both print form and as the web-based N calculator. *ND-15*

Nitrogen Recommendations for Dryland Corn in North Dakota

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All the 2010 research sites for this project were arranged, characterized, and prepared by taking soil samples. The research experiments will be planted during the growing seasons of 2010 and 2011. Experimental factors to be evaluated are N response curves from increasing rates of N along with a zero N treatment, as well as different responses of the selected corn hybrids grown. *ND-16* ■

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Research Supporting Nutrient Stewardship

July 2010

THE principles of 4R Nutrient Stewardship require scientific support for the choice of practices that deliver the right source of nutrients at the right rate, time and place. The science needs to test these practices for their outcomes in terms of economic, social, and environmental sustainability.

This issue of *INSIGHTS* features Interpretive Summaries of the research projects supported by IPNI in the Northeast Region. More detail can be found at the research database at >**www.ipni.net/research**<.

Ohio

Impact of Phosphorus and Potassium Fertilization and Crop Rotation on Soil Productivity and Profitability

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Project Cooperator: Edwin Lentz

Growers in the eastern U.S. Corn Belt often fertilize the whole rotation rather than the individual crops. Typically, in the fall prior to corn planting, farmers supply enough P and K to satisfy the nutrient needs of both corn and the following soybean crop. This practice has proven to be a viable option for corn-soybean rotations on soils with adequate nutrient levels, but questions arise for producers in a 3-year rotation of corn-corn-soybean. In 2006, studies assessing P and K fertilization strategies were started in three locations. Two rotations were compared: corn-corn-soybean, and corn-soybean. These rotations were fertilized following soybeans, at P and K rates corresponding to zero, once, and twice the crop removal for the rotation. Corn yield was increased at one location by application of both P and K fertilizer. Optimum fertilization boosted yields from the 213 to 215 bu/A range to 223 to 225 bu/A. The other two locations did not show consistent yield increases. In 2007, each location had corn in the first rotation and soybeans in the second. Neither crop responded to the P and K treatments, even though the soybean crop produced yields as high as 66 bu/A. Drought reduced corn yields to a range of 122 to 159 bu/A. Changes in soil test levels are being monitored. In 2008, K treatments boosted soybean yields by 7 to 10 bu/A, and the high rate of P increased corn yields by 22 bu/A at the Western Research Station, the only location not affected by drought. At the East Badger location, P treatments increased corn yields by 9%. At the Northwest Research Station, drought reduced corn and soybean yields to about half of normal, and there were no responses to P or K treatments.

In 2009, responses to the 4 years of application of P and K occurred at only one of three sites, and were small (less than 5%). Changes in soil test P are responding to applied P. But soil test K is more puzzling, with no response to applied K in several instances. These mysteries will require further investigation. These current yield response observations provide useful support for extensionists receiving questions from producers in light of their concerns with fertilizer prices. The experiment is continuing in 2010. *OH-16F*

Ontario

Optimizing Application of Phosphorus and Potassium to Processing Tomatoes under Drip Irrigation in Ontario

Project Leader: Dr. Tiequan Zhang, Research Scientist, Agriculture and Agri-Food Canada, Greenhouse and Processing Crops Research Center, Harrow, Ontario N0R 160. Telephone: 519-738-2251, 476. E-mail: zhang@agr.gc.ca

Recent research has indicated that processing tomatoes require higher rates of N when grown with fertigation. The objective of this research is to determine optimum rates of P and K for the higher yields obtained in this production system. Four rates of P, from 0 to 180 lb P_2O_5/A, were applied in a factorial combination with four rates of K from 0 to 640 lb K_2O/A, in a drip-irrigated

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Notes and Abbreviations: N = nitrogen; P = phosphorus; K = potassium; S = sulfur; ppm = parts per million.

system fertilized with N at 240 lb/A. Soil test levels for P and K varied from year to year, but were generally high, representative of those of typical producer fields.

From 2006 to 2009, marketable yield responded to P and K, each in 2 of the 4 years. Yields were boosted 5% and 11% by P at soil test P levels of 37 to 65 ppm. Potassium increased soluble solids content and also raised marketable yields by 10% and 12% at soil test K levels of 160 to 233 ppm. Vitamin C was increased 1 year in 3 by P, but not by K. Neither P nor K influenced lycopene concentrations in any of the 4 years. The positive yield and quality impacts measured at these relatively high soil test levels support current nutrient use practices of progressive growers, but opportunity to improve fertilizer uptake efficiency remains, particularly for P. The field research was completed in the 2009 growing season, and the project completion is planned for early 2010. *ON-28*

Long-term Optimum Nitrogen Rates for Corn Yield and Soil Organic Matter in Ontario

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Project Cooperators: John Lauzon and Greg Stewart

Decisions on optimum N rates are often made on the basis of single-year responses. Data are limited on the long-term impact on productivity and soil organic matter of rates higher or lower than these short-term optima. This controlled experiment was designed as a base for testing the application of dynamic soil-crop-atmosphere models as predictors of N rates for corn that optimize sustainability. The specific objectives include: (1) assessment of short and long-term effects of N on productivity, environmental impact, profitability, and cropping system sustainability; and (2) validation of crop models, such as Hybrid-Maize, for simulating yield potential, seasonal growth and yield, and fertilizer N management requirements.

The 2009 growing season was the first in which treatments were applied. Economically optimum rates of N were 15% higher than recommended for the pre-plant application, and 32% higher than recommended for the side-dress application, possibly because of a relatively cool, wet, and long growing season. Corn grain N concentration was 0.60 to 0.66 lb/bu at rates of N sufficient for maximum economic yield. Residual soil nitrate increased sharply when N rates exceeded the economic optimum, and were higher for side-dress than for pre-plant N applications. This project also received support from the Ontario Agri Business Association, for sampling soil residual nitrate and soil organic carbon. The project implementation so far forms an excellent basis for achieving the long-term objectives. *ON-29*

Virginia

Evaluation of Ammonium Sulfate Nitrate in Virginia Snap Bean Production

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Fresh-market snap beans occupy 5,500 acres in Virginia. Producers are interested in exploring sources and rates to improve N use efficiency. This trial compared five N sources (urea with dicyandiamide, ammonium nitrate, calcium nitrate, ammonium sulfate-nitrate, and urea-ammonium nitrate) at three rates.

For spring-grown beans, urea with dicyandiamide increased yield by 25% over the control, while the other sources did not. For fall-grown beans, all N sources increased yield by 56% over the control, with an optimum N rate of 80 lb/A, and reduced symptoms of common rust *(Uromyces appendiculatus)*.

These first-year findings support N management decisions that optimize food yields while minimizing risk of water contamination by N on the sandy loam soils of the Chesapeake Bay watershed. *VA-22F*

Evaluation of Ammonium Sulfate Nitrate in Virginia Sweet Corn Production

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Virginia farmers grow over 3,000 acres of fresh market sweet corn. They are interested in exploring sources and rates to improve N use efficiency. This trial compared three N sources (urea-ammonium nitrate, ammonium nitrate, and ammonium sulfate-nitrate) at three rates. The first two N sources were compared with and without S, applied as gypsum, at a rate designed to supply the equivalent amount of S provided by ammonium sulfate-nitrate (65 lb/A).

The N sources increased marketable yields by 16 to 50% using optimum N rates ranging from 110 to 125 lb/A. Agronomic efficiency ranged from 11 to 35 lb of marketable yield increase per pound of N applied. Sulfur added as gypsum did not increase yields, but ammonium sulfate-nitrate produced higher yields than the other two N sources.

These first-year findings support N management decisions that optimize food yields while minimizing risk of water contamination by N on the sandy loam soils of the Chesapeake Bay watershed. *VA-23F*

Maryland

Building a Maximum Yield Cropping System for Corn, Wheat, and Doublecropped Soybeans in Maryland

Project Leader: F. Ronald Mulford, University of Maryland, Poplar Hill Research Center, 24094 Nauticoke Road, Quantico, MD 21856. Telephone: 410-548-7051. Fax: 410-548-7049. E-mail: fm18@umail.umd.edu

Project Cooperator: William Kenworthy

The goal of this study is to develop a management program that increases crop yield, input efficiency, and profit potential in a predominantly no-till cropping system. This cropping system consists of four crops planted over 3 years, including: no-till soybeans in corn stubble, followed by minimum-till wheat double cropped with no-till soybeans, and then no-till corn.

In research on the Eastern Shore of Maryland, N use efficiency in corn and wheat has improved when ammonium sulfate (AS) was blended with either urea or ammonium nitrate (AN). Research in 2009 again confirmed that blends containing an amount of AS sufficient to supply 30 lb S/A produced corn yields higher than those achieved with granular urea applied pre-plant. Despite a drought year, these blends produced corn yields of around 120 bu/A with a total application of 120 lb N/A. Blends of ammonium nitrate with ammonium sulfate and urea produced yields as high as those with ammonium sulfate and urea in no-till and higher than those with ammonium sulfate and urea in strip-till. *MD-06F*

Ammonium Sulfate and Ammonium Sulfate Nitrate Application on White Potatoes

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Project Cooperator: David Armentrout

Managing plant nutrition for potatoes can be challenging since the crop's nutrient demands are high, and so is its potential for impact on soil and water quality. This experiment examines the effects of N sources for potatoes grown in rotation with wheat, soybeans, and corn within strip-till and no-till management systems.

In 2009, urea and ammonium sulfate applied pre-plant proved to be equally effective for increasing potato yield. Highest potato yields were obtained when urea and ammonium sulfate were applied pre-plant, followed by side-dressing with urea and ammonium sulfate nitrate. *MD-14F* ■

COMING EVENTS

Soil Fertility II - Dealer Education Course

24-26 November 2010

Woodstock, Ontario, Canada

This course will help you develop a detailed understanding of the management of plant nutrition required for efficient use of fertilizers. The course follows the IPNI Soil Fertility Manual, and is useful for both preparation for the Certified Crop Adviser exam and for continuing education. Students are asked to bring along, for discussion purposes, one or more soil test reports and/or example cases outlining the source-rate-timing-placement for a particular crops or cropping systems of interest to their clients.

Contact: Tracey Forrester at the Ontario Agri Business Association, 519-822-3004.

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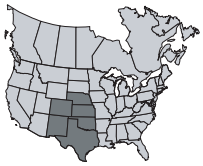
Southern and Central Great Plains Region Research Report



July 2010

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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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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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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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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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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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* ■