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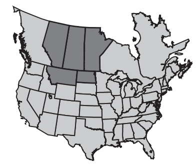
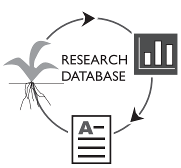


September 2011

Northern Great Plains Research Report

It is always interesting to see the research results of new fertilizer technologies. There are often potential improvements in developing new forms of fertilizer or fertilizer additives; better ways to determine the appropriate rate to apply nutrients whether on a whole field or sub-field management zone; fine tuning when is the most effective time to apply nutrients to a crop as affected by crop type, and weather experienced in a particular year; or where to better place the fertilizer nutrients so the crop uptake and efficiency of use in improved. In the fertilizer industry we summarize effective use of fertilizer nutrients as using the 4R Principles of Fertilization as defined as applying the Right Form of Fertilizer at the Right Rate, Time, and Place. Research in 2010 conducted in the IPNI Northern Great Plains Region of North America has been done to increase agronomic knowledge to better help farmers apply the 4R Principles.



This issue of *INSIGHTS* contains brief Interpretive Summaries of research projects supported or arranged by IPNI in the Northern Great Plains Region in 2010. 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 Nitrogen Fertilizers Treated with Polymer Additives to Increase Fertilizer Efficiency

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In 2010, only the N experiment was conducted at the University of Alberta-Ellerslie Research Farm. The P experiments at Ellerslie and Breton in Alberta were not conducted due to a shortage in summer staff.

Spring wheat grew with very favorable conditions, with adequate and not excessive precipitation. All of the N treatments resulted in similar yields, and there was no statistical difference 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). There were differences between fertilizer placement methods, with banding resulting in greater yields than surface broadcasting for all N forms. Also, differences between N rates with 120 lb N/A yielding greater than 60 lb N/A, and both 120 and 60 lb N/A out-yielding the control, or zero N, treatment. *AB-26F*

Urea Granules for Broadcast Application in No-till Cropping

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This experimental study 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 at planting. 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, that 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, 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

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planted on April, 27. The growing season was favorable to growth with adequate, but not excessive precipitation. Barley was harvested on August 30, 2010.

The three hypotheses of the study were: 1) that spring applications would out-yield fall applications; 2) that the large granules would out-yield the regular size granules; and 3) that the addition of urease, or urease plus nitrification inhibitors would out-yield regular untreated urea. However, results show little differences between experimental factors. 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, out-yielded the common farm practice of side-banding urea during planting. The side-banding treatment yielded an average of 88 bu/A. Additionally there was an excellent response to added N with the control or zero-N treatment yielding only 58 bu/A, while all broadcast N treatments averaged between 95 and 108 bu/A. It is planned to continue this experiment for two more growing seasons. *AB-27*

Large Urea Granules for Broadcast Application in No-till Cropping

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Progress on this project proceeded well with all the fall and spring treatments being applied on time and as planned. Unfortunately, extremely wet weather during the summer of 2010 caused flooding of much of the research site, which resulted in complete or partial losses of plots within two replicates. Statistical analysis of plots remaining was done using the missing plot function of the statistical analysis program used. The variability of the data resulted in little significant differences in the experimental factors of timing of application (fall compared to spring), size of granule (regular urea compared to 1/2-in. diameter urea), and with or without addition of a urease inhibitor. This project will be continued for 2 more years at this site. *AB-28*

British Columbia

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

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Unfortunately, this set of research experiments was conducted in an area that experienced severe drought the third of 3 years running since initiation of the study. The research site received 180 mm (7 in.) of growing season precipitation compared to a normal amount of 295 mm (11.6 in) and there were little soil moisture reserves from the previous droughty growing season. Even so, the spring barley crop did grow and mature though yields were low.

In the P experiment there was no significant response to applied P with the control or zero-P treatment averaging lower than all P treatments, but not significantly. The zero-P treatment yielded 27 bu/A, and all the P treatments yielded between 28 to 33 bu/A, with a Least Significant Difference (LSD) of 5.9 at a 95% level of confidence. The severe drought did not allow sufficient crop growth to determine any response to P or differences between polymer treated or untreated P fertilizers. There seemed to be marginally better growth in the area of the N experiment, but yields were still severely depressed due to the drought. The limited moisture did not allow any yield increase between the two rates of N (53 and 106 lb N/A). In comparing the three forms of N, the overall average yields did show some differences. Regular untreated urea averaged 35 bu/A, the Super Urea 40 bu/A, and the Nutrisphere-N® treated urea yield was 40 bu/A, with an LSD of 5 bu/A at 95% confidence. The data from the 3 years of the study at this site will be grouped and final data analysis will be 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 Traditional and Enhanced Efficiency Phosphorus Fertilizers on Canola Emergence, Yield, Maturity, and Quality

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

Phosphate fertilizer is a major input cost for canola production. An adequate supply of P is needed in the first 2 to 6 weeks of growth to optimize canola yield http://www.canola-council.org/phosmgmt.aspx. This P is commonly supplied by applying monoammonium phosphate (MAP). Seed-placing or side-banding the MAP increases its accessibiity to seedlings early in growth, while application in a band minimizes the reactions between P fertilizer and soil, which normally reduce its availability for plant uptake. However, the amount of MAP that can safely be seed-placed in canola is limited due to the risk of seedling damage. Rates of P required to optimize yield of modern, high-yielding hybrids may be higher than can safely be seed-placed. While the rate can be increased by moving the fertilizer away for the seed as a side-, mid-row, or pre-plant band, this may reduce the effectiveness of the fertilizer, increase the cost of fertilizer application, and lead to seed-bed disruption and moisture loss. Many producers are using seed-placed MAP, often at reduced rates, which may reduce crop yield potential, and can still risk seedling damage.

A number of enhanced efficiency P products have been developed to improve the effectiveness of seed-placed P fertilizer, reducing the risk of seedling damage, and/or maintain P in an available form for a longer period to enhance crop uptake. These products include a polymer-coated MAP that releases phosphate slowly into the soil, Polyon® (a polymer-coated product), and Avail® stabilized phosphate. The study will provide information to determine if these benefits occur. However, the extremely cool and wet weather in 2010 led to plot damage, and increased the variability in the trials. The enhanced efficiency P products had little effect on most of the growth parameters assessed. Although the original plan was to run these sets of experiments for 3 years and 2010 was the third year, the research experiments will be continued for a fourth year in 2011 to make up for the cool and excessively wet growing season in 2010. *MB-22*

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

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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

This study was initiated as a follow-up to field studies conducted from 2002 through 2009 for eight growing seasons. The original phase of this study was conducted at five field sites across the Canadian prairies to determine the influence of repeated applications of monoammonium phosphate (MAP) fertilizer on accumulation of cadmium (Cd) in crops. This phase of the study will observe the residual and plant uptake of Cd during 3 years of cropping without any additional P fertilizer. Originally at each location, three rates of P fertilizers (0, 20, 40, and 80 kg P/ha) from three different sources varying in Cd concentration (0.38 mg Cd/kg, 71 mg Cd/kg, and 211 mg Cd/kg) were applied annually and sites were seeded following a durum wheat-flax-durum wheat-flax crop sequence. Treatments were applied to the same plots each year so that the cumulative effects of P applications could be assessed over time.

Cadmium concentration was higher in durum wheat than flax and varied with location. Cadmium concentration in the seed of both crops increased with application of P fertilizer even when the fertilizer contained only trace concentrations of Cd, indicating that P fertilization directly influenced Cd concentration of crops apart from the effect of Cd addition. Seed Cd concentration was higher when the fertilizer contained greater Cd concentrations, particularly when rate of fertilizer application was also high. Cadmium concentration in crops was directly proportional to the total amount of Cd applied over time, but the effect of fertilizer application varied with soil characteristics. Highest availability of Cd added in P fertilizer was on coarse-textured or acidic soil, while availability of applied Cd was lower on fine-textured or higher pH soils. Therefore, soil characteristics that affect phytoavailability must be taken into account when assessing the risk of transfer of Cd into the food chain from P fertilization. The experimental design of the follow-up study is to grow the same crops as previously for three additional growing seasons, but without addition of P fertilizer. This is to observe the subsequent uptake of Cd in the crops and how this will affect Cd concentration in grain of the crops at the five different sites. The sites were planted in early May of 2010, and crops were harvested in September. The plant sample analyses are still in progress. *MB-24*

Montana

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

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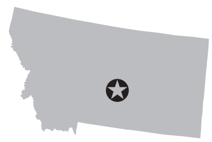

Ten field investigations [i.e., ammonia (NH_3) gas sampling campaigns] have been completed as part of this project over the past 3 years. The magnitude of N losses due to ammonia volatilization are quite variable and very much dependent on the soil moisture conditions, rainfall, and climatic conditions that are experienced following application of the fertilizer granules. The best example of this is provided by the contrast in results from Campaigns #2 and #5. These investigations were carried out at the same field site, yet N losses from urea differed by more than 10 times (3.1% versus 39.9%) between the fall and spring applications, respectively. Surface soil moisture conditions at time of fertilization were dry and fertilizer granules remained undissolved and visible for 24 days during Campaign #2. Beginning on November 2, 0.98 in. of rain fell over a 67 hour period, which was sufficient to dissolve the fertilizer granules and transport the urea to a depth in the soil profile where it was protected from volatilization losses. In contrast, the spring fertilizer was applied to the soil surface with a trace of snow (Campaign #5). Although the surface temperatures were at 31 °F (-0.6 °C), the fertilizer granules began to dissolve almost immediately, but ammonia volatilization losses duringthis campaign were extremely large, because only light precipitation was received over the first month (e.g. 0.3 in.), and fertilizer N remained exposed near the surface and were subject to volatile ammonia losses when urea hydrolysis occurs from the action of soil and crop urease activity.

Enough research data is being gathered to categorize and determine what weather conditions allow ammonia volatilization conditions to exist, and planned research in 2011 will expand this information to allow formulations of recommendations to farmers on how to reduce the risk of ammonia volatilization. *MT-17*

North Dakota

Nitrogen Recommendations for Dryland Corn in North Dakota

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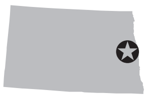

This project is intended to be conducted for 3 years, at 15 to 16 sites each year in order to gather sufficient data to allow the development of N recommendations for dryland corn in various corn-growing regions of North Dakota. Each site was carefully selected after being screened for residual N so that soil N levels were low enough to ensure crop response to added N fertilizer. Six N rates (check, 40 lb N, 80 lb N, 120 lb N, 160 lb N, and 200 lb N) were applied to each individual small plot, which were planted to corn by growers. Any row starter of other fertilizer applied to the experimental plots was noted and the N it included was added to the known available N pool for the plots. When the plots were in an annual legume, such as soybean or dry bean, a 40 lb N credit was also added to the known available N pool. When the corn was in the 8 to 12 leaf stage, a Greenseeker® sensor was used over each plot in the 16 most eastern experiments. The ears were collected, dried to about 10% moisture, and then shelled. Grain yield was determined along with its moisture content and test weight. Final statistical analysis will be done after all data from the planned 3 years of research is grouped and analyzed. *ND-16*

Saskatchewan

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

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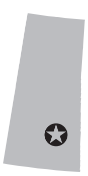

This project, at the Indian Head Research Farm near Indian Head, Saskatchewan, consists of three experiments comparing regular granular urea, urea treated with Nutrisphere-N® (a polymer coating), and Super Urea (including both urease and nitrification inhibitors) at 45, 90, and 135 kg N/ha. The experiments were conducted on spring wheat, barley, and canola. This study was initiated in April 2008, repeated in 2009 and 2010, and will be conducted for a fourth year in 2011.

In 2010, growing conditions were good, with ample to excess moisture, with 417 mm of moisture compared to a 30-year normal of 318 mm. There was only a slightly cooler 4-month average temperature of 12.7 °C compared to the 30-year normal of 13.1 °C. 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*

Willow Biomass Quality for Bioenergy and Bioproduct Applications

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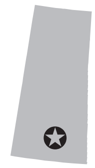
Project Cooperator: Ryan Hangs



Growing willow as a renewable dedicated bioenergy and bioproduct feedstock is advantageous for a number of reasons, such as its naturally fast growth rate, along with important environmental benefits like providing a much cleaner energy source relative to fossil fuels. The majority of research to date has focused on the quality of willow biomass for bioenergy conversion and increasing plantation productivity through cultural practices. However, no one has investigated the effects of different agronomic practices on the wood quality of willow biomass for its different potential end uses. The potential exists, therefore, to not only increase plantation productivity through irrigation and fertilization, but also to accentuate favourable biomass quality characteristics through optimizing soil moisture and nutrient availability under an intensive management regime.

The study is being carried out in the existing Canadian Forest Service 2-year-old hybrid willow plantation, located in Saskatoon, Saskatchewan. The plantation is a clonal trial with seven different clones of willow. Three different rates of both irrigation and fertilizer treatments were imposed on each bed. The three irrigation treatments consist of either no additional water added above rainfall or drip irrigation used to maintain soil moisture at 75% (half water) or 100% (full water) field capacity, measured using soil moisture probes installed within each plot. The three fertilization treatments include no fertilizer or fertilizer applied once annually over the 3-year rotation, either at the recommended rate (Fert Treatment #1) or 2x the recommended rate (Fert Treatment #2). The recommended rate consists of a balanced fertilizer blend of 100:30:80:50 (N:P:K:S), which is intended to not only match hybrid willow growth requirements, but also replenish nutrients exported when harvesting willow with annual biomass production of 15 to 22 t/ha. The 2x recommended rate is intended to test the upper limit of willow growth response to added fertilizer. Analytical laboratory work is on-going and results will be completed in early 2011, with a final report being prepared in later 2011. *SK-42* ■

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