Cost-Effective N Management Using Reduced Rates of Polymer Coated Urea in Corn

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Objectives & Relevance:
Poorly drained soils are common in Missouri. Farmers with poor drainage have additional options for N management using polymer coated urea (Merchán Paniagua et al., 2005; Schwab et al., 2005). Polymer coated urea has been shown to reduce N₂O flux in plots with poor drainage (Merchán Paniagua et al., 2005). Performance of polymer coated urea has been equivalent to anhydrous ammonia in Northern Missouri (Motavalli et al., 2005) and less consistent in Central Missouri (Medeiros et al., 2005). Preliminary research in 2005 at Novelty has indicated polymer coated urea rates may be reduced up to 30% while maintaining corn grain yields similar to a 150 lb/a rate regardless of application timing (Figure 1). This may be a cost-effective management option for farmers to offset the cost of the polymer coating. In addition, incentive payments through the Conservation Security Program are available for qualified producers using products such as polymer-coated urea.

The objectives of this study are to: 1) evaluate yield response of no-till corn with reduced rates of polymer coated urea compared with non-coated urea at different application timings, 2) determine the interaction between application timing and N source on ammonium-N and nitrate N in the soil profile, and 3) assess the impact of application timing and placement on polymer coated urea degradation.

Procedures:
- **Objective 1**: Evaluate yield response of no-till corn with reduced rates of polymer coated urea compared with non-coated urea at different application timings.

  A field trial with four replications will be established at the Greenley Research Center, adjacent to the North Fork Salt watershed, to evaluate crop response to polymer coated urea compared to non-coated urea at 0, 50, 100, and 150 lbs N/acre. Application timings will include an early preplant (one month prior to corn planting), at planting (broadcast applied after planting), and broadcast sidedress (1-2 ft corn) treatments. An untreated and standard
anhydrous treatment at 150 lbs N/acre will be included as a control. A gross margin will be calculated each treatment to compare relative returns.

- **Objective 2:** Evaluate the interaction between application timing and N source on ammonium-N and nitrate-N in the soil profile.

  The field trial in Objective 1 will be monitored for ammonium-N and nitrate-N at three timings throughout the season (first rainfall after the sidedress timing, prior to silking, and black layer) and throughout the profile at four incremental depths (0-5, 6-10, 11-15 and 16-20 inches). The untreated control and 150 lb N/a rates of polymer coated urea, urea alone, and anhydrous treatments will be intensively monitored to accomplish this objective.

- **Objective 3:** Determine the impact of application timing and placement on polymer coated urea polymer degradation and N availability.

  A field study will utilize buried bags to evaluated degradation of the polymer-coated urea to determine N release throughout the growing season. This method has been utilized in wheat research on poorly drained soils (Schwab et al., 2005) and potato research on sandy soils (Rosen and McNearney, 2005), but N release has not been evaluated on poorly-drained soils for corn planted in different residues common in Missouri. This study will include a factorial arrangement of 3 residues (no-till wheat stubble with red clover, no-till soybean residue, and reduced till soybean residue), 3 application depths (surface applied, 2 inch depth, and 4 inch depth), 3 application timings (March, April, and May), and 5 removal timings (April, May, June, July, and black layer). Each treatment will be replicated three times. A nylon window screen packet will be constructed for each treatment. Each screen packet will hold approximately 10 grams of polymer coated urea. Packets will be recovered from each treatment, washed with ice water, dried and stored in a freezer until final weights of all packets can be determined. An on-site weather station will be utilized to determine environmental differences between systems.

**Current status and importance:**

Availability of ammonium nitrate and anhydrous may be limited in the future. The slow-release properties of polymer coated urea have appealing characteristics for corn producers in watersheds with the potential of surface water runoff or soils with high leaching potential (Rosen and McNearney, 2005). Placement of polymer coated urea has demonstrated improved utility and yield of potato in Wisconsin (Rosen and McNearney, 2005) and corn in Minnesota (Randall, unpublished) compared to other N sources. Finally, incentive payments through the Conservation Security Program were available to producers in Missouri utilizing coated urea technology. This could impact over 1.8 million acres in qualified watersheds (NRCS, 2005). Recently, N prices have increased dramatically while corn prices have decreased. A polymer coating may increase cost of N up to $0.11/lb; therefore, reduced rates of polymer coated urea need to be evaluated to balance the additional cost of the coating while maintaining the yield potential of corn. However, no published research has evaluated the release of the polymer coated urea for corn in field experiments on poorly drained soils. No research has evaluated degradation as affected by residue, tillage, or placement in the soil. No published research has
reported the effects of reduced rates of polymer coated urea and determined the interaction with application timing as a cost-effective method to reduce N application rates.

**Timetable:**

<table>
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<tr>
<th>Time Period</th>
<th>Description</th>
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<tr>
<td>February-May 2006</td>
<td>Prepare treatments, plot preparation, and burial treatment preparation</td>
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<tr>
<td>April-September 2006</td>
<td>Manage plots, apply treatments, and soil sample</td>
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<tr>
<td>September 2006</td>
<td>Harvest and resample soil</td>
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<tr>
<td>Oct-Dec 2006</td>
<td>Analyze and summarize results</td>
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<tr>
<td>2007</td>
<td>Repeat 2006 procedures</td>
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</table>

**Strategy for application/transfer of knowledge:**

Transfer of knowledge will be mainly via written and oral educational programs, including press releases, newsletter articles, radio interviews, television interviews, and conferences. On-site field days will provide a forum for farmers and agriculture professionals to learn about on-going research results.

**References:**


Budget:

Salaries and fringe benefits........................................................................................................14,000
Supplies ..................................................................................................................................3,200
Presentations, publications, and documentation .......................................................................500
Soil processing and analysis ......................................................................................................1,000
2006 Total ..................................................................................................................................18,700

Salaries and fringe benefits ........................................................................................................14,000
Supplies ..................................................................................................................................3,200
Presentations, publications, and documentation .......................................................................500
Soil processing and analysis ......................................................................................................1,000
2007 Total ..................................................................................................................................18,700

2-year Total .................................................................................................................................$37,400

Budget narrative:

Salaries and fringe benefits: Funds are requested for partial support of a research technician and
temporary summer worker.
Supplies: Covers cost sample containers, fertilizer, seed, plot preparation, planting, weed control
harvesting, flags, and other field supplies and operations.
Presentations, publications, and documentation: This will help defray cost of publication and
documentation of results and conclusions as well as travel and board for one researcher to attend
a professional conference for presentation of results.
Soil processing and analysis: Analysis of nitrate-N and ammonium will cost $7/sample.
Resume of KELLY A. NELSON

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EDUCATION:  
Ph.D.  Weed Science, Dep. of Crop and Soil Sci., Michigan State University, May 2000  
M.S.  Weed Science, Dep. of Crop and Soil Sci., Michigan State University, May 1997  
B.S.  Plant Science, Dep. of Agronomy, University of Missouri-Columbia, May 1995

PROFESSIONAL EXPERIENCE:  
University of Missouri, Novelty, MO.  June, 2000 to present.  Research Agronomist and Assistant Professor.  

PUBLICATIONS:  
Refereed Publications


Other Publications
2004: 10 abstracts, 2 proceedings, 33 bulletin/reports, and 14 invited presentations.
2003: 8 abstracts, 1 fact sheet, 21 bulletin/reports, 8 invited presentations, and 1 CD-ROM published interview.
2002: 3 abstracts, 8 fact sheets, 1 newsletter article, 15 bulletin/reports, 8 invited presentations, and 1 video.
2001: 1 abstract, 2 fact sheets, 8 bulletin/reports, and 4 invited presentations.
2000: 1 abstract, 1 fact sheet, 1 newsletter article, 1 bulletin/report, and 1 invited presentation.

**Professional Activities:**
American Society of Agronomy
Crop Science Society of America
Weed Science Society of America
North Central Weed Science Society of America

**Awards:**
2005: Gamma Sigma Delta Outstanding Junior Faculty Award
Resume of PETER P. MOTAVALLI

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EDUCATION:

Ph.D., 1989, Soil Fertility and Plant Nutrition  
M.S., 1984, Soil Fertility and Plant Nutrition  
B.S., 1982, Agronomy  
B.S.F.S., 1978, Foreign Service  
Cornell University, Ithaca, NY  
University of Wisconsin, Madison, WI  
University of Wisconsin, Madison, WI  
Georgetown University, Washington, DC

RESEARCH, EXTENSION AND TEACHING EXPERIENCE:

University of Missouri, Columbia, MO (Mar., 1999 – present). Associate Professor of Soil Nutrient Management in the Dept. of Soil, Environmental and Atmospheric Sci., School of Natural Resources.

University of Guam, Mangilao, GU (Aug., 1994 – Mar., 1999). Associate Professor of Soil Science in the Agricultural Experiment Station, College of Agriculture and Life Sciences.


SELECTED PUBLICATIONS

Articles in Journals:


Extension Publications:


Motavalli, P.P., K. Nelson, G. Stevens, A. Kendig, M. Nathan, and D. Dunn. 2004. Selection of foliar-applied potassium fertilizer sources and rates of application to optimize soybean


PROFESSIONAL ORGANIZATIONS:

Soil Science Society of America
American Society of Agronomy
Ecological Society of America

AWARDS AND FELLOWSHIPS:

1978 - Phi Beta Kappa
1978 - 1979 Fulbright-Hays Fellowship, Khartoum, Sudan
1998 Faculty Award for Excellence in Research, University of Guam
2003 Junior Faculty Research Award, Gamma Sigma Delta, Univ. of Missouri