Objectives & Relevance:
Corn acreage has increased over 25% in Missouri and total acreage in the U.S. increased nearly 10 million acres over 2006. High yield corn production systems have integrated fungicide applications to maximize photosynthetic efficiency of the plant. Over the past four years, median corn yields for 16 site/years increased over 8 bu/acre with a strobilurin fungicide such as pyraclostrobin (Headline®) (Nelson and Smoot, 2007). The greatest yield increases due to fungicide applications have occurred in high yield environments.

Research has established a link between plant nutrition and disease incidence including the disease suppressing effects of K, Cl, Mn, B, and P (Fixen et al, 2004). Combining a foliar fertilizer with a fungicide application may reduce application costs, improve disease suppression and nutrient response, and increase flexibility in managing crop response to environmental conditions during the growing season. No published research has evaluated interactions between fungicides and foliar fertilizers on corn. No research has been published on the effects of fungicide treatments on corn plant nutrient levels in the field.

The objective of this research is to evaluate improvements in yield and monitor nutrient uptake of a foliar fertilizer-fungicide management system for corn.

Procedures:
- A two-year field trial will be conducted under sprinkler irrigation to assess corn response to fungicide-fertilizer treatments at Novelty, Portageville, and Albany. The sprinkler irrigation will provide a high yield environment and a higher potential for greater disease incidence.
- Previous research evaluated soybean response to numerous fertilizer sources (Nelson et al., 2004). Simultaneous corn research conducted in 2005 and 2006 determined fertilizer rates that caused less than 1% visual injury when applied at the V3-V4 stage of development (Nelson, unpublished). The following treatments and rates were selected for this research based on previous experience and locally available foliar fertilizers used on corn in combination with fungicide treatments in 2007: 3-18-18 at 2 gal/acre, 0-0-30 at 2 gal/acre, potassium thiosulfate at 1 gal/acre, potassium thiosulfate plus urea triazone at 1 gal/acre, potassium chloride at 13 lb/acre, 28-0-0 controlled release nitrogen as methylene urea and diurea with less than 0.01% Cl at 2 gal/acre, 24-0-1-0.6 slow release N with 0.25% B at 3 gal/acre, 22-0-2-1 with 0.25% B at 1 gal/acre, and 6-0-0 with 10% Ca at 1.25 gal/acre.
- The study will be arranged as a randomized complete block design with four replications. Treatments will consist of a factorial arrangement of foliar fertilizers combined with and without the fungicide pyraclostrobin (Headline®) at 6 oz/acre applied at silking. These treatments will be applied with a CO₂ propelled hand boom at 5 gallons/acre to simulate airplane application. The carrier for the foliar treatments will be water and all equipment is currently available to the researchers.
• Leaf injury and incidence of disease will be rated after application.
• Analysis of corn ear leaf tissue will be used to monitor the nutrient status of the plant.
• The ear leaf tissue status of the fungicide-treated and untreated plants will be intensively monitored at one location from the time of application until black layer to build background information to target synergistic foliar nutrient applications.
• The center two rows will be harvested for yield and moisture converted to 15% prior to analysis. Grain samples will be collected. Grain protein, oil and starch will be determined using NIR spectroscopy.

Current status and importance:
Fungal infections decrease the area of photosynthetic tissue which reduces the transfer of assimilates from their source to the ear and diverts them to fungal growth, defense systems, and increased respiration. 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., unpublished). 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 fertilizer at the time of application. 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.

Current research has evaluated the interaction between the strobilurin fungicide pyraclostrobin (Headline) and a common liquid fertilizer used in turfgrass (NutriCal®) used to supply Ca and N (Figure 1). The goal of this research was to provide additional N during a period of increased N uptake and provide Ca, a secondary messenger, induced by pathogenic infection, mechanical injury, ABA, IAA, and light (Marschner, 1995) with a fungicide and determine the effect on corn yield. Headline increased corn grain yields 16 and 19 bu/acre in 2006 and 2004, respectively (Figure 1). Preliminary research indicated that corn yield increased 26 bu/acre in 2006 when 6-0-0 was tank mixed with Headline; however, yield was reduced as rates of 6-0-0 were increased to 2.5 and 5 gallon/acre (Nelson, unpublished).

There was a dramatic increase in the use of strobilurin fungicides in corn in 2007; however, no research has evaluated interactions between fertilizer sources and a fungicide treatment. This research will help Missouri farmers make informed decisions regarding fungicide-fertilizer interactions and how these applications affect productivity and profitability.

Expected economic impact of the project:
High yield environments may have the greatest risk of disease and have demonstrated substantial yield increases with fungicide treatments. In a high yield environment (2004), corn grain yields increased over 20 bu/acre with a fungicide treatment alone. Integrating pest management strategies and nutrient management is a cost-effective utilization of custom application equipment. The current cost of fertilizers would allow farmers to improve nutrient use efficiency using a foliar application approach especially at a critical time of corn development. This research will directly impact the fertilizer, custom applicator, and corn industries in the state. A 10% adoption on 3.4 million acres of corn could increase returns over $15 million.
Figure 1. Corn grain yield response to 6-0-0 with 10% Ca tank mixed with Headline at 6 oz/acre. The non-treated control grain yield was 240 and 140 bu/acre in 2004 and 2006, respectively. LSD values (P = 0.1) in 2004 and 2006 were 16 for each year (Nelson, unpublished).

**Timetable:**

- Feb., 2008: Assemble products for treatments
- April, 2008: Plant research trial
- July, 2008: Apply foliar fertilizer and fungicide treatments, harvest ear leaf samples, rate incidence of disease.
- Sept.-Dec., 2008: Harvest experiments and analyze plant tissue samples
- Nov.-Dec., 2008: Analyze research results
- Feb., 2009-Dec., 2009: Repeat same trial as in 2008

**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* ................................................................. 13,000

*Presentations, publications, travel, and documentation* ........................................... 500

*Supplies* ................................................................................................. 4,900

*Tissue sample processing and analysis* ................................................................. 5,000

2008 Total ........................................................................................................... 22,400

*Salaries and fringe benefits* ................................................................. 14,000

*Presentations, publications, travel, and documentation* ........................................... 1000

*Supplies* ................................................................................................. 4,900

*Tissue sample processing and analysis* ................................................................. 5,000

2009 Total ........................................................................................................... 24,900

2-year Total........................................................................................................... $47,300

Budget narrative:

*Salaries and fringe benefits:* Funds are requested for partial support of a research technical support and temporary summer workers.

*Presentations, publications, and documentation:* This will help defray cost of publication and documentation of results and conclusions as well as assist travel and board for one researcher to attend a professional conference for presentation of results.

*Supplies:* Covers cost of sample containers, fertilizer, seed, plot preparation, planting, weed control harvesting, flags, and other field supplies and operations.

*Tissue sample analysis:* Ear leaf nutrient analysis.

- Regular tissue analysis for N, P, K, Ca, and Mg for all treatments and all 3 locations, 10 days after application
- Complete tissue analysis + Cl, 3 reps, weekly sampling of the non-treated control and fungicide only treatment at Novelty
Resume of KELLY A. NELSON

University of Missouri Greenley Research Center
P.O. Box 126, Hwy 156 E
Novelty, MO 63460
Phone: 660-739-4410 or 660-216-8394  Fax: 660-739-4500
E-mail: nelsonke@missouri.edu

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
Associate Professor.
Assistant.
Trapper.

PUBLICATIONS:


Fang, M., P.P. Motavalli, R.J. Kremer, and K.A. Nelson. 2007. Assessing changes in soil
microbial communities and carbon mineralization in Bt and non-Bt corn residue-amended soils.

and soybean (Glycine max L.). Weed Technol. 21:186-190.

management in corn (Zea mays) and soybean (Glycine max) and the impact on soybean cyst
nematode (Heterodera glycines) egg population densities. Weed Technol. 20:965-970.


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

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

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FAX: (573) 884-5070
E-mail: motavallip@missouri.edu

EDUCATION:

Ph.D., 1989, Soil Fertility and Plant Nutrition
Cornell University, Ithaca, NY
M.S., 1984, Soil Fertility and Plant Nutrition
University of Wisconsin, Madison, WI
B.S., 1982, Agronomy
University of Wisconsin, Madison, WI
B.S.F.S., 1978, Foreign Service
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 WILLIAM E. (GENE) STEVENS

EDUCATION

Mississippi State University PhD 1992 Agronomy
University of Tennessee-Knoxville M.S. 1982 Plant and Soil Science
Union University B.S. 1979 Biology and Journalism

EMPLOYMENT AND PROFESSIONAL EXPERIENCE

1994-Present  Crop Production Specialist, Plant Science Div., University of MO, Columbia, MO
1990-1994  Soil Scientist, Agronomy, MS State University/Crop Simulation, Starkville, MS.
1984-1990  Research Associate, North MS Branch Expt. Station, Holly Springs, MS

SERVICE AND AWARDS

2002-Present  Rice Technical Work Group, Executive Committee
2002-Present  MU-CAFNR, Chairman, Professional Track Faculty Committee
2006-Present  MU-Plant Science Division, Promotion and Tenure Committee
2007  Co-chair Southern Plant Nutrition Planning Committee
2006  Pyeontaek, South Korea Agricultural Assessment Team
2001  Innovation in Agribusiness Award, Monsanto Company
1998  Conservation Partnership Award, Natural Resource Conservation Service

PUBLICATIONS DURING THE LAST FIVE YEARS


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, implemented, and monitored 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.
Resume of Laura E. Sweets

Laura Elizabeth Sweets

October 2007

Business Address:
University of Missouri
108 Waters Hall
Columbia, MO  65211
573-884-7307

Professional Positions:
Extension Associate Professor  July 2001 to date
University of Missouri
Columbia, Missouri

Extension Assistant Professor  1995 to 2001
University of Missouri
Columbia, Missouri

Plant Pathologist/Senior Scientist  1990 to 1995
Ag Research
Pillsbury/Green Giant
LeSueur, Minnesota

Associate Professor/Extension Plant Pathologist  1980 to 1984
Iowa State University
Ames, Iowa

Extension Assistant/Director, Plant Disease Clinic  1974 to 1980
Research Assistant
University of Minnesota
St. Paul, Minnesota

Education:
Ph.D. University of Minnesota, 1981
Major: Plant Pathology
Supporting Program: Agronomy, Botany and Entomology
Thesis: Study of Potato Storage Rot Microorganisms
M.S. University of Minnesota, 1977
Major: Plant Pathology
Supporting Program: Microbiology and Biochemistry
Thesis: The Effect of Environmental and Nutritional Factors on the Mycelial Growth of Typhula incarnata and Typhula ishikarienis
B.A. Carleton College, Northfield, Minnesota, 1974
Major: Biology
**Professional Awards:**

- Burch Extension Award, University of Missouri, April 2002
- Meritorious Service Award, University Extension, Iowa State University, November 1990

**Relevant Grant Support:**

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