Addressing nitrogen controversies
Peter Scharf, University of Missouri, Plant Sciences Division

Objective & Relevance:
The objective of this project is to collect data that will help to address several controversies about nitrogen management, including:

1) How do various nitrogen rate recommendation systems perform?
2) Is foliar N more efficient than soil-applied N, and is Coron more efficient than UAN?
3) Among the range of new N products and N-enhancement products, which are profitable to use and how do they rank?

This project is relevant to Missouri agriculture because nitrogen fertilizer management has profound effects on profitability. With high grain prices, large yield responses to N, and high N prices, the economic importance of wise nitrogen management has never been greater. At the same time, more products, systems, and management options are available than ever before. This creates confusion and controversy, as reflected in the Request for Proposals (Is a pound of N a pound of N?, verification of claims). Research to address this complexity and controversy will help producers make profitable decisions.

Procedures:
● Three separate small-plot experiments will be conducted at Bradford Farm near Columbia. All experiments will use corn as the test crop.
   ○ This farm has claypan soils representative of the grain-producing claypan soils that are found across much of the northeast quarter of Missouri.
   ○ Each experiment will address one of the three objectives listed above.
● Nitrogen rate recommendation systems experiment
   ○ Treatments will be N rate recommendation systems. Four replications of these treatments will be used in the experiment.
   ○ The same systems will be used for the same plots over the three-year duration of the project.
   ○ Corn will be grown every year in order to maximize:
     - Any cumulative effects of treatments on the soil.
     - The power of the comparisons between recommendation systems.
   ○ Nitrogen rate recommendation systems to be used include:
     - Constant 140 lb N rate. This is the rate that produced the Maximum Return To Nitrogen (the recommendation approach recently adopted by Iowa, Illinois, Minnesota, and Wisconsin) for 30 on-farm nitrogen rate experiments in Missouri. What this means is that if a single rate had to be applied to all 30 fields, 140 lb N/acre was the rate that produced the best economic return.
     - Preplant soil nitrate test. A nitrogen rate credit (as described in Missouri guidesheet G9177) based on a preplant soil nitrate test will be subtracted from the 140 lb base rate.
     - Sidedress soil nitrate test. Nitrogen rate will be calculated using the Iowa State University interpretations.
     - Chlorophyll meter. Nitrogen rate will be calculated using chlorophyll meter measurements taken at growth stage V7 (knee high) and the equation in my Agronomy Journal publication.
- Reflectance sensor. Nitrogen rate will be calculated using reflectance sensor measurements taken at growth stage V7 (knee high) and an equation from my previous research on these sensors.
- High rate: 180 lb N/acre.
- Low rate: 100 lb N/acre.
- Check treatment. No N fertilizer applied.

**Foliar N efficiency experiment.**
- A low N rate will be used.
  - Corn will be N-stressed and ability of treatments to efficiently deliver N will be at a premium.
  - All treatments will receive the same N rate (except the unfertilized check).
- Treatments will be foliar Coron, foliar UAN, dribbled UAN, broadcast ammonium nitrate, and broadcast urea with Agrotain.

**New N products and N-enhancement products experiment.**
- Treatments will include standard N sources, urea + Agrotain, urea + Nutrisphere, ESN (coated urea), Nurea, Calcium ammonium nitrate, and possibly others.
- All treatments will be preplant surface-applied at the same N rate.

**Current status and importance of nitrogen management controversies:**
- Some corn belt states have recently adopted N rate recommendations which are sensitive to corn and N prices, but not to any specifics of the individual field.
- Other systems are being promoted for diagnosing the best N rate for each field.
- These two types of systems are nearly opposite in approach and should be tested against each other.
- There is increasing producer interest in foliar N applications to corn and whether these are more efficient than soil-applied N. Coron is a Helena product that is intended for foliar application; it is generating quite a bit of interest, and claims to have a 5:1 nitrogen efficiency advantage over 28% N.
- A wide array of new N fertilizers and N enhancement products has come on the market over the past few years. These all get a premium price above the already-high price of N fertilizer. Many producers wonder whether these products are worth the extra cost.

**Timetable:**

<table>
<thead>
<tr>
<th>Month</th>
<th>Activity</th>
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<tbody>
<tr>
<td>March 2008</td>
<td>Prepare experimental areas at Bradford Farm.</td>
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<tr>
<td></td>
<td>Acquire fertilizer materials and N-enhancement products.</td>
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<td>April 2008</td>
<td>Take preplant soil samples.</td>
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<td></td>
<td>Apply preplant N treatments.</td>
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<td></td>
<td>Plant corn.</td>
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<td>June 2008</td>
<td>Take sidedress soil samples.</td>
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<tr>
<td></td>
<td>Take reflectance and chlorophyll meter measurements.</td>
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<td></td>
<td>Apply sidedress treatments.</td>
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<td></td>
<td>Apply all treatments for foliar N efficiency experiment.</td>
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<tr>
<td>September 2008</td>
<td>Harvest plots.</td>
</tr>
<tr>
<td>Oct-Dec 2008</td>
<td>Analyze data.</td>
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<tr>
<td>Jan-Feb 2009</td>
<td>Progress report.</td>
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<tr>
<td>March 09-Feb 10</td>
<td>Repeat March 08-Feb 09</td>
</tr>
<tr>
<td>March 10-Dec 10</td>
<td>Repeat March 08-Dec 08</td>
</tr>
<tr>
<td>Jan-Feb 2011</td>
<td>Final report.</td>
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</table>
Jan-Feb 2011    Develop educational programs, present results at Extension meetings.

**Strategy for application/transfer of knowledge:**
- Written and oral (presentation) educational materials will be developed to promote understanding and application of results.
- Written materials will include newsletter articles and possibly guidesheets.
- Presentations will be used in Extension meetings, sent to regional Extension Agronomists for their use, and shared with anyone who requests them.

**Budget:**

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<th>Item</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
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<tbody>
<tr>
<td>Research Specialist 35% time</td>
<td>$15,000</td>
<td>$15,000</td>
<td>$15,000</td>
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<td>Benefits @ 30%</td>
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<tr>
<td>Soil sample analysis</td>
<td>200</td>
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<tr>
<td>Field supplies and fuel</td>
<td>800</td>
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<td><strong>Total year 1</strong></td>
<td><strong>$20,500</strong></td>
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<td>Total year 2</td>
<td><strong>$20,500</strong></td>
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<td>Total year 3</td>
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<td><strong>3-year total budget</strong></td>
<td><strong>$61,500</strong></td>
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Plant Sciences Division
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University of Missouri
Columbia, MO 65211

Research and Extension education interests
- developing, evaluating, and promoting tools to predict crop N needs, including variable-rate N management
- evaluating N management alternatives including source and timing
- minimizing environmental impacts of agricultural nutrients
- coordinated management of soil, fertilizer, and manure nutrients
- tailoring fertilizer and lime recommendations to account for soil properties
- economic comparisons of production alternatives

Education

<table>
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<tr>
<th>Degree</th>
<th>Date</th>
<th>Institution</th>
<th>Major</th>
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<tbody>
<tr>
<td>Ph.D.</td>
<td>May 1993</td>
<td>Virginia Polytechnic Inst. and State University</td>
<td>Crop &amp; Soil Environmental Sciences</td>
</tr>
<tr>
<td>M.S.</td>
<td>July 1988</td>
<td>Virginia Polytechnic Inst. and State University</td>
<td>Agronomy</td>
</tr>
<tr>
<td>B.S.</td>
<td>August 1982</td>
<td>University of Wisconsin</td>
<td>Biochemistry, Genetics</td>
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Recent Research Publications

Scharf, Peter C. and William J. Wiebold. Soybean yield responds minimally to nitrogen...
 Recent Extension Publications
Scharf, Peter. 2007. Flooded fields could come up short on nitrogen, MU specialist warns. Press release through MU Extension & Ag Information.
Scharf, Peter. 2007. New nitrogen fertilizer algorithm delivers the right rate for corn and lessens potential negative impact to the environment. Press release through MU Extension & Ag Information.