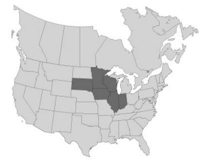
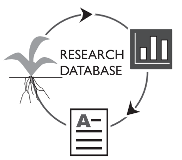
INSIGHTS
International Plant Nutrition Institute

September 2011

Northcentral Research Update Report



AGRICULTURE is being asked to solve monumental problems — global warming, hypoxia, eutrophication, food security, and sustainable energy to name a few. The research of soil fertility and plant nutrition is as important as ever as we strive to better understand the elements of sustainable nutrient management. The studies contained in this publication are efforts to that end, and represent continued efforts to help agriculture meet the growing number of demands placed upon it.



This issue of *INSIGHTS* features the brief Interpretive Summaries related to research projects partially supported by IPNI and the Foundation for Agronomic Research (FAR) in the Northcentral Region. This information and more detail on each project can be found at the research database at our website: >**www.ipni.net/research**<.

Iowa

Variability in Soil Test Potassium and Crop Yield in Iowa

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A project studying impacts of rootworm incidence and genetic rootworm resistance on corn response to K fertilization was completed. Treatments were two hybrid isolines with or without rootworm resistance and five K fertilizer rates.

Data from 27 site-years showed that root injury by rootworms was much less for the resistant hybrid. The grain K concentration seldom differed between hybrids, but grain yield and K removal were greater for the resistant hybrid half the time. On average, the yield-maximizing K rate was slightly less for the resistant hybrid even though yield was higher. Potassium concentration and uptake in vegetative tissue was higher for the resistant hybrid when K supply was low. Results indicated better K use efficiency of hybrids with rootworm resistance, although higher grain yield and K removal resulted in higher K rates to maintain soil test K (STK).

There was progress in three other areas. Work continued at five long-term trials with corn-soybean rotations managed with and without tillage to understand STK temporal variability and relationships among fertilization rates, removal, and STK. We summarized 15 years of data for the no-till treatment. Potassium fertilization had a small effect on grain K concentration but increased yield and K removal when STK was less than 150 to 180 mg/kg. Yield was poorly correlated with grain K concentration, but was linearly correlated with K removal. Iowa's average grain K concentration corresponded with the highest concentrations observed. There was a large stratification of STK and non-exchangeable K. The non-exchangeable K partially explained large STK variation across K rates and years. We harvested and sampled the second year of two trials to evaluate interactions among hybrids, N fertilization, and K fertilization in corn. There were large yield responses to N, moderate response to K at one location, and a small positive NxK interaction at one location. Results of tissue tests for grain and leaves are being studied.

We also advanced on the study of K recycling with corn residue. This work is complemented by a similar study for soybean. There was significant K leaching to the soil from standing plants and residue during the period encompassing physiological maturity, harvest, and late fall (before the winter freeze). Study of this issue at different locations and years together with rainfall should explain a great deal of temporal variability in STK. *IA-09F*

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Evaluation of MicroEssentials Sulfur Fertilizer Products for Corn Production

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Project Cooperator: Daniel Barker

The main objective of this study was to evaluate the MicroEssentials MES10® (12-40-0-10S) product as a S and P fertilizer source for corn production. This source is comprised of monoammonium phosphate (MAP) plus ammonium sulfate (AMS) and elemental S in equal proportions. A second objective was to provide additional data on the potential for corn response to S fertilization in Iowa. In addition, a second MicroEssentials product (MESZ® 12-40-0-10S-1Zn) was evaluated as a Zn fertilizer source. Sites were chosen in New Hampton and Tripoli, Iowa, based on their potential for soil S deficiency as well as their higher probability for response to S additions.

Results indicate plant S response to applied S from all S fertilizer products (similar leaf S concentration response from each product), but no yield response to S application at either site in 2010. There was plant P response to all P fertilizer products (leaf P concentration increase), and a yield increase to applied P at both sites. The yield increase from P application was present for all P fertilizers. Based on the results in 2010, no difference was noted between S or P fertilizer products. There was no yield increase with application of Zn as MESZ. The MESZ product also appeared to supply plant equivalent S and P compared to the AMS and MES products. *IA-18F*

Illinois

Comparison of Ammonium Sulfate Nitrate and Ammonium Sulfate to Other Turf Nitrogen Fertilizer Sources

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Turf fertilizers must provide effective turf greening to maximize visual quality. Proper N nutrition is key. Currently, the industry standard for turf N fertilization is urea; however, several other products are available that may not only match the color and quality produced by urea but also provide a longer period of effectiveness. This study, conducted on a Kentucky bluegrass/perennial ryegrass mixture, investigated several different N fertilizer sources, all of which were applied at a rate of 1 lb N/1,000 ft^2: 1) ammonium sulfate nitrate (Sulf-N 26); 2) polymer-coated, sulfur coated urea (PCSCU); 3) ammonium sulfate; 4) UFLEXX, an N source containing two proprietary inhibitors; and 5) urea. Supplemental S (as gypsum) was applied to treatments where the N source did not contain it. Clipping weights and visual turf quality were measured weekly.

Clipping weights did not differ among fertilizer sources for any of the weeks following treatment application. All sources produced similar responses in biomass production and all were greater than where no N had been applied. All fertilizer sources produced improvements in turf quality, but no statistical differences existed among sources. Although not statistically significant, there is a possibility that ammonium sulfate nitrate and ammonium sulfate may produce turf quality improvements more rapidly than the other sources.

The study will be continued to further investigate these sources and more replicates over time will help improve the ability of statistical analyses to determine differences. *IL-36F*

Indiana

Comparative Nutrient Use Efficiency by Candidate Biofuel Crops

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Project Cooperators: Sylvie Brouder, Keith Johnson, and Brad Joern

This report focuses on efforts at the Throckmorton Purdue Agricultural Center, where the objective is to determine how variation in soil test P and K impacts biomass yield, tissue P and K concentrations, and biomass composition (neutral detergent fiber, acid detergent fiber, lignin, sugars, starch) of switchgrass. This research has taken on additional importance because engineers have recently revealed that efficiency of conversion of plant biomass to liquid fuels using pyrolysis is markedly reduced with K in biomass. Briefly stated, high biomass yield with minimal tissue K will be one of several key factors determining system efficacy.

Plots were established in 2007 on a site where a previous alfalfa nutrition study created a wide range in soil test P and K. Biomass yields have been obtained in 2008, 2009, and 2010. Biomass sample analyses for all years have been completed. Soil samples (0 to 10 and 10 to 20 cm) have been obtained and P and K analyses completed. Analysis of variance and regression are being used to determine the relationships among soil and tissue P and K levels and biomass yield and composition. Mr. Patrick Woodson joined the research effort in the summer of 2010 and will complete the analysis of these data for his M.Sc. degree. *IN-25F*

Agronomic Evaluations of Nine Decades of Soybeans: Nitrogen Utilization

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How has N fixation and N utilization changed in soybean cultivars over time? To answer these questions, a multi-state N utilization study was initiated in 2010. In this study, soybean yield, nutrient content, and N use efficiency are being measured and calculated. There are two whole plot treatments: 1) no N applied and 2) N applied at 500 lb N/A (non-limiting to yield). Comparing these two treatments provides insights into the N needs of soybean plants and how well these needs are being met through N fixation. To understand how N utilization has been changing over time, the N treatments are being applied to approximately 60 soybean cultivars released from the 1920s to 2009. These cultivars were acquired from the National Soybean Research Center at Urbana, Illinois, for crop maturity groups II and III. Studies were initiated in 2010 in Indiana, Illinois, Wisconsin, and Minnesota. Indiana and Illinois evaluated the group III cultivars, while Wisconsin and Minnesota evaluated the group II cultivars.

Indiana's preliminary results exhibited a gain of 0.5 bu/A/yr with the fertilizer N supply (500 lb N/A) compared to a gain of 0.4 bu/A/yr with N supply from the soil and biological N fixation. Plant tissue analyses are currently being conducted and the data are yet to be analyzed. The field experiment addresses N utilization, but is very limited in inferences of nodulation efficiency. Therefore, the nodulation of these cultivars will be examined in the greenhouse. *IN-27F*

Minnesota

Evaluation of Ammonium Sulfate Nitrate as a Nitrogen Source for Potato and Sweet Corn Grown on Sandy Soils

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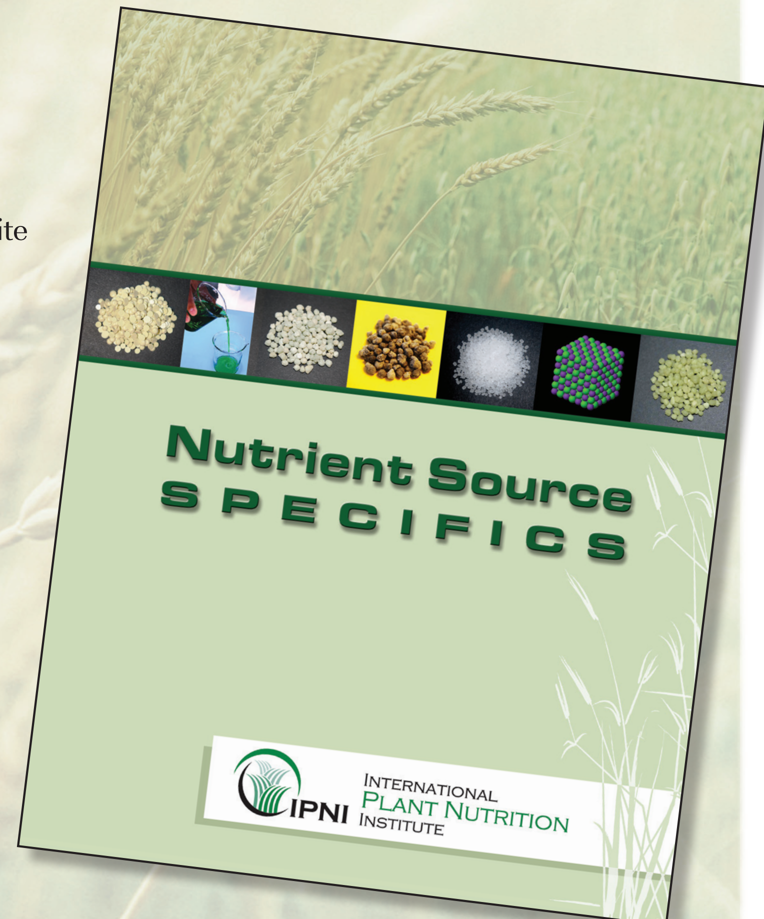
A field experiment at the Sand Plain Research Farm in Becker, Minnesota, was conducted in 2010 to evaluate ammonium sulfate nitrate (ASN) as an alternative to other N sources in Red Norland potato and sweet corn. Treatments included ASN, 50/50 urea + ASN, ammonium nitrate (AN), urea ammonium nitrate (UAN, 28%), urea, and a low N control.

Potato yield and quality were not affected by treatment, possibly due to significant freeze damage early in the study. For the sweet corn study, which was planted after the freeze, application of ASN plus urea or ASN alone resulted in higher green and husked yields than AN or UAN. Sweet corn yields with urea were intermediate between AN, UAN, and the ASN treatments. The positive yield response in the sweet corn with ASN is not entirely clear, but it is likely related to better S nutrition and possibly to less leaching of N as more of the N is in the ammonium/urea form than AN. Application of ASN plus urea or ASN alone consistently resulted in a higher mean N and S concentrations in petiole samples from the potatoes than other treatments, although not always by a significant amount. The ASN treatments also resulted in consistently higher N and S concentrations in sweet corn ear leaf samples compared with AN and UAN treatments, but not always significantly higher. ASN appears to be a suitable N and S source for sweet corn. Further research is needed to evaluate ASN for potato. *MN-27F* ■

Nutrient Source Specifics

is a series of brief, condensed, one-page fact sheets highlighting common commercial fertilizers and nutrient sources in modern agriculture. These topics are written by scientific staff of the International Plant Nutrition Institute (IPNI) for educational use. Mention of a fertilizer source or product name does not imply endorsement or recommendation. This series is available as PDF files at this URL: >www.ipni.net/specifics<

1. Urea
2. Polyphosphate
3. Potassium Chloride
4. Compound Fertilizer
5. Potassium Sulfate
6. Potassium Magnesium Sulfate: Langbeinite
7. Urea-Ammonium Nitrate
8. Thiosulfate
9. Monoammonium Phosphate (MAP)
10. Ammonia
11. Potassium Nitrate
12. Ammonium Sulfate
13. Sulfur
14. Triple Superphosphate
15. Nitrophosphate
16. Gypsum
17. Diammonium Phosphate
18, Calcium Carbonate (Limestone)
19. Phosphate Rock
20. Coated Fertilizer
21. Single Superphosphate
22. Ammonium Nitrate



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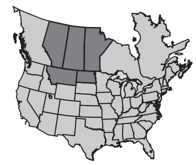

September 2011

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.

RESEARCH DATABASE

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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E-mail: ross.mckenzie@gov.ab.ca

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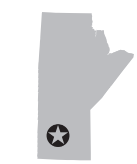
Project Cooperators: Gerhard Rakow and Jo-Anne Relf-Eckstein



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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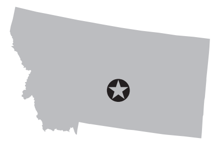

Ten field investigations [i.e., ammonia (NH_3) gas sampling campaigns] have been completed as part of this project over the past 3 years. The magnitude of N losses due to ammonia volatilization are quite variable and very much dependent on the soil moisture conditions, rainfall, and climatic conditions 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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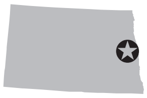

This project is intended to be conducted for 3 years, at 15 to 16 sites each year in order to gather sufficient data to allow the development of N recommendations for dryland corn in various corn-growing regions of North Dakota. Each site was carefully selected after being screened for residual N so 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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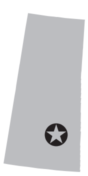

This project, at the Indian Head Research Farm near Indian Head, Saskatchewan, consists of three experiments comparing regular granular urea, urea treated with Nutrisphere-N® (a polymer coating), and Super Urea (including both urease and nitrification inhibitors) at 45, 90, and 135 kg N/ha. The experiments 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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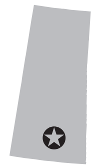
Project Cooperator: Ryan Hangs



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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INSIGHTS
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Research Supporting Nutrient Stewardship

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**<.

Delaware

Evaluating Nitrogen Sources for Corn on the Delmarva Peninsula

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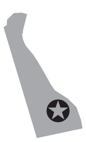

Numerous corn fields showed visual symptoms of S deficiency in the past 5 years, and in 2009 corn yield climbed more than 50 bu/A in response to applied S. In 2010, five studies compared N sources including ammonium sulfate and ammonium sulfate nitrate (ASN) at sites in Delaware and on the Eastern Shore of Maryland. These studies also included urea, polymer-coated urea, urea ammonium nitrate (UAN), and forms of urea with inhibitors of urease and nitrification.

Growing conditions in 2010 were extremely hot and dry, especially June through early July. A local farmer noted, “In the thirty-some years that I’ve been farming, I’ve never experienced a year with such a long period of day-after-day intense heat and no rain.” Drought conditions at the three non-irrigated sites led to smaller-than-expected responses to N in general and no significant differences among N sources. However, inclusion of S in the N source increased grain S at all three locations, and alleviated visual symptoms of S deficiency at one of the three. The lack of superior response to enhanced-efficiency forms of N is consistent with expectations, since there was little opportunity for N loss in the dry growing conditions.

At two irrigated sites, one showed no differences among N sources, and at the other either dribble-band UAN with urease inhibitor or broadcast ASN at sidedress produced yields 18 to 31% higher than either a UAN knife treatment or urea broadcast at sidedress. SuperU (urea with inhibitors of urease and nitrification) also performed well. Further evaluation of the results will continue after plant tissue analysis is completed. *DE-05F*

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Maryland

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

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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 doublecropped 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/A of S 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/A of N. 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.

In 2010, several N sources improved yields of no-till corn

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

relative to broadcast granular urea. These sources included polymer-coated urea, partial blends including ammonium sulfate, urease inhibitors and other materials. Several of these same sources nudged yields to over 200 bu/A in on-farm trials near Baltimore. Comparison of 16 different N sources for wheat showed large effects (9 bu/A) of including AS in the blend and a statistically significant 5 bu/A yield boost from the Nutrisphere product. These trials have generated enthusiasm among producers for continued testing of practices to improve N use efficiency. *MD-06F*

Cantaloupe Fertilizer Source Trial

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Project Cooperator: David Armentrout

Cantaloupe growers have shown interest in using new sources and forms of N fertilizer that have provided promising research results in wheat and corn. The objective of this trial was to evaluate the performance of two products containing S — ammonium sulfate-nitrate (ASN, 26-0-0-14) and a 14-5-8.4-7.5 product — in comparison to a standard ammonium nitrate control. For cantaloupe grown with a black plastic mulch, fertilizers were applied on the soil surface prior to laying the mulch.

In 2010, all three treatments produced similar yields of about 11 to 12 t/A. There appeared to be no response to applied S. *MD-13*

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.

In 2010, including no-till corn in the rotation increased potato yields by 25 cwt/A above those with strip-till corn. Both fertilizer treatments that included ammonium sulfate increased potato yields by 30 cwt/A compared to urea as the primary N source. Blends of ammonium sulfate with urea performed equally compared to those with ammonium nitrate. *MD-14F*

New York

Comparison of Tissue Potassium and Whole Plant Potassium for Alfalfa

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Price increases for potash-based fertilizers in recent years triggered many New York alfalfa producers to ask if K applications can be reduced without impacting yield, quality, or stand survivability. This experiment examines tissue tests as part of several possible diagnostic criteria that could potentially be used to fine-tune K recommendations.

In 2010, tissue samples taken of the top 6 in. of plants compared closely to whole plant samples for K concentrations, with a 1:1 relationship across a wide range of K rates. A residual effect of manure application was detected, even though the last application had been 5 years earlier. Tissue K levels reached 2% at a soil test K level of about 140 ppm. Tissue K concentrations were not related to yields. Yields ranged widely with previous history of the soils, with much higher yields on plots that followed silage corn grown with manure or compost applications. *NY-09*

Ohio

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

Project Leader: Edwin M. Lentz, PhD., Associate Professor, Crops Specialist, OARDC/Hort. & Crop Sciences, Agriculture and Natural Resources Extension, Educator. The Ohio State University Extension, 3140 S SR 100, Suite E, Tiffin, Ohio 44883-8810. Telephone: +1 419-447-9722, Ext 11. E-mail: lentz.38@osu.edu

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.

In 2010, all sites were in corn, with sites varying dramatically in yields, from 105 to 258 bu/A. Corn following soybeans yielded 7% higher than corn following corn. As in past years, yield responses to applied P and K were modest, and in line with expectations based on soil test levels. The results of the past 5 years have been in agreement with the currently accepted critical levels for soil test P and K. However, the absence of low soil test levels in this experiment limits the application of these data to calculations of economic consequences. 2010. *OH-16F*

Ontario

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

Project Leader: Dr. Bill Deen, University of Guelph, Dept of Plant Agriculture, 5 Stone Road, Guelph, ON N1G 2W1. Telephone: +1 519-824-4120x53397. E-mail: bdeen@uoguelph.ca

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 rate and application timing 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.

Favorable growing conditions in 2010 resulted in high yields, 195 bu/A at an optimum N rate of 190 lb/A, more than 50% higher than recommended. At this optimum rate, partial N balance (PNB) was 63% and recovery efficiency (RE) of N was 54%. Neither application timing nor duration of N treatment produced significant differences in optimum rate. Soil residual nitrate-N at harvest was about 10 lb/A higher at the optimum rate compared to the recommended rate, but was not affected by application timing or duration of treatment.

This project also received support from the Ontario Agri Business Association, for sampling soil residual nitrate and soil organic carbon commencing in 2009, and from the Canadian Fertilizer Institute, for measuring nitrous oxide emissions from late summer 2010. This additional support enables a more complete assessment of sustainability. *ON-29*

Hybrid Interactions with Nitrogen and Foliar Fungicides

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Project Cooperators: J.D. Lauzon, W. Deen, T. Tenuta, G.A. Stewart, and K. Janovicek

Growers have shown interest in corn hybrid differences in response to applications of fungicide and N. Fungicides can potentially improve N use efficiency by delaying leaf senescence and enhancing the "stay-green" physiological mechanism. This project aims to determine the potential for yield improvement through exploitation of hybrid-fungicide-N interactions. Field trials implemented at three sites in southwestern Ontario compared six hybrid pairs (triple-stacked with corn rootworm resistance versus Roundup-Ready-only isolines) at five N rates with two fungicides (Headline and Proline) and a non-fungicide control.

Results from two of the three sites showed strong evidence of hybrid-by-N interactions, and some evidence of hybrid-by-fungicide interactions. The highest yield of 224 bu/A was produced by the Pioneer hybrid 35F44 (a triple-stack) with Headline fungicide and N applied at 120 lb/A. The triple-stacked trait in general, however, did not have much influence on N use efficiency. The fungicides interacted only slightly with N rate, tending to increase both optimal rates and yields by about 2%. Dry growing conditions near the end of the season may have limited the expression of the stay-green trait, and the trials are planned to be repeated in 2011. *ON-30*

Nitrogen for Vegetable Crops

Project Leader: Alan McKeown, University of Guelph, Department of Plant Agriculture, PO Box 587, Simcoe, ON N3Y 4N7. Telephone: +1 519-426-7127x334. E-mail: amckeown@uoguelph.ca

Vegetable growers have traditionally used ammonium nitrate as their main source of N. However, security and environmental concerns, and an increasing need for S as well as N, have prompted interest in use of different forms of N. This study compared sources and rates of N and S fertilizer in terms of yield and quality of fresh market tomatoes and late-season storage cabbage.

Response trials were conducted at the Simcoe research station in Ontario, Canada. Several N forms including ammonium sulfate, ammonium sulfate-nitrate, and polymer-coated urea supplied N at least as effectively as ammonium nitrate for marketable yields of both tomato and cabbage. The experimental design did not allow for testing of response to S at optimum N rates. *ON-31F*

Virginia

Evaluation of Ammonium Sulfate Nitrate in Virginia Sweet Corn Production

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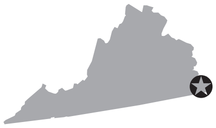

Virginia farmers grow over 3,000 acres of fresh market sweet corn. They are interested in exploring sources and rates to improve N use efficiency. This trial compared three N sources (urea-ammonium nitrate, ammonium nitrate, and ammonium sulfate-nitrate) at three rates. The first two N sources were compared 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).

Averaged over two seasons (2009 and 2010), the three N sources increased marketable yields by 30 to 65% using optimum N rates ranging from 110 to 170 lb/A. Agronomic efficiency at optimum rates ranged from 26 to 45 lb of marketable yield increase per lb of N applied. Sulfur added as gypsum did not increase yields, and sources did not show consistent differences across the two seasons.

These 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* ■

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COMING EVENTS

Soil Fertility - Dealer Education Course

13-15 December 2011

Guelph, 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.

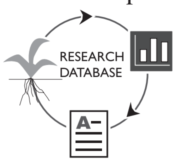
Contact: Tracey Forrester at the Ontario Agri Business Association, 519-822-3004.

INSIGHTS
IPNI
International Plant Nutrition Institute

October 2011

Southeast Region Research Report

RESPONSIBLE management of crop nutrients requires research. Research is one step in the development process of best management practices (BMPs) that specify the right source of nutrient to be applied at the right rate, time, and place. Scientists need to test these practices for their impact on productivity, profitability, cropping system sustainability, and environmental health..



This issue of *INSIGHTS* features the brief Interpretive Summaries related to research projects supported by IPNI in the Southeast Region. This information and even more detail on each project can be found at the research database at our website: >**www.ipni.net/research**<.

Alabama

Evaluation of Rates and Timings of Liquid Nitrogen Fertilizer to Optimize Alabama Wheat Yields With and Without Fall Tillage

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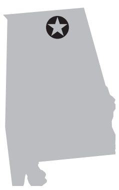
Project Cooperator: Kip Balkcom



This was the third year of the project to evaluate N fertilizer rates and timing for wheat on different soils in Alabama. A tillage variable is also included. Data collected from the test sites include wheat tillering counts and weights, leaf-N values at Feekes growth stage 4 and 6, and moisture, test weights, and yields at harvest.

The 2009-2010 growing season in Alabama was not optimum for wheat production. A wet fall delayed

wheat plantings and wet conditions in January and February delayed N applications in many areas. Four test sites were established, but one site had to be abandoned due to poor stands. In 2010, wheat tillering rates and N content were much lower at all locations than in previous years. Applying 20 lb N/A at planting did increase tillering rates at all sites, but they were still low compared to previous years. Non-inversion tillage increased wheat yields compared to conventional tillage at the two test sites located on sandy soils in central and south Alabama, but no-tillage produced equivalent wheat yields compared to conventional tillage on the silty clay soil test site in northern Alabama. In these tests wheat yields were lower than normal, but generally responded to higher N rates than seen in previous years. Early timing of N applications (Feekes 4) was critical especially on the sandy soil sites. Residual soil N measurements are inconsistent on Alabama soils.

This year's data support the use of tiller counts and tissue N concentrations in timing N fertilizer applications. The three years of data also indicate that on the sandy soils in Alabama, fall N fertilizer rates may need to be increased or spring N applied sooner to maximize wheat tillering and yields. The silty clay soils of northern Alabama generally have higher residual soil N values, but this year's data also support the use of tillering rates and N concentration for timing of N applications on these soils. *AL-19*

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Arkansas

Biomass and Macronutrient Accumulation and Losses in Switchgrass During and After the Growing Season

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A switchgrass growth and composition trial was conducted in 2009 and 2010 at the University of Arkansas. The trial consisted of 12 sampling dates from early May to mid-February. For the 2009-10 growing season, peak yield (6.25 t/A) occurred at the August 28 sampling date. Yields were essentially level from September 30 to October 27, and then followed a gradual decline until February 17, 2010. Moisture content declined linearly in-season and curvilinearly post-season, attaining levels safe for storage of direct-chopped biomass in December onward (<20%). Cutting the stand crop at dates through November would require field curing before packaging and transport to safe storage because of excessively high moisture. Data for the 2010-11 harvest year trended similarly to that of 2009-10. In 2010, moisture content declined to around 50% by September 28. After October 26, moisture content declined more sharply, reaching 16% by December 20. As in 2009, crop moisture content was not safe for direct chopping and immediate storage before December. Nitrogen, P, and K concentrations were determined on sub-samples to determine uptake and removal in the harvested biomass. In 2009, N uptake exhibited a broad peak between July 3 and Sept. 27. The peak N removal was 71 lb N/A on August 28, the same day as peak biomass yield. The senescent period showed N removal rates reduced to about half the peak level, ending at 26 lb N/A in mid-February. Potassium uptake peaked on July 3 at 121 lb K/A (2 months before peak biomass yield) and declined to 20 lb K/A by February 17. There was substantially more K than N removed during June through August, but they declined to similar low levels by winter. Interestingly, peak dates of N and K uptake did not coincide. Phosphorus uptake increased gradually and at very low levels (14 lb P/A) to July 31, then declined to nearly zero by mid-February. Loss of all three nutrients in the latter half of the sampling year likely resulted from a combination of leaf and seed droppage (not measured) during senescence, re-mobilization of mobile nutrients for next year's growth to roots and the crown, and by leaching from the leaves. *AR-33*

Florida

Bahiagrass Production and Nitrogen Leaching from Various Nitrogen Fertilizer Sources

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Bahiagrass covers nearly 5 million acres in Florida and is the most widely used improved grass in the state. This grass requires relatively moderate amounts of N for optimum production and can efficiently respond to inorganic fertilizer application. Nitrogen fertilizer can increase both yield and nutritive value of bahiagrass pastures, particularly in low fertility Coastal Plain soils, where N is often the most limiting nutrient for forage production. Although N is an important agronomic input for productive bahiagrass pastures, the increasing costs of commercial fertilizers and environmental problems associated with improper fertilization management have prompted the need to re-examine optimum rates and efficient sources to supply pastures with N. This experiment was designed to examine the effectiveness of various N sources on bahiagrass dry matter yield, nutritive value, and N leaching potential. Nitrogen was applied at 0, 50, and 100 lb/A/yr as ammonium nitrate (AN), ammonium sulfate (AS), urea, and ammonium sulfate nitrate (ASN) on Basinger fine sand. The study was conducted at the Range Cattle Research and Education Center in Ona, Florida, during May to November, 2010.

All N fertilizer sources increased cumulative bahiagrass dry matter yield by approximately 69% comparedto control plots (no N applied). Bahiagrass yields responded linearly as N rates increased from 0 to 100 lb/A. Bahiagrass crude protein concentration was not significantly affected by N source. There were no significant differences in bahiagrass crude protein concentrations between the control plots (CP = 7.6%) and the treatments receiving 50 lb N/A treatment (CP = 7.7%). However, application of N at rates of 100 lb N/A resulted in higher CP concentrations (CP = 8.7%). Nitrogen leaching as nitrate (NO_3-N) and ammonium (NH_4-N) was not significantly affected by either N source or N rate. Results indicated that N leaching from plots receiving N fertilizer was similar to control plots (no N added). Nitrate and ammonium concentrations for all treatments did not exceed the acceptable environmental threshold and likely do not pose any serious threat to the environment. *FL-29F*

Louisiana

Precise Midseason Nitrogen Rate Determination for Use Efficiency and Yield Optimization of Rice

Project Leader: Dr. Dustin Harrell, Louisiana State University, Rice Research Station, 1373 Caffey Road, Rayne, LA 70578

Project Cooperator: Brenda Tubana and Tim Walker

The development of a more profitable and environmentally-sound production system is essential to maintain a competitive rice industry in the Mid-South region of the USA. Nitrogen fertilizer is one of the major agricultural inputs and is considered as the most expensive plant nutrient in rice production. This project was continued in 2010 to: 1) update the working algorithm of the proposed sensor-based N decision tool for estimating midseason N requirement of rice; 2) evaluate the performance of the 2009 sensor-based N decision tool; and 3) address the issue on water reflectance interference on sensor readings. Sensor readings were collected from seven variety x N trials established in Louisiana and Mississippi once a week for five consecutive weeks starting at panicle initiation.

Regression analysis was performed after the data from 2008 to 2010 were grouped by growing degree days (GDD) and adjusted using days from seeding to sensing (DAS). For the 1,501 to 1,700 GDD group, where the majority of the site-years were at or close to panicle differentiation, the coefficient of determination value (r^2) of the predictive model for grain yield potential using the normalized difference vegetation index (NDVI)/DAS was only 0.48. Improvement on the relationship of grain yield and NDVI/DAS was made when the data were further grouped by climate regime, i.e. temperate (r^2 = 0.53) versus sub-tropical (r^2 = 0.63). In two out of four sites, variably applying midseason N to rice based on sensor readings resulted in a 10 and 48 kg N/ha reduction in applied N, which translated into 15% and 5% higher NUE compared with the standard N rate recommendation. The sensor-based N tool recommended 12 and 7 kg N/ha higher than the standard N rate for the other two sites and resulted in higher grain yield and similar NUE values compared with the standard N rate. The NDVI readings collected using the nadir sensor head position, in general, consistently obtained good relationships with biomass at panicle differentiation (PD) and 50% heading when compared with tilted or twisted sensor head orientations.

Our findings suggest that a yield potential predictive model for rice will be established from NDVI readings that will be collected using the nadir sensor head orientation. *LA-23*

Kentucky

Evaluation of Sidedress Nitrogen Sources in Dark Tobacco

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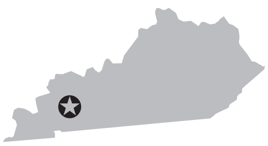

Research was conducted in 2010 at the West Farm of Murray State University to evaluate the effect of several sidedress N sources on crop vigor, yield, and quality grade index of dark fire-cured tobacco. The site was a Grenada silt loam with soil test P index of 56 (medium), soil test K index of 175 (low), and pH 6.1. One ton/A agricultural lime was applied and disk-incorporated in early spring and 150 lb N/A, 100 lb P_2O_5/A, and 220 lb K_2O/A were broadcast and incorporated to the entire area on June 7, one week prior to transplanting 'PD7318LC' dark tobacco on June 15. All other production practices followed standard recommendations. Weather conditions during the 2010 season were wet early in the season with hot/dry conditions occurring after June 15, just after transplanting and continuing for much of the remainder of the season. Sidedress N applications were made on July 9 at 150 lb N/A. Seven N source treatments were used in the trial and included no sidedress (150 lb N/A pre-transplant only), Sulf-N 26 ammonium sulfate nitrate, a 50:50 blend of Sulf-N ammonium sulfate:urea, ammonium nitrate, UAN-32 liquid, UCAN-21 liquid (CN-9 + UAN-28), and potassium nitrate.

Mid-season crop vigor was evaluated in late July with no growth differences observed among N sources. Dark fire-cured tobacco total yields ranged from 2,609 to 3,130 lb/A with no statistical differences among N sources. There were some differences in the leaf grade only, with highest leaf yield coming from the ammonium nitrate treatment and lowest leaf yield coming from the UAN-32 treatment. There were also minor differences in quality grade index between treatments, with highest grade index occurring with the Sulf-N 26 ammonium sulfate nitrate treatment and lowest grade index occurring in the potassium nitrate treatment. *KY-10F*

Mississippi

Precise Mid-Season Nitrogen Rate Determination for Use Efficiency and Yield Optimization of Rice

Project Leader: Dr. Timothy Walker, Mississippi State University, Delta Research and Extension Center, PO Box 197, Stoneville, MS 38776..

Project Cooperators: Dustin Harrell and Brenda Tubana

The development of a more profitable and environmentally-sound production system is essential to grain The development of a more profitable and environmentally-sound production system is essential to maintain a competitive rice industry in the Mid-South region of the USA. Nitrogen fertilizer is one of the major agricultural inputs and is considered as the most expensive plant nutrient in rice production. This project was continued in 2010 to: 1) update the working algorithm of the proposed sensor-based N decision tool for estimating mid-season N requirement of rice; 2) evaluate the performance of the 2009 sensor-based N decision tool; and 3) address the issue on water reflectance interference on sensor readings. Sensor readings were collected from seven variety x N trials established in Louisiana and Mississippi once a week for five consecutive weeks starting at panicle initiation.

Regression analysis was performed after the data from 2008 to 2010 were grouped by growing degree days (GDD) and adjusted using days from seeding to sensing (DAS). For the 1,501 to 1,700 GDD group, where the majority of the site-years were at or close to panicle differentiation, the coefficient of determination value (r^2) of the predictive model for grain yield potential using the normalized difference vegetation index (NDVI)/DAS was only 0.48. Improvement on the relationship of grain yield and NDVI/DAS was made when the data were further grouped by climate regime, i.e. temperate ($r^2 = 0.53$) versus sub-tropical ($r^2 = 0.63$). In two out of four sites, variably applying midseason N to rice based on sensor readings resulted in a 10 and 48 kg N/ha reduction in applied N, which translated into 15% and 5% higher NUE compared with the standard N rate recommendation. The sensor-based N tool recommended 12 and 7 kg N/ha higher than the standard N rate for the other two sites and resulted in higher grain yield and similar NUE values compared with the standard N rate. The NDVI readings collected using the nadir sensor head position, in general, consistently obtained good relationships with biomass at panicle differentiation (PD) and 50% heading when compared with tilted or twisted sensor head orientations.

Our findings suggest that a yield potential predictive model for rice will be established from NDVI readings that will be collected using the nadir sensor head orientation. *MS-16*

Nitrogen Uptake, Residual Effects, and Nitrogen Translocation in Alamo Switchgrass

Project Leader: Dr. Rocky Lemus, Mississippi State University, Plant & Soil Science, Mississippi State, MS 39762. Telephone: +1 662-325-7718. E-mail: rlemus@pss.msstate.edu

Project Cooperator: Jack Varco

Switchgrass grown as a biofuel crop has been shown to have a significant response to N applications in poor quality soils during the early years of its production. An N response study was conducted at Mississippi State University over the past 1.5 years. Data collected thus far indicate that switchgrass total N concentration declines in late summer because of translocation of aboveground N to the nutrient reserve below ground (roots and crown).

Radio labeled ^{15}N was used to test the hypothesis that well-established switchgrass depends more on an internal nutrient translocation system than on the uptake of applied N. A linear increase in seasonal yields was observed, but no significant mean separations were observed in 2009 or 2010. Average yields indicated a 20% and 30% increase for the 56 and 112 kg N/ha application rates when compared to the control. Shoot and root samples are being analyzed for ^{15}N, C, P, and K. The amount of total N removed from the system was directly related to biomass yield, and was significantly affected by harvest time and biomass component (shoot, crown, and roots). Importantly, there were no significant changes in N content between an early winter harvest (November) and a late winter harvest (February). The below-ground canopy at 15 cm depth indicated that 63% of the biomass was allocated to crowns while 37% was allocated to roots. A significant below ground biomass type x date interaction was observed in the percent of biomass distribution. Crowns had a higher N (64 g/m^3) content that roots (37 g/m^3). Nitrogen content was also affected by sampling date and N rate. Significant changes in N concentrations were observed between aboveground biomass and below ground constituents across sampling date, but no significant differences were observed between crown and root. Nitrogen concentration was affected by N rates in both above- and below-ground biomass. Nitrogen concentration fluctuated over the sampling dates with higher concentrations towards the beginning of the growing season, which declined at the end of the season.

This study indicates that N translocation occurs soon after senescence and thus there is no reason to risk yield losses by delaying harvest over the winter. *MS-17*

South Carolina

Incorporating Soil Electric Conductivity in Developing Variable Nitrogen Application for Corn in the Southeastern U.S.

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Project Cooperators: Ahmad Khalilian, David Wallace, and Ymene Fouli

This study was conducted from 2008 to 2010 at the Pee Dee Research and Education Center located near Florence, South Carolina. The objective was to evaluate optical sensing technology to predict sidedress N requirement under different tillage systems and soil electrical conductivity (EC) zones. In 2009, the predicted sidedress N application of 40 lb was sufficient, compared to a standard N application of 80 lb N/A. In 2010, predicted sidedress rate of 120 lb N/A increased corn yield by about 10 bu/A compared to the standard sidedress N application. Comparing tillage systems, significantly higher corn yields were obtained from strip-till than no-till and conventional tillage in 2008, whereas higher yields were recorded from conventional than no-till in 2009. Corn yields significantly increased with N application of up to 80 lb/A in 2008, but there was no significant yield increase with increasing N rates from 0 to 120 lb N/A in 2009, mainly due to drought conditions. Due to relatively higher moisture and nutrient holding capacity, significantly higher grain yields were observed in soil EC zone 3 (highest EC) in 2008, and zones 2 and 3 in 2009 compared to zone 1. In 2010, further evaluation of N applications under different soil EC zones showed a quadratic response of N application on corn yield under soil zone 1 and linear responses under zones 2 and 3. Predicted sidedress N rates at V6 based on optical sensing technology showed that a calculated sidedress rate of 30 lb N/A was adequate for zone 1 and 60 lb N/A (rate 25% lower than the calculated average across zones) was sufficient for soil zones 2 and 3.

These results indicate that the predicted sidedress N for the sandiest area of the field may have to be evaluated separately for N applications from the field average. As for the soils with higher soil EC, 25% lower N rate than the predicted rate of 80 lb N/A based on the algorithm may be sufficient without significant yield reductions. Optical sensing technology can be successfully used to help growers improve profitability by optimizing N application rates. The sidedress N recommendations should account for soil EC zones to improve N use efficiency for dryland corn and reduce nitrate leaching potential. *SC-14* ■

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INSIGHTS
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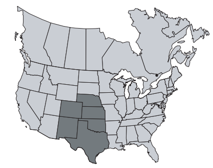
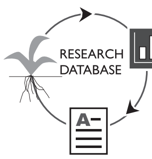
Southern and Central Great Plains Region Research Report



September 2011

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

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

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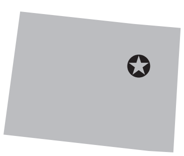
Project Cooperators: Thomas Borch and Jeffrey L. Collett, Jr.



Ammonia (NH_3) deposition has recently been targeted as a primary contributor to atmospheric and ecosystem changes in Rocky Mountain National Park (RMNP). 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.

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.

The first year of this study was spent determining the best approach to isotope analysis. Progress over the past year includes completion of conditional samplers for field studies, some field sampling, and NH_3 studies from native soils in the RMNP. RMNP native soil studies have shown that NH_3 flux can vary greatly with sampling period. Additionally, grassland soils have higher NH_3 emissions than forest soils. Preliminary analysis of volatilized NH_3 shows that N deposited in RMNP via precipitation is retained by the soil. *CO-13F*

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Kansas

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

Project Leader: Dr. Alan Schlegel, Kansas State University, Southwest Kansas Research and Extension Center, Rt 1, Box 148, Tribune, KS 67879. Telephone: +1 316-376-4761. E-mail: schlegel@ksu.edu

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 2010 results of this project were impacted by hail, thus yields of both crops were reduced compared to other years and caution should be used in interpreting 2010 data. Nevertheless, N alone increased corn yield by a factor of 3.3, while N and P applied together increased yield by about five fold. Averaged across the past ten years, N and P applied together increased irrigated corn yield by 140 bu/A. Application of 120 lb N/A (with P) has generally been sufficient to produce greater than 90% of maximum yield. Phosphorus fertilizer at the lowest P rate more than tripled corn yield, and application of the highest P rate increased yield by a factor of 3.8. The no fertilizer treatment in the sorghum study produced 51 bu/A. Nitrogen fertilizer alone increased sorghum yield by about 25 bu/A, while N plus P increased yield by 35 bu/A. Application of 40 lb N/A (with P) was sufficient to produce about 85% of maximum yield in 2010. Potassium fertilization had no effect on sorghum yield. This is one of the few continuous, long-term crop nutrition studies in the U.S. *KS-23F*

Effect of Potassium, Chloride, and Nitrogen on Corn, Wheat, and Doublecropped Sunflower Grown on Southeastern Kansas Claypan Soil

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Project Cooperators: Douglas J. Jardine and Kenneth W. Kelley

Corn acreage has been increasing in southeastern Kansas in recent years because of the introduction of short-season cultivars that enable producers to partially avoid mid-summer droughts. Also, producing a crop after wheat and in rotation with corn may provide producers additional revenue by growing three crops in 2 years. Recent interest and developments in oil-type sunflower provide an alternative to soybeans for growers to doublecrop after wheat. The objective of this project is to determine the effect of N, K, and Cl^- fertilization on yield, yield components, and nutrient uptake of short-season corn, wheat, and double-crop sunflower grown in a 2-year rotation.

Corn yield, yield components, and stalk rot severity were unaffected by K or Cl^- fertilization (50 lb K_2O, 40 lb Cl^-) in 2010. Increasing N fertilizer rate (0, 50, 100, and 150 lb/A) increased corn yield primarily because of its impact on kernel weight and kernels per ear, but N rate had no effect on stand, ears per plant, or stalk rot severity. Dry matter production was significantly increased by K fertilization during vegetative and early reproductive growth stages; however, this response declined and was non-significant at the dough and physiological growth stages. Chloride had no effect on dry matter production at any growth stage. Nitrogen only significantly affected dry matter production in late reproductive growth stages. Wheat was planted in fall 2010 and after harvested in 2011 will be followed by doublecropped sunflower. *KS-38F*

Texas

Nutrient Uptake and Removal Dynamics in Muskmelon Grown in South Texas

Project Leader: Dr. John L. Jifon, Texas A&M University, Texas Agricultural Experiment Station, 2415 E Hwy 83, Weslaco, TX 78596. Telephone: +1 956-968-5585. Fax: +1 956-969-5620. E-mail: jljifon@agprg.tamu.edu

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 is also critical. 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. 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 nutrient recommendations.

Leaf, stem, and fruit tissues of muskmelons were sampled from fields with different soil types and analyzed to calculate nutrient removal amounts. Estimates of nutrient removal amounts in 2009 and 2010 ranged from 16 to 43 lb N/A, 3 to 8 lb P/A, and 33 to 98 lb K/A. There was significant variability among sites, with higher overall nutrient removal in clay textured soils than lighter, more sandy soils. Fruit soluble solids ranged from 9.8 to 12%, and were also higher in heavy soils. Observations from the region suggest that appropriate fertilizer input is important in improving both yield and quality of muskmelon, and is especially important under sandy soils. *TX-52F*

Potassium Fertilizer Management in Irrigated Cotton in West Texas

Project Leader: Dr. Kevin Bronson, Texas A&M University, Texas AgriLife Research, 1102 E FM 1294, Lubbock, TX 79403. Telephone: +1 806-746-4013. Fax: +1 806-746-6528. E-mail: k-bronson@tamu.edu

Project Cooperator: Randal Boman

High soil K fertility in the western part of Texas is often taken for granted. Over 90% of the region's soils test high in extractable soil test K. However, cotton fields have been exhibiting pre-mature leaf drop recently, which may be linked to K deficiency. Growers are concerned that the traditional extractable K soil test does not reflect actual availability to cotton. Nevertheless, the typical practice of not applying K fertilizer, combined with high picker-type lint yields leads to "K mining" of west Texas soils. Fertilizer K source and rate trials were established in two furrow-irrigated west Texas locations in 2009 (Lubbock and Reeves counties). Specific objectives were to: 1) assess lint yield response to K fertilizer rates (0, 40, 80, 120, 160, 200 lb K_2O/A) 2) assess lint yield response to K fertilizer source (KCl and K thiosulfate); 3) assess different procedures for determining soil K availability; and 4) monitor leaf K between early bloom and first open boll as a function of K fertilizer rate.

Hail destroyed the Reeves site in 2010, so crop measurements came only from Lubbock. No yield response to K rate or source was observed. However, "dynamic" K soil testing using cation exchange resins did show net fixation in Reeves and net release in Lubbock County in both years. Water soluble K was lower at the Reeves site in both years. Salinity and sodicity reduced yields at Reeves. It appears that there was little benefit to K application over the course of this study. *TX-54F* ■

INSIGHTS
IPNI
International Plant Nutrition Institute

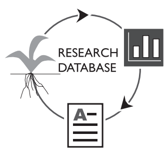
September 2011

Western Region Research Update

Research to Maintain Competitiveness

Farmers are always looking for a better way to grow their crops. Even though the agricultural productivity in Western North America is among the highest in the world, there are still things that can be done better.

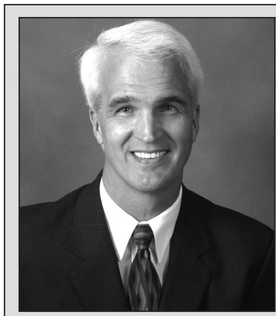
A recent emphasis of IPNI has been to remind people of ways to improve nutrient stewardship. There are many economic, ecological, and social pressures that are encouraging farmers to reevaluate some of their traditional practices. In particular, better understanding of the "4R" concept for nutrients (the Right Source, Right Rate, Right Time, and Right Place) has helped growers implement management practices that may improve nutrient stewardship.



Implementing the 4R approach to fertilizer use reminds us that we cannot be satisfied with always doing things the way they have been done in the past. IPNI is pleased to partner with leading researchers to learn better ways of using valuable plant nutrients in the most appropriate way.

The reports provided here reflect only a small fraction of the research projects that IPNI supports worldwide. Supporting important agronomic research is central to our mission of responsible management of plant nutrients for the benefit of the human family.

This issue of INSIGHTS features a brief summary of some research projects supported by IPNI in Western North America. Further information on these and other global projects supported by IPNI can be found at the research database on our website: >**www.ipni.net/research**<.



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California

Sampling Technique and Maturity Effects on Nutrient Concentrations in Alfalfa

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Project Cooperator: Dan Putnam

Soil tests are effective to detect some nutrient deficiencies, but plant tissue tests are believed to be more accurate. Plant samples often better reflect nutrient availability and uptake versus soil samples. Unfortunately, most alfalfa growers do not tissue test and will fertilize based upon past practice with little idea of the actual nutrient status. Tissue testing techniques vary from state-to-state. Simplified and standardized methods of analysis could promote wider adoption of tissue testing for nutrient monitoring purposes. Currently all guidelines are based on sampling alfalfa at one-tenth bloom growth stage, but alfalfa is frequently harvested before this stage. Research was needed to compare different sampling methods and to evaluate the change in nutrient concentration with advancing maturity.

Research was conducted in five locations in Northern California to compare the P, K, S, B, and Mo concentration of alfalfa using three different sampling protocols (whole plant samples, top 15 cm samples, or fractionated plant samples. Alfalfa was sampled at early bud, late bud, and 10% bloom for all three cuttings to determine the effect of plant maturity and time of year on nutrient concentration.

Nutrient concentration declined with advancing maturity for all sampling methods and nutrients. The concentrations of B and Mo decreased slightly with advancing maturity, but the degree of decline was not considered to be sufficient to warrant adjusting critical values. There appeared to be no advantage to sampling portions versus whole plants suggesting adaptation of the most practical method (whole plants) for sampling. Cored bale sampling (similar to whole tops) may be a recommended procedure due to ease of use and the ability to combine with normal sampling for forage quality analysis. *CA-26F*

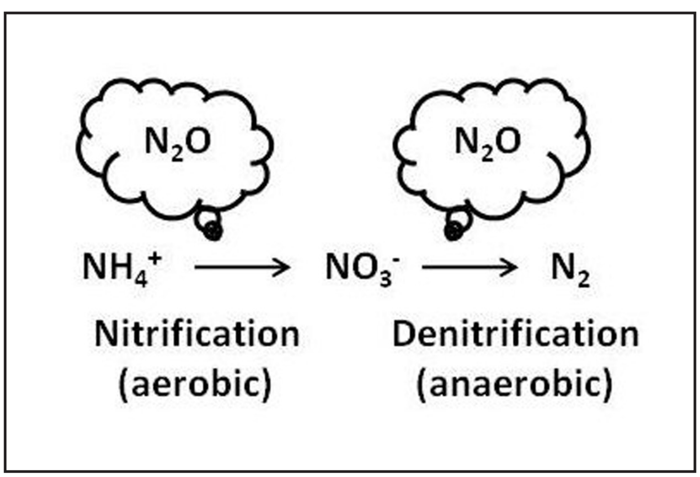
Nitrous Oxide Emissions from the Application of Fertilizers: Source Partitioning

Project Leader: Johan Six, University of California, Plant Sciences Department, 2136 PES, MS-1, Davis, CA 95616. Telephone: +1 530-752-1212. E-mail: jwsix@ucdavis.edu.

There is considerable interest to identify and implement agricultural practices that optimize nutrient management and reduce greenhouse gas emissions. Many California agricultural conditions are ideal for the production of food, but also nitrous oxide (N_2O) losses. Improving fertilizer use efficiency by better coordination of N availability and crop demand is beneficial. On-farm research was conducted in Yolo County to investigate the effect of management on annual N_2O fluxes and to determine the source of the observed N_2O fluxes.

In the first study, drip irrigation and fertigation were found to significantly reduce N_2O emissions compared with furrow irrigation. The reduced N_2O emissions are likely due to better synchrony between N availability and crop demand. Fertigation allows for more control over how much N is being added and there is less mineral N in the soil. Win-win examples like this need to be communicated as much as possible to ensure formulation of policies for climate change mitigation and adaptation that benefit everyone involved.

In a second study we also tested Natural Abundance (NA) ^{15}N techniques to source partition N_2O in a conventionally managed tomato cropping system. With this NA technique, lighter atoms react faster than heavier atoms, resulting in an isotopically enriched substrate and a depleted product. Enriched ^{15}N was also utilized in other treatments. Some key results included: 1) the calculation of the fraction of N_2O derived from denitrification, nitrification, or from other sources during our one-week experiment; 2) daily field measurements of ^{15}N in N_2O and mineral N allowed us to track the rapid changes in mineral N forms in the soil; 3) a better understanding of fractionation factors for nitrification and denitrification derived N_2O emissions and N_2O reduction to N_2 for the soil. *CA-29F*



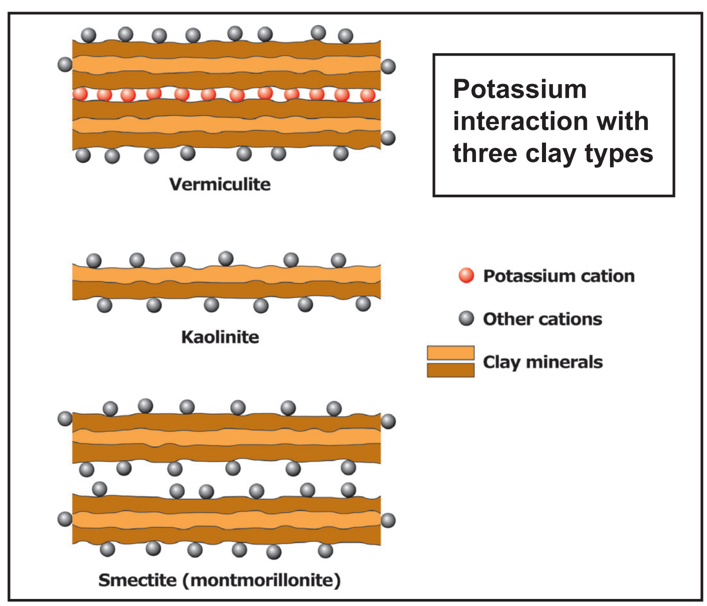
Potassium Fixation and its Significance for Crop Production

Project Leader: Stuart Pettygrove, University of California, Department of Land, Air & Water Resources, One Shields Ave., Davis, CA 95616. Telephone: +1 530-752-2533. Fax: +1 530-752-1552. E-mail: gspettygrove@ucdavis.edu

Project Cooperator: Randal Southard

Potassium is found in several fractions in soil, but only the soluble and exchangeable forms are important for immediate plant nutrition. Potassium that is fixed in montmorillonite clay readily diffuses back into soil solution and becomes available for plant uptake. However, vermiculite clay complexes K very strongly and it is only released very slowly back into solution. Although vermiculite is chemically a clay mineral (layer silicate), it can also occur in the silt and sand size fractions. Vermiculite is a weathering product of biotite mica minerals and is commonly found on the east side of the San Joaquin Valley in California. The extent and distribution of these K-fixing soils has been examined in previous IPNI-supported research. This current research is looking at how to manage fertilizer K to meet the needs of drip-irrigated wine grapes on these vermiculitic soils.

Winegrapes grown in this region often experience K deficiency, but excess K in juice and wine is also a problem. These vineyards are typically drip-irrigated, which restricts the volume of the rootzone. The high K demand under heavy fruit load and competing soil fixing reactions make nutrient management difficult. Field experiments are underway to look at appropriate K fertilizer strategies. Potassium-fixing soils may require thousands of pounds of potash per acre before a point is reached where only maintenance K applications are required. Fixed K is slowly available to plants, but is not well estimated by the usual soil test procedures such as with the ammonium acetate extract. Improvements of the current lab tests are being examined, including better interpretation of the analytical results. The study is also studying the impact of soil drying on K fixation and release. *CA-31F*

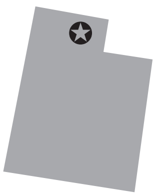


Utah

Utah-Specific Potassium and Phosphorus Nutrient Management for Tart Cherry Productivity and Quality

Project Leader: Grant Cardon, Utah State University, Extension Soils, 4820 Old Main Hall Rm 164, Logan, UT 84322. Telephone: +1 435-797-2278. E-mail: grant.cardon@usu.edu

Project Cooperators: Brent Black and Earl Seeley



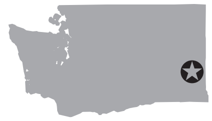
Tart cherries, also called sour or pie cherries, are best known as ingredients in desserts and beverages. Nearly all tart cherries are frozen, canned, or dried. Fertilizer recommendations for cherry production in Utah are very old or not in existence. Improved fertilizer management is known to increase fruit yields, improve cherry quality and color, improve the health benefits of the fruit, and enhance grower profitability. The first-year study established single-tree plots that received variable P and K application in a factorial design from multiple P and K fertilizer sources. Applications were made to all trees in May and again in June for some treatments. Leaf and fruit samples were collected during the growing season and analyzed for nutrients. Fruit yield and quality were monitored at harvest. The experiment is conducted on three sites: two commercial orchards and one research farm.

In the first full year after establishment of treatments, the trees had very high cherry yield due to their alternate bearing pattern. Yields were generally greatest when a 1:1:1 ratio of N:P:K was applied in May and again in June. The chemical analysis of tissue samples is still underway. With most tree experiments, it is important to repeat the measurements for multiple years. This helps to account for weather variables, alternate bearing patterns, and the nutrient reserve stored within the tree that can mask short-term nutritional changes. The continuation of this study will lead to improved production levels and better leaf diagnostic tools. *UT-07F*

Washington

Root Responses to Fertilizer Placement and Source

Project Leader: William Pan, Washington State University, Department of Crop & Soil Science, 210 Johnson Hall, Pullman, WA 99164. Telephone: +1 509-335-3611. E-mail: wlpan@wsu.edu



Previous methods to monitor root development and their response to fertilizer have suffered from major limitations. Recent advances in digital scanners now enable the capture of high resolution root images at low cost and provide real-time monitoring of plant development.

An imaging method was developed to evaluate crop species differences in root and root hair morphology using high resolution scanners and to determine if the method could detect root responses to nutrient source and placement. High resolution desktop scanners (1890 pixels/cm) were buried in containers filled with soil to monitor root development. This new technique can successfully track a single root or root hair over short time intervals (~10 min), which is useful in determining temporal and spatial patterns of root hair growth and development in the soil environment. A major advantage of this method is its provision of large, high resolution images of root systems growing through soils, allowing for the characterization of root hair development in space and time without disturbance.

Preliminary scans have examined the effect of fertilizer source and placement on root growth and proliferation. Images will be posted on the IPNI website as they become available *WA-14F* ■

Nutrient Source Specifics

is a series of brief, condensed, one-page fact sheets highlighting common commercial fertilizers and nutrient sources in modern agriculture. These topics are written by scientific staff of the International Plant Nutrition Institute (IPNI) for educational use. Mention of a fertilizer source or product name does not imply endorsement or recommendation. This series is available as PDF files at this URL:
>www.ipni.net/specifics<

1. Urea
2. Polyphosphate
3. Potassium Chloride
4. Compound Fertilizer
5. Potassium Sulfate
6. Potassium Magnesium Sulfate: Langbeinite
7. Urea-Ammonium Nitrate
8. Thiosulfate
9. Monoammonium Phosphate (MAP)
10. Ammonia
11. Potassium Nitrate
12. Ammonium Sulfate
13. Sulfur
14. Triple Superphosphate
15. Nitrophosphate
16. Gypsum
17. Diammonium Phosphate
18, Calcium Carbonate (Limestone)
19. Phosphate Rock
20. Coated Fertilizer
21. Single Superphosphate
22. Ammonium Nitrate