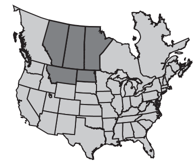
INSIGHTS
IPNI INTERNATIONAL PLANT NUTRITION INSTITUTE



September 2012

Northern Great Plains Research Report

The emphasis on research to improve crop yields and harvested crop quality is regaining importance because of continuing population growth and an increased demand for improved food quality and quantity. This renewed emphasis is needed after a couple of decades when production agriculture was thought to be a lower priority. This was a misconception because even though we generally had ample yields and food supplies through the two decades from 1990 to 2010, food production never loses it's importance. However, the importance of maintaining and improving yields through research advances received less attention. Greater crop yields result when there are improvements in nutrient management resulting in improved fertilizer use efficiency. Improved yields and greater fertilizer use efficiency is the emphasis of research for IPNI in the Northern Great Plains Region.

This issue of *INSIGHTS* contains brief Interpretive Summaries of research projects supported or arranged by IPNI in the Northern Great Plains Region in 2011. 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

Project Leader: Dick Puurveen, University of Alberta Sustainable Resources Department, Edmonton, AB. E-mail: puurveen@ualberta.ca

Project Cooperators: Claire Langlois, Guy Lafond, and Brian Hellegards

This project consisted of two experiments, one at Willingdon, Alberta comparing P fertilizer sources; and another at Dapp, Alberta comparing N fertilizer sources. This study was initiated in April 2008 making this the fourth year of experiments conducted by the University of Alberta.

In the P experiments, 13 treatments compared two P fertilizer products [granular monoammonium phosphate (11-52-0) and liquid polyphosphate (10-34-0)], three P rates (9, 18 and 27 lb P_2O_5/A), and P fertilizer product with and without the Avail® fertilizer additive. Unfortunately, there appeared to be no response to P at the site, and because of adverse cool and excessive moisture conditions affecting germination and seedling establishment. There was no observable difference between the two P fertilizer products, rate of P, and whether Avail® was added or not.

In the N experiment, an experimental design was used to compare three forms of N (urea, ESN® urea, and Nutrisphere®-treated urea), and four rates of N (22, 44, 88 and 132 lb N/A). All N fertilizer was side-banded at planting. A check or zero N treatment was included in each replicate to assess N response. The coefficient of variation (CV) was high for the site, i.e. 24.5%, due to uneven flooding adversely affecting plant stands over the plot area. There was a moderate response to N observed with the 88 and 132 lb N/a rates significantly out yielding the zero N treatment average. There was no observable difference between N forms except at the 88 lb N/A rate where ESN and Nutrisphere N resulted in higher yields compared to regular urea. *AB-26F*

Large Urea Granules for Broadcast Application in No-till Barley Cropping

Project Leader: Dick Puurveen, University of Alberta Sustainable Resources Department, Edmonton, AB. E-mail: puurveen@ualberta.ca

This is the third year of an experimental study that was initiated to evaluate the potential use of two technologies for broadcast urea granules prior to no-till planting of small grain cereals in the Northern Great Plains region of North America. This is seen as a possibility to allow N application with less energy required during planting compared to banding N. The two technologies being evaluated are: 1) the size of the urea granules, comparing regular size granules (approximately 3 mm, or 1/8 in.) to large forestry grade granules (approximately 10 mm or 1/2 in.) and 2) adding urease inhibitor, and or a urease plus nitrification inhibitor to the granules. One additional experimental factor is the timing of application, which being in the mid-fall, compared to early spring, and at planting. There are two control treatments included in the study. One is a zero N treatment in order to determine the N response at the site,

Dr. Thomas L. Jensen
Northern Great Plains Director
International Plant Nutrition Institute (IPNI)
102-411 Downey Road
Saskatoon, SK S7N 4L8
Phone: 306-652-3535
Fax: 306-664-8941
E-mail: tjensen@ipni.net
Website: www.ipni.net

Notes and Abbreviations: N = nitrogen; P = phosphorus and the other is a common farmer practice of side-banding N fertilizer during the planting operation, or so-called "double-shoot planting". All rates of N were 62 lb N/A, which is sub-optimal, but chosen to hopefully show potential differences between experimental factors. The research experiment was conducted at the University of Alberta (AB) Research Farm at Ellerslie, AB. Spring barley was no-till planted on April 27, 2011. The 2011 growing season was very wet and cool during May, but warmed up for June, July and August. Moisture was adequate, but not excessive precipitation. Barley was harvested on September 8, 2011.

All the broadcast urea treatments with large or regular sized granules, and with or without addition of an urease inhibitor, or an urease inhibitor plus a nitrification inhibitor, yielded similarly to the common farm practice of side-banding urea during planting. The side-banding treatment yielded an average of 73 bu/A. There was an overall response to added N with the control or zero-N treatment yielding only 65 bu/A, while some of the N treatments yielded up to 90 bu/A. It is planned to continue this experiment for one more growing season. *AB-27*

Large Urea Granules for Broadcast Application in No-till Spring Wheat

Project Leader: Ross McKenzie, Alberta Agriculture, Food and Rural Development Agricultural Research Division, Lethbridge, AB. E-mail: ross.mckenzie@gov.ab.ca

Project Cooperator: Ross McKenzie

This is the second site-year for this experiment. In 2010, the experiment was severely flooded, and this is the first year of analyzable data. The control zero N treatment yielded 43 bu/A, with the highest fertilizer treatment yielding 71 bu/A. The site was quite variable with a coefficient of variation (CV) of 15%. All of the fertilizer treatments were applied with a sub-optimal N rate (63 lb N/A) because emphasis of this experiment was to compare timing, i.e. fall versus spring; size of urea granule, i.e. regular sized urea (1/8 in.) vs. large of the urea granule (1/2 in.); and whether or not adding an urease inhibitor (Agrotain®) resulted in greater yields. All of the N fertilizer treatments resulted in similar yields statistically. There didn't appear to be any advantage or disadvantage of using a larger sized granule as the 1/2 in. granules performed just as well as the regular 1/8 in. granules. There was no statistical yield disadvantage to fall application compared to spring application, or adding Agrotain to the urea, but there did appear to be a trend towards higher yields in the spring applications, and with application of Agrotain. *AB-28*

Large Urea Granules for Broadcast Application for No-till Cropping in Spring Wheat

Project Leader: Audrey Bamber, Chinook Applied Research Assn, Oyen, AB. E-mail: cara-ab@telus.net

Project Cooperators: Dick Puurveen, Ross McKenzie, and Chengci Chen

The crop year 2011 was an excellent growth year with 8.8 in. of precipitation after planting and warm dry weather in July and August to ripen the spring wheat crop sufficiently so that harvest was done on 8-Sept-2011, close to an average harvest date for the area. The challenge about having a moist warm growing season is that even though the site was

initially rated as deficient in N, there was probably above average mineralization of N soil organic matter by the soil microbial population. The above average N mineralization caused the check or zero N treatment to yield well, 68 bu/A, compared to the N fertilizer treatments all applied at 63 lb N/A, that ranged from 66 to 74 bu/A. Yields in this area are more commonly around 40 to 45 bu/A. Measurements of grain height at harvest showed that the majority, 16 out of 18, of the 18 fertilizer treatments had significantly taller wheat (at 90% confidence) than the check treatment. That being 30 in. height for the check treatment compared to a range from 31 to 34 in. height for the fertilizer N treatments. Variability at the site was very low for both yield and crop height, i.e. 7% and 3% coefficients of variation (CV) respectively. All fertilizer treatments yielded well with no significant differences between granule size (1/8 in. compared to 1/2 in.), time of application (fall or spring), and with or without urease and nitrification inhibitors. It is hoped that with a more normal precipitation year in 2012 that there will be a greater response to fertilizer N compared to the check treatment, and that differences between N fertilizer treatments will be observed. *AB-29*

British Columbia

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

Project Leader: Claire Langlois, BC Grain Producers Association, Dawson Creek, BC. E-mail: bcgpa-r@pris.ca

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

Fortunately, this set of research experiments was conducted under favorable weather conditions in 2011. During the previous 3 years (2008 to 2010) this area experienced severe drought, but growing season moisture was received close to the normal 11.6 in., in contrast to 2010 when only 7 in. was received. Barley yields were high with average yields over 100 bu/A.

In the P experiment there was no significant response to applied P with the control or zero-P treatment yielding similar to all rates of P, both 15 and 30 lbs P_2O_5/A. The zero-P treatment yielded 100 bu/A, and all the P treatments yielded between 94 to 114 bu/A, with a Least Significant Difference (LSD) of 20 bu at a 90% level of confidence. Perhaps since the area came out of a severe drought after 3 years, there was enough available P from increased microbial activity that there was no response to applied P. Since there was no response to P, there was no differences observed between form of P fertilizer (i.e. ammonium polyphosphate, or monoammonium phosphate), rate of P_2O_5 (0, 15 or 30 P_2O_5/A), and whether or not the Avail® polymer was added or not.

There was an even higher yield measured in the N experiments. The check or zero N treatments averaged 120 bu/A, while all the N fertilized treatments, both 54 or 108 lb N/A averaged around 150 bu/A. There was about a 30 bu/A response to added N whether 54 or 108 lb N/A. In comparing the three forms of N, the overall average yields did not show any significant differences. Regular untreated urea averaged 150 bu/A, the Super Urea® 150 bu/A, and the Nutrisphere®-N treated urea yield was 151 bu/A, with an LSD of 7 bu/A at 90% confidence. The data from the 4 years of the study at this site will be grouped and final data analysis done to compare regular P and N fertilizers to those treated with polymer additives, and urease, and nitrification inhibitors. This analysis will be described in the final project report. *BC-17F*

Manitoba

Impact of Long-Term Application of Phosphate Fertilizer on Cadmium Accumulation in Crops

Project Leader: Cynthia Grant, Agriculture & Agri-Food Canada, Brandon, MB. E-mail: cgrant@agr.gc.ca

Project Cooperators: Wole Akinremi (University of Manitoba), Don Flaten (University of Manitoba), Xiying Hao (AAFC Lethbridge), Ross McKenzie (Alberta Agriculture), Dick Purveen (University of Alberta), and Sukhdev Malhi (AAFC Melfort).

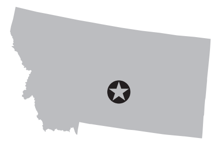
Cadmium (Cd) can accumulate in soils from long-term application of P fertilizer, but the availability of the Cd added in P fertilizers will be affected by soil characteristics. Field studies were established in 2002 at seven sites across the Canadian prairies to evaluate the impact of repeated applications of 0, 20, 40, and 80 kg P/ha of mono-ammonium phosphate (MAP) fertilizer containing 0.38, 70, or 210 mg/kg of Cd. The sites were planted each year following a durum wheat-flax cropping sequence. Fertilizer was applied each year until 2009. Grain concentration of Cd was measured each year in each treatment and the soil concentration of Cd, P and other elements was measured in the 0 to 7.5 and 7.5 to 15 cm soil depths in the control and at the highest P application rates. In 2010 and 2011, crops were seeded with no addition of P fertilizer to evaluate the residual effect of the long-term application of P and Cd on grain Cd content. Chemical and statistical analysis of the 2010 and 2011 samples is continuing.

Based on the data analyzed to date, extractable P was strongly related to the amount of P added to the soil with the rate of increase being inversely related to soil CEC, pH, Fe, and Ca. DTPA extractable soil Cd in the surface 7.5 cm depth increased with application of MAP containing moderate or high concentrations of Cd, but concentration in the 7.5 to 15 cm depth only increased with the high-Cd MAP. Cadmium concentration in both durum wheat and flax seed increased with increasing input of Cd, but the magnitude of the effect varied with soil characteristics and was not consistently related to DTPA-extractable soil Cd. Plant availability of the Cd added in P fertilizer was higher on coarse-textured or acidic soil than on fine-textured or higher pH soils. As the effect of MAP applications on extractable P and Cd in the soil and on grain Cd concentration is affected by soil characteristics, it is important to consider soil characteristics when assessing environmental and health risks associated with P and Cd accumulation in soils. *MB-24*

Montana

A Micrometeorological Study to Quantify Ammonia Volatilization Losses from Surface-Applied Urea in the Semiarid Northern Great Plains

Project Leader: Richard Engel, Montana State University Land Resources and Environmental Sciences, Bozeman, MT. E-mail: rengel@montana.edu



Montana grain growers annually seed over 5 million acres of wheat, primarily winter wheat. Nitrogen is the primary nutrient that limits wheat production on this land. Hence N fertilization is essential for sustaining yields as well as ensuring production of high protein quality grain. To meet this challenge Montana wheat growers apply N fertilizer to their fields. Most frequently this is achieved through broadcast applications of urea-N (46-0-0) to the soil surface with applications occurring between October and early May. Surface urea applications are susceptible to ammonia (NH_3) volatilization losses if not incorporated with tillage or by rainfall. A number of environmental and soil related factors interact together to affect this process and define the magnitude of loss. Research has continued on this project for the fourth year.

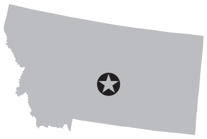
There have been sufficient sites where NH_3 losses were measured (approx. 20), with different weather patterns experienced, that it is now possible to better understand what weather and soil conditions result in low, moderate, and higher relative losses of NH_3. The loss amounts and associated weather patterns can be separated into three categories: low (when applied urea loss is <10%), moderate (when applied urea loss varies between 10 and 20%) and high (when applied urea loss is >20%). Associated soil and weather patterns for these categories include urea applied to dry soil surface then large precipitation events (>0.7 in.) following fertilization for the low category, urea applied to dry soil surface followed by light scattered precipitation events (<0.3 in.) for the moderate category, and urea applied to wet or damp soil surfaces followed by slow drying without precipitation, daily soil temperatures cold (-2 to 3°C) for the high category.

At all of the research sites besides a control or zero N treatment, there has been an application of NBPT urease inhibitor (Agrotain® at 0.01% by weight) to urea for comparison. Generally use of NBPT has been shown to reduce NH_3 losses by around 50%. Additional laboratory experiments are being conducted to better understand the effect of soil pH on the length of effectiveness of the NBPT. This is being done because of observations made of increased length of effect of NBPT on alkaline soils compared to acidic soils. Laboratory research on this will continue over the next year. *MT-17*

Nitrogen Fertilization Methods for No-till Cropping of Winter Wheat in Central Montana

Project Leader: Chengci Chen, Montana State University CARC, Moccasin, MT. E-mail: cchen@montana.edu

Project Cooperators: Audrey Bamber, Dick Puurveen, and Ross McKenzie



The most common method of applying N fertilizer to winter wheat crops in central Montana, is to broadcast urea or dribble apply liquid urea ammonium nitrate in the late fall, or early spring. With shallow soil profiles in central Montana, the soils do not hold much precipitation over winter. When precipitation exceeds the soil water holding capacity, the excess water carries N out of the soil profile, causing ground water contamination.

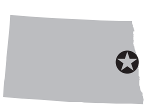
A study was started in the fall of 2010 to compare other possible methods of applying N fertilizer to winter wheat crops, that may reduce the risk of leaching or denitrification losses of applied N fertilizer. Other possible methods include side-banding urea during the planting operation of wheat in mid to late September, placement of ESN® or controlled-release polymer coated urea in the seed-row of wheat at planting, or application of urea treated with urease and nitrification inhibitors in the mid-fall or early spring. In this experiment the winter wheat was planted in mid-September 2010, the two at-planting treatments described above were applied at this time. The fall broadcast treatments were applied on October 5, 2011, and the spring broadcast treatments on March 24, 2012. Treatments included: urea broadcast in mid fall, urea broadcast in early spring, Super Urea® broadcast in mid fall, Super Urea broadcast in early spring, ESN applied in the seed-row at planting in the fall, regular urea applied in the seed-row at planting in the fall, and check (no N applied).

Winter wheat grain yield was significantly affected by N source, application timing, and application method. Generally, spring application had greater yields than fall application. This study will be continued for two more growing seasons. *MT-18*

North Dakota

Nitrogen Recalibration for Corn in North Dakota

David Franzen, North Dakota State University Department of Soil Science, Fargo, ND. E-mail: david.franzen@ndsu.edu



This is the second year of the project designed to allow the research-based re-evaluation of the corn N recommendations in North Dakota. A total of 22 sites were planned in 2011. With the sites from 2010, there have been a total of 36 sites that can be evaluated. In addition, sensor readings using both a Greenseeker® (N-Tech) sensor and a Holland Scientific Crop Circle sensor were used when the corn was about 6 leaf and again about 2 weeks later over the top, and at the later season also below canopy height. These sensor readings were taken to try to develop a predictive measurement to guide growers in the need for added N at side-dress time. The site yield and N-rate evaluations were evaluated as a whole and partitioned based on regional and soil considerations.

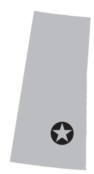
The response of corn to N rate from the total of the two years was quite variable ($R^2 = 0.19$). The no-till sites, a total of five in the 2 years, responded differently than conventional sites, and the 50 lb N/A long-term credit used in the spring wheat and durum recommendations also appears to be justified for corn. High clay sites required far more N for similar yields as the remaining eastern North Dakota sites. Based on a comparison of similar yields from the rest of eastern North Dakota, clay sites lost about 80 lb N/A in 2010 due probably to denitrification and more than 120 lb N/A in 2011. The well-tiled clay sites were less affected by N loss and responses to N near those of medium-textured soil sites in the east. Considering the amount of N lost in high clay soils in 2010 and 2011, and probably by growers in many springs, there is ample cause to begin recommending a planned side-dress N application in high clay soils. It is planned to conduct field sites for two more years, 2012 and 2013, and then summarize the experimental results and release updated N recommendations for the various regions in North Dakota. *ND-16*

Saskatchewan

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

Project Leader: Guy Lafond, Agriculture and Agri-Food Canada Indian Head Research Farm, Indian Head, SK. E-mail: lafond@agr.gc.ca

Project Cooperators: Claire Langlois, Dick Puurveen, and Brian Hellegardsa



This project, at the Indian Head Research Farm near Indian Head, Saskatchewan, 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. The study was initiated in April 2008, and repeated in 2009, 2010, and 2011. In 2011, growing conditions were cool and more moist than normal, early in the growing season, and drier and warmer than normal in the last half of the growing season.

A significant response to N was observed for all three crops. There was a slight overall yield benefit to the slow release N products observed with canola, but not for wheat or barley. It is thought that the soil conditions susceptible for denitrification losses were met at Indian Head from late May through June which could have increased the potential for a benefit to the side-banded Super-U and NSN, but at least for the barley, yields were limited more by the excess spring moisture than by N. Both the wheat and the canola ended up yielding well and the response to N for both crops was quite linear up to 134 kg N/ha. The conditions suitable for denitrification losses are not experienced very often in this area of Saskatchewan, but it does demonstrate the potential benefits of these enhanced urea products when the potential for N loss is high. *SK-40F* ■

International Plant Nutrition Institute
3500 Parkway Lane Suite 550
Norcross, GA 30092-2806
Phone: 770-447-0335
Website: www.ipni.net

Ref # 12075