Enhanced Efficiency Liquid N Applications for Corn

Investigators:
Kelly Nelson, Div. of Plant Sciences, Univ. of Missouri, Novelty, MO
Peter Motavalli, Dept. of Soil, Environ., and Atmos. Sci., Univ. of Missouri, Columbia, MO
Bruce Burdick, Div. of Plant Sciences, Univ. of Missouri, Albany, MO

Objectives and Relevance:
Corn production in Missouri has averaged approximately 2.9 million acres since 2004 with a value of $1.2 billion in total production (NASS, 2009). High yield corn production systems have integrated fungicide applications to maximize photosynthetic efficiency of the plant to meet the growing food, fuel, and fiber demands. Plant growth stimulation with the strobilurin fungicides has been related to a reduction in the incidence of disease as well as increased nitrate uptake and assimilation in small grains (Köhle et al., 2002). Research has shown that pyraclostrobin was important in stimulating nitric oxide, a key messenger in plants (Conrath et al., 2004). Increased nitrate uptake and assimilation following an application of a strobilurin fungicide would justify additional nitrogen fertilizer at the time of application to corn. Identifying fertilizer sources that synergistically increase yield with a fungicide treatment would provide opportunities to manage disease, reduce application costs, and provide additional fertilizer when crop demand is greatest. In 2008 and 2009, N loss limited grain production in several production fields. Research in 2004 and 2005 evaluated rescue N applications for corn (Nelson et al., 2010). Late applications were beneficial for restoring yield; however, liquid N applications reduced yield when broadcast applied from 2 to 4 ft tall corn.

Over the past two years, commercially available liquid fertilizers were evaluated for corn grain yield response (Nelson et al., 2009). Products were identified that consistently increased corn grain yield. Nitamin (30-0-0), slowly available N from triazone and methylene urea, at 1 gallon/acre increased yields 28 bu/acre at four of the six site years. When Nitamin was combined with Headline at 6 oz/a, there were inconsistent yield responses. Other research evaluated rates of Nitamin up to 4 gallon/acre with and without Headline in 2008 and 2009 (Figure 1) (Nelson and Meinhardt, 2009). Combinations with Headline at 6 oz/acre were similar to this research; however, a reduced rate of Headline (3 oz/acre) with Nitamin at 1 gal/acre synergistically increased yield 26 bu/acre particularly when Headline was added to the spray mixture first followed by Nitamin. A rate response to Nitamin alone increased yield 2 bu/lb of applied N. Research is needed to confirm the effect reduced rates of Nitamin and Headline as well as the efficiency of this N source for late applications in corn. Recommended rates could be correlated with SPAD leaf readings at the time of application which would provide N rate recommendations at the time of fungicide application.

The objectives of this research are to:
1. Validate the effect of mixing order of an enhanced efficiency liquid N rates with a preventative fungicide, and
2. Provide foliar liquid fertilizer recommendations based on SPAD readings at silking.
Figure 1. Grain yield response to Nitamin rates with and without Headline at 6 oz/acre or 3 oz/acre plus nonionic surfactant at 0.25% v/v in 2008 (A) and 2009 (B). The LSD ($P < 0.05$) was 18 and 14 in 2008 and 2009, respectively. Mixing order is the sequence listed in the legend.

Procedures:

- The study will be arranged as a randomized complete block design with six replications at each site. Foliar fertilizer and fungicide treatments will be applied with a CO$_2$ propelled hand boom at 3 gal/acre. There will be two overhead irrigated sites (Novelty and Albany) each year.

- Three-factor factorial study. Factorially establish N response differences using four different preplant rates of N fertilizer (0, 75, 150, and 300 lbs N/a) with three Nitamin rates (0, 1, and 3 gal/acre) and the presence or absence of Headline at 3 or 6 oz/a either added first or following the addition of Nitamin to the spray mixture. Foliar applications will be made when the corn is silking (VT).

- Corn injury from 0 (no visual crop injury) to 100% (complete crop death) will be evaluated 7 and 14 days after treatment (DAT) based on the combined visual effects of N source on necrosis, chlorosis, and stunting.

- The incidence of foliar disease will be rated on a scale of 0 (no disease) to 100% (complete infestation) 28 and 42 DAT.

- A Minolta chlorophyll meter (SPAD-502) will be used to determine ear leaf greenness differences among treatments at the time of application. The effect of enhanced efficiency liquid N on grain yield will be correlated with the SPAD readings.

- The center two rows will be harvested for yield and converted to 15% moisture prior to analysis.
**Current Status and Importance of Research:**
In years when N fertilizer loss has been suspected, a late application of reduced rates of the N fertilizer and fungicide has increased yield 26 bu/acre depending on the mixing order. Enhanced efficiency liquid N application has shown that yield increased 2 bu/acre for every pound of applied liquid N when the fertilizer was applied alone. The yield response appears to be related to the mixing order of the fertilizer additive. A clear understanding of these interactions is needed to help farmers make an informed decision on the utilization of such pesticide/fertilizer combinations.

**Expected Economic Impact:**
An aerial application of liquid N additive plus fungicide cost farmers approximately $37/acre in 2009. Recommending the fertilizer additive alone, fungicide alone, or a reduced rate of the fungicide plus fertilizer would save farmers from $10 to 17/acre. Understanding when an additive and/or fungicide is needed and the expected returns is essential for recommending an enhanced efficiency liquid N fertilizer as part of an integrated crop management system. Basing enhanced efficiency liquid N fertilizer applications on SPAD readings at silking will help in the decision making process to include or exclude a fertilizer additive and help determine an economical rate of the additive.

**Timetable:**
- Feb., 2010: Assemble products for treatments
- April, 2010: Plant research trial and apply response treatments at both locations
- July, 2010: Apply foliar fertilizer and fungicide treatments, SPAD readings, rate incidence of disease.
- Sept.-Dec., 2010: Harvest experiments and analyze results
- Feb., 2011-Dec., 2011: Repeat same trial as in 2011

**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:**
### Proposed Budget:

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<th>CATEGORIES</th>
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<tr>
<td>A. Salaries</td>
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Budget narrative:

*Salaries and fringe benefit* funds are requested for partial support of a research technical support and/or graduate research assistant.

*Presentations, publications, and documentation* will help defray cost of publication and documentation of results and conclusions as well as assist travel and board for presentation of results.

*Equipment use and maintenance* will help defray machinery use and maintenance costs associated with field research.

*Other Direct Costs:* Covers cost of analysis, sample containers, fertilizer, seed, plot preparation, planting, weed control harvesting, flags, and other field supplies and operations.
RESUME. OF KELLY A. NELSON

Research Agronomist and Associate Professor
Division of Plant Sciences
Greenley Memorial Research Center
University of Missouri
P.O. Box 126, Hwy 156 E
Novelty, MO 63460

Tel: (660) 739-4410
Fax: (660) 739-4500
Email: nelsonke@missouri.edu
http://aes.missouri.edu/greenley/research/index.htm

EDUCATION
• M.S. Crop and Soil Sciences, Dep. of Crop and Soil Sci., Michigan State Univ. (1997)
• B.S. Plant Science, Dep. of Agronomy, Univ. of Missouri (1995)

APPOINTMENTS
• Research Agronomist & Associate Professor, Univ. of Missouri, Novelty, MO (2007-present)
• Research Agronomist & Assistant Professor, Univ. of Missouri, Novelty, MO (2000-2006)
• Teaching Assistant, Michigan State Univ., East Lansing, MI (1996)

OTHER EXPERIENCE
• Research Technician, Ciba Crop Protection, Lee's Summit, MO (1994)
• Integrated Pest Management, Gypsy Moth Technician, Univ. of Missouri, Columbia, MO (1992)
• Crop and Livestock Production Assistant, Nelson Farms, Skidmore, MO (1980-1995)

HONORS AND AWARDS
• ASABE Blue Ribbon Award, Circular Publication, Questions and answers about drainage water management for the Midwest, American Society of Agricultural and Biological Engineers (2007)
• Junior Faculty Award, Gamma Sigma Delta, Honor Society of Agriculture (2005)

SCHOLARLY SOCIETIES
• Sigma Xi
• Gamma Sigma Delta
• Honor Society of Phi Kappa Phi
• Golden Key National Honor Society
• Phi Eta Sigma Honor Society

PROFESSIONAL ORGANIZATIONS
• American Society of Agronomy
• Crop Science Society of America
• Weed Science Society of America
• North Central Weed Science Society of America
SERVICE
- North Central Regional Drainage Committee (NCR-207) (2003-present); Secretary 2008-2009; Chair 2009-2010
- Missouri Agriculture Leaders of Tomorrow Class XIII (ALOT) (2008-present)
- Missouri Livestock Symposium Committee (2001-present)
- Manuscript reviewer for eight peer-reviewed journals (2000-present)
- North Central Weed Science Society (1996-present); Membership Committee Chair (2006-2008)
- Weed Science Society of America (1996-present); Extension Committee(2001-2003)
- Missouri Wind Resources (2006-present)

PUBLICATIONS:


Resume of PETER P. MOTAVALLI

Associate Professor, Soil Nutrient Management
Dept. of Soil, Environmental and Atmospheric Sci.
School of Natural Resources
University of Missouri-Columbia
302 ABNR Bldg.
Columbia, MO 65211 USA

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


PROFESSIONAL ORGANIZATIONS:

Soil Science Society of America
American Society of Agronomy

SELECTED AWARDS AND FELLOWSHIPS:

2000 - present Adjunct Assistant Professor, Division of Plant Sciences, Univ. of Missouri
2001 - 2006 Member of Editorial Board, Journal of Plant Nutrition
2002 - 2003 New Faculty Teaching Scholar, University of Missouri
2003 Junior Faculty Research Award, Gamma Sigma Delta
2003 Chair of USDA Regional Committee on Soil Organic Matter (NCR 59)
2004 Outstanding Teaching Award, CAFNR, Univ. of Missouri
2004 Chair of Environmental Quality Division (A-5), Amer. Soc. of Agronomy
Resume of Bruce Burdick

Professional Experience

University of Missouri 2001-2007

Superintendent, Hundley Whaley Research Center, Albany, MO 2003-2007

Responsible for the management of the center research and operations. Serves as the principal investigator on research projects on the center. Projects have included soil fertility, seed traits, variety testing, herbicide testing, and other corn and soybean agronomic studies.

Research Associate / Project Manager 2001-2003

Designed and implemented field trials evaluating yield and other agronomic traits of potential transgenic corn lines. Located and secured cooperators and subcontractors throughout the United States to conduct studies. Monitored status of each site throughout the year.


Senior Field Biologist, 1995-2000
Senior Technical Development Representative 1990-1995
Senior Market Development Representative, 1985-1990
Market Development Representative, 1981-1985

Provided technical support and training in $40 million five state Midwest sales region. Generated new product research and development, together with discovery and expansion of new marketing areas for existing product line. Selected activities included data analysis and summarization, technical information writing, technical presentations to growers and industry professionals, complaint and contract research negotiations, field trial design and implementation, small plot research and large scale sales demonstrations.