IPNI INSIGHTS
INTERNATIONAL PLANT NUTRITION INSTITUTE

Research Supporting Nutrient Stewardship

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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

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Project Cooperator: Edwin Lentz

Growers in the eastern U.S. Corn Belt often fertilize the whole rotation rather than the individual crops. Typically, in the fall prior to corn planting, farmers supply enough P and K to satisfy the nutrient needs of both corn and the following soybean crop. This practice has proven to be a viable option for corn-soybean rotations on soils with adequate nutrient levels, but questions arise for producers in a 3-year rotation of corn-corn-soybean. In 2006, studies assessing P and K fertilization strategies were started in three locations. Two rotations were compared: corn-corn-soybean, and corn-soybean. These rotations were fertilized following soybeans, at P and K rates corresponding to zero, once, and twice the crop removal for the rotation.

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

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Project Cooperators: John Lauzon and Greg Stewart

Decisions on optimum N rates are often made on the basis of single-year responses. Data are limited on the long-term impact on productivity and soil organic matter of rates higher or lower than these short-term optima. This controlled experiment was designed as a base for testing the application of dynamic soil-crop-atmosphere models as predictors of N rates for corn that optimize sustainability. The specific objectives include: 1) assessment of short and long-term effects of N 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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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

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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.