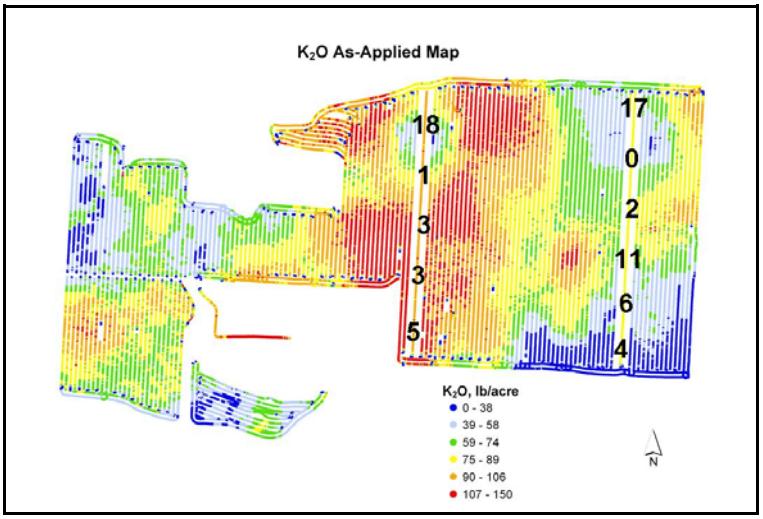
Yield response to P & K fertilizers over landscapes

Peter Scharf and Kent Shannon
University of Missouri, Plant Sciences Division and MU Extension

Objective & Relevance:
The objective of this project is to measure grain crop yield response to P and K over landscapes and identify factors that favor response. Soil tests are currently used as the main tool to predict response, but we know that many other factors are involved.

This project is relevant to Missouri agriculture because fertilizer is a major crop input whose price has fluctuated dramatically in recent years. Adequate P and K nutrition is crucial for optimizing yields, but unneeded applications have negative effects on profitability and on the environment. Currently soil testing is the main (and nearly the only) tool for targeting applications of P and K fertilizer. We think we can Widely available yield monitoring technology will allow us to work with producers to measure crop response to P and K and identify the factors contributing to that response.

Procedures:
- We will target working with three producers each year.
- An effort will be made to work with producers in different regions of the state in order to make results applicable to different regions.
- Our basic procedure will be to install field-length strips with and without P & K fertilizer, then analyze yield monitor data to quantify and localize the yield responses to P & K.
- We have tried this at the pilot scale with a single producer this year. In this case P and K were placed in a subsoil band in February, but four strips were left with no P or K (see field map below). Colored areas show where P & K were applied, and the four white strips are the ones left without P & K. Strips were 16 rows wide. Corn yields in this field were excellent for the Nevada area, averaging over 160 bushels/acre.
- By subtracting yield with P & K from yield in the adjacent strip(s) without P & K, we can measure yield response to P & K. Numbers on the field map indicate corn yield response to P & K (in bushels/acre).
- Responsive areas at the north end of the field were not different in yield, pH, or soil test P or K from non-responsive areas.
- A soils map shows that the soils in the responsive areas were derived from sandstone, while soils in the rest of the field were derived from shale.



Current status and importance of P & K response over landscapes:

- Soil testing is currently used as nearly the only variable to predict where fertilizer response will occur.
- We know from the calibration research on which the soil tests are based that the range of possible yield responses is wide within each soil test category.
- We also know that there are other factors influencing nutrient availability to crops, including water relations, soil oxygen, mineral content of the soil, soil organic matter, soil pH, root growth, and so on.
- Measuring response over a range of landscapes should help us to identify which of these other factors are important in determining crop response to P and K.

Timetable:

February 2010	Locate cooperating producers. Plan side-by-side strips with and without P & K.
March 2010	Apply side-by-side strips with and without P & K.
April-May 2010	Plant corn or soybean.
June-July 2010	Scout field trials, take notes and photos. Note GPS locations of any important notes or photos.
Sept-Oct 2010	Harvest.
Nov-Dec 2010	Analyze data, identify locations of significant yield response and factors that differentiate them from non-responsive areas.
December 2010	Progress report.
Feb ‘11-Dec ‘11	Repeat Feb ‘10-Dec ‘10 tasks
December 2011	Final report.
Jan-Feb 2012	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 and farm press 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.
- Results will be posted on the University of Missouri Nutrient Management website

Budget:

Category	Amount budgeted in:	
	2010	2011
labor and benefits for setup and scouting	$6000	$6000
labor and benefits for data analysis	8000	8000
field supplies and fuel	1000	1000
TOTAL	$15,000	$15,000

2-year total budget **$30,000**

Peter Clifton Scharf

Professor and Nutrient Management Specialist
Plant Sciences Division
210 Waters Hall
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

Degree	*Date*	*Institution*	*Major*
Ph.D.	May 1993	Virginia Polytechnic Inst. and State University	Crop & Soil Environmental Sciences
M.S.	July 1988	Virginia Polytechnic Inst. and State University	Agronomy
B.S.	August 1982	University of Wisconsin	Biochemistry, Genetics

Recent Research Publications

Scharf, P.C., and J.A. Lory. 2009. Calibrating reflectance measurements to predict optimal sidedress nitrogen rate for corn. Agron. J. 101:615-625.

Williams, J.D., N. R. Kitchen, P. C. Scharf, and W. E. Stevens. 2009. Within-field nitrogen response in corn related to aerial photograph color. Online. Precision Agric. DOI 10.1007/s11119-009-9137-x.

Hong, N., P.C. Scharf, J.G. Davis, N.R. Kitchen, and K.A. Sudduth. 2007. Economically optimal nitrogen rate reduces residual soil nitrate. J. Environ. Qual. 36:354-362.

Scharf, P.C., N.R. Kitchen, K.A. Sudduth, and J.G. Davis. 2006. Spatially variable corn yield is a weak predictor of optimal nitrogen rate. Soil Sci. Soc. Am. J. 70:2154-2160.

Cromley, S.M., W.J. Wiebold, P.C. Scharf, and S.P. Conley. 2006. Hybrid and planting date effects on corn response to starter fertilizer. Online. Crop Management doi:10.1094/CM-2006-0906-01-RS.

Scharf, P.C., S.M. Brouder, and R.G. Hoeft. 2006. Chlorophyll meter readings can predict nitrogen need and yield response of corn in the north-central U.S. Agron. J. 98:655-665.

Scharf, Peter C., Newell R. Kitchen, Kenneth A. Sudduth, J. Glenn Davis, Victoria C. Hubbard, and John A. Lory. 2005. Field-scale variability in optimal N fertilizer rate for corn. Agron. J. 97:452-461.

Recent Extension Publications

Scharf, Peter and John Lory. 2006. Best Management Practices for nitrogen fertilizer in Missouri. 12 p. MU Extension publication IPM1027.

Lawton, Kurt. 2009. Does this stuff really work? Progressive Farmer January 2009 p. PF-1 to PF-2. Using information from Peter Scharf.

Hoskins, Tim. 2008. Aerial survey estimates crop losses due to nitrogen deficiency. Iowa Farmer Today, Dec. 17, 2008. Using information from Peter Scharf. This story also ran in Farm & Ranch Guide and in Tri-State Neighbor.

Lory, John, and Peter Scharf. Managing high phosphorus prices. Integrated Pest & Crop Management 18:113.

Morrison, Liz. 2008. Extend Your N: 15 Tips For Improving Your Nitrogen ROI. Corn & Soybean Digest, Sept. 1, 2008. Using information from Peter Scharf.

Lory, John and Peter Scharf. 2008. Rescue nitrogen applications on corn can still be profitable. Integrated Pest & Crop Management 18:80.

Scharf, Peter. 2008. Soil samples show nitrogen loss. Integrated Pest & Crop Management 18:74.

Scharf, Peter. 2008. Nitrogen loss scoresheet. Integrated Pest & Crop Management 18:68.

Lory, John and Peter Scharf. 2008. Is my nitrogen still there? Integrated Pest & Crop Management 18:27,35.

Scharf, Peter and David Dunn. 2008. Nitrogen loss in wheat. Integrated Pest & Crop Management 18:22,25.

Scharf, Peter. 2008. Nitrogen prices through the roof again. Integrated Pest & Crop Management 18:25.

Scharf, Peter and David Dunn. 2008. Potential for N loss with heavy rains on wheat. Mid-America Farmer Grower, March 25, 2008, p. 13.

Oltman, Brian. 2008. Wheat N timing. Ag Professional, Jan. 2008. Using information from Peter Scharf.

D. Kent Shannon

Work Address	Home Address
1012 N. Highway UU	12901 East Hwy FF
Columbia, MO 65203	Centralia, MO 65240
573-445-9792	573-682-9990

SUMMARY OF QUALIFICATIONS

- Have a practical knowledge of agricultural production.
- Have developed educational programs with the goal of improving agricultural profitability.
- Have a good ability to work with others.
- Take pride in a job well done.
- Willing to learn, so as to broaden my knowledge as an agricultural engineer.

RELEVANT EXPERIENCE

Helped Missouri citizens turn knowledge into know-how as a Regional Extension Agricultural Engineering Specialist.

Served as Associate Director of the Missouri Precision Agriculture Center.

Worked along with my dad and brother on the family farm.

EMPLOYMENT HISTORY

2008 to present	University of Missouri Extension Natural Resource Engineering Specialist, University of Missouri System-Boone County, Columbia, Missouri
1998 to 2008	Associate Director of the Missouri Precision Agriculture Center, University of Missouri-Columbia, Columbia, Missouri
1992 to 1998	University Outreach and Extension Agricultural Engineering Specialist, University of Missouri System-Adair County, Kirksville, Missouri
1991 to 1992	Graduate Student University of Missouri-Columbia, Missouri
Summer of 1990-1991	Extension Associate University of Missouri-Portageville, Missouri
Summers of 1987,88 and 89	Brush Crew Laborer Macon Electric Cooperative-Macon, Missouri
1982-90	Helped work on family farm Larry Shannon Farms-Anabel, MO

EDUCATION

M.S., Agricultural Engineering, University of Missouri, May 1993
B.S., Agricultural Engineering, University of Missouri, December 1990

PROFESSIONAL AND COMMUNITY INVOLVEMENT

American Society of Agricultural Engineers, served as President, Vice President, Secretary, and Parliamentarian of the Student Branch-University of Missouri. Honored at Mid-Central Conference in the Student Paper Contest 1990. Honored as Young Member of the Year of the Missouri Section of the American Society of Agricultural Engineers 1997. Honored as with the Achievement Award from the Missouri Agriculture Extension Professionals 2001.

Member of Ten Mile Baptist Church, Anabel, MO, served as Sunday School Superintendent for 5 years.

Selected Publications

Shannon, K., C. Ellis, G. Hoette. 2002. Performance of "Low-Cost" GPS receivers for Yield Mapping. ASAE Paper No. 021151, St. Joseph, MI:ASAE.

Shannon, K., G. Davis, K. Sudduth, W. Wiebold. 2002. Precision Agriculture Masters Program – Educating Missouri Crop Producers About The Benefits Of Precision Agriculture Through On-Farm Research. ASAE Paper No. 021016, St. Joseph, MI: ASAE.

Shannon, D.K., H.L. Palm, N.R. Kitchen, K.A. Sudduth. 2004. Implementation and Validation of Sensor-Based Site-Specific Crop Management Through On-Farm Research. *In* Proc 7th Intl. Conf. on Precision Agriculture. ASA/SSSA/CSSA, Madison, WI.

Abstracts and Professional Presentations

Shannon, D.K., H.L. Palm, N.R. Kitchen, K.A. Sudduth. 2005. On-Farm Research – A Tool for Implementing and Validating Spatial Technologies for Site-Specific Crop Management. ASAE Paper No. 051069, St. Joseph, MI: ASAE.

Shannon, K., K. A. Sudduth. 2005. Performance of Lower Cost GPS Receivers for GPS-Aided Guidance. ASAE Paper No. 051090, St. Joseph, MI: ASAE.

Shannon, K., C. Ellis, G. Hoette. 2006. Performance of a Decimeter Accuracy GPS Receiver for the Development of Topographic Maps. ASAE Paper No. 061046, St. Joseph, MI: ASAE.

Shannon, D.K., H.L. Palm, P. C. Scharf, N.R. Kitchen, K.A. Sudduth. 2006. ALTERNATIVES TO USING A REFERENCE STRIP FOR REFLECTANCE-BASED NITROGEN APPLICATION IN CORN. *In* Proc 8th Intl. Conf. on Precision Agriculture. ASA/SSSA/CSSA, Madison, WI.

Extension Publication Guidesheets

Precision Agriculture: Yield Monitors (WQ 451)
Casady, W.W., D.L. Pfost, C. Ellis, and D.K. Shannon
http://extension.missouri.edu/explore/envqual/wq0451.htm

Precision Agriculture: Global Positioning System (GPS) (WQ 452)
Pfost, D.L., W.W. Casady, and D.K. Shannon
http://extension.missouri.edu/explore/envqual/wq0452.htm