

Indiana NCERA180 Report—2005

Site-Specific Management Center (SSMC)

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Gary Steinhardt, Agronomy

Mack Strickland, Ag. & Biological Engineering

Larry Theller, Ag. & Biological Engineering

Tony Vyn, Agronomy

Stephen Weller, Horticulture & Landscape Architecture

Abstract: In 2005 the work of the SSMC focused on disseminating results of site-specific management research at Purdue to the agricultural community, via the website (www.purdue.edu/ssmc), the monthly site-specific management seminar on campus, articles in the trade press and conference presentations.

Publications (all available at www.purdue.edu/ssmc):

Erickson, Bruce. Precision from the Ground Up in Brazil. *SSMC Newsletter*, January, 2005.

Erickson, Bruce and Jess Lowenberg-DeBoer. Using Spatial Data Analysis to Compare Rotated and Continuous Corn Systems over Time. *SSMC Newsletter*, February, 2005.

Boyer, Jeff, Bruce Erickson, and Stephen Hawkins. Using Site-Specific Tools to Manage Field-Scale Research. *SSMC Newsletter*, March, 2005.

Gumz, Mary and Stephen C. Weller. Using Spectral Vegetation Indices to Differentiate Weeds in Mint in Remote Sensing Images. *SSMC Newsletter*, April, 2005.

Chung, Sun-Ok, Ho-Jin Lee, and Jung-Keun Park. Precision Agriculture in the Republic of Korea. *SSMC Newsletter*, May, 2005.

Lowenberg-DeBoer, Jess. New Grain and Soil Sensors at the 5th European Agriculture Conference. *SSMC Newsletter*, June, 2005.

Iqbal, Javed, Phillip R. Owens, H. Tewelde, D.E. Rowe, and Bruce Erickson. Using Multispectral Aerial Imagery to Estimate the Growth of Cotton Fertilized with Poult Litter and Inorganic Nitrogen. *SSMC Newsletter*, July, 2005.

Erickson, Bruce. Step-by-Step Yield Monitor Data Analysis. *SSMC Newsletter*, August, 2005.

Iqbal, Javed, Phillip R. Owens, Ishtiaq Ali, and Frank D. Whisler. A Web-Database of Soil Physical Properties for Crop and Environmental Monitoring. *SSMC Newsletter*, September, 2005.

Erickson, Bruce. Ten Years of Precision Survey finds Adoption Follows Returns. *SSMC Newsletter*, October, 2005.

Erickson, Bruce. Workshop Helps Farmers Utilize One of Their Key Resources: Information. *SSMC Newsletter*, November, 2005.

Griffin, Terry W., Raymond J.G.M. Florax, and Jess Lowenberg-DeBoer. Yield Monitors and Remote Sensing Data: Sample Statistics or Population? *SSMC Newsletter*, December, 2005.

Precision Agricultural Services Survey

Principal Investigator: Jay Akridge

Department of Agricultural Economics, Purdue University, West Lafayette, IN 47906, phone: (765) 494-4327; fax: (765) 494-4333; email: Akridge@purdue.edu.

Abstract: The annual survey of crop input retailers showed that three-quarters of respondents used precision technologies in some way in their dealership. Dealers are expanding adoption of precision technologies for internal uses. The growth in the number of dealerships offering precision services has slowed, but grower adoption has continued to expand slowly. Another survey is planned for early 2006.

Publications:

Whipker, Linda, and Jay Akridge, "2005 Precision Agricultural Services: Dealership Survey Results." Staff Paper No. 05-11, Center for Food and Agricultural Business, Purdue University, West Lafayette, IN, USA, September 2005.

Whipker, Linda and Jay Akridge. "Reception" *CropLife*. June 2005, pp 12-17.

Site Specific Agricultural Research at Regional Agriculture Centers

Principal Investigators: Jeff Boyer, Stephen Hawkins, P.C. Walker, and R.L. Nielsen.

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Abstract: The increasing availability of precision agriculture technologies is facilitating an increase in field-scale agronomic research by researchers and farmers alike. Such large-scale research, however, challenges research station personnel to develop efficient systems that best balance researchers' needs for statistical design and experimental precision with the research farm's logistical needs associated with operating commercial-scale field equipment for field research purposes. Additionally, long-term field-scale research usually requires the development of a GIS database to document the spatial nature of field equipment operations, imposed research treatments, and geo-referenced data collected from the research plots. Finally, researchers want to avoid anomalies in the field while ensuring that plots really will fit in a field before traveling or wasting hours redrawing plot plans in the field. One solution in managing larger plots is to utilize DGPS-enabled software, hardware, and equipment to locate reference points over time, collect data, and communicate results with researchers and the public. The principal investigators won the 2005 American Society of Agronomy Div. A-7 Innovator Award.

Site-Specific Fertilizer Recommendations and Sampling Guidelines

Principal Investigator: Sylvie Brouder

Department of Agronomy, Purdue University, West Lafayette, IN 47906, phone: (765) 496-1489; fax: (765) 496-2926; email: sbrouder@purdue.edu

Abstract: Research involves site-specific data integration, evaluation, and development related to fertilizer recommendations and use efficiency in Indiana cropping systems. Research activities have emphasized protocols for delineating management zones and evaluation of soil fertility interactions related to grain quality.

Publications:

Brock, A., S.M. Brouder, G. Blumhoff, and B.S. Hofmann. 2005. Defining yield-based management zones for corn-soybean rotations. *Agron. J.* 97, 1115-1128.

Brouder, S.M., B.S. Hofmann, and D.K. Morris. 2005. Accuracy of common soil sampling strategies and estimation techniques. *Soil Sci. Soc. Am. J.* 69:427-442.

Decision Making in Precision Agriculture

Principal Investigator: Daniel R. Ess

Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, IN 47906, phone: (765) 496 3977; fax: (765) 496 1115; email: ess@purdue.edu

Publications:

Fountas, S. Blackmore, S. Ess, D. Hawkins, S. Blumhoff, G. Lowenberg-Deboer, J. Sorensen, C.G. Farmer experience with precision agriculture in Denmark and the US Eastern Corn Belt. *Precision Agriculture*. 2005 Apr. v. 6, no. 2

Theory and Practice of Spatial Econometrics

Principal Investigators: Raymond Florax

Department of Agricultural Economics, Purdue University, West Lafayette, IN 47906, phone: (765) 494-4300; fax: (765) 496-9176; email: rflorax@purdue.edu

Abstract: Research deals with spatial data analysis, spatial econometrics, spatial and environmental modeling, and meta-analysis. Started the new brownbag series "Spatial Analysis @ Purdue" in November.

Publications:

Griffin, T., G. Fitzgerald, R. Florax., J. Lowenberg-DeBoer, E. Barnes, and R. Roth, "Local and Global Spatial Correlation in Precision Farming Experiments: Field-Scale Tillage Comparisons for Cotton Yield data" (in press).

Evaluation of Weed Species Spatial Distribution

Principal Investigators: Kevin Gibson, Richard Dirks
Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47906, phone: (765) 494-2161; fax: (765) 496-0363; email: kgibson@purdue.edu

Abstract: A tractor-mounted mechanical vision system for weed detection is being developed to provide highly accurate, detailed maps of weed populations in agronomic crop fields. The system utilizes a Patchen weed-seeker, digital imagery and GPS equipment, with the ultimate goal to combine weed maps with other precision technologies to evaluate the relationship between environmental variables and weed species spatial distribution.

Remote Sensing Applications in Agriculture

Principal Investigator: Chris J. Johannsen
Department of Agronomy, Purdue University, West Lafayette, IN 47906, phone: (765) 494-6248; fax: (765) 496-2926; email: johan@purdue.edu

Abstract: Focus on remote sensing applications including soil landscape dynamics relating to soil variability and soil management zones, yield-influencing factors, automated correction of sensor errors, vegetation damage by insects, flooding impacts on corn and soybeans, and weed anomaly monitoring. Research related to weed detection, crop residue detection and soil & crop anomaly classification is planned for 2006.

Publications:

Getman, D, J. Harbor, C.J. Johannsen, B. Engel, and G. Shao. 2005. Improving the Accuracy of Historic Satellite Image Classification by Combining Low-Resolution Multispectral Data and High-Resolution Panchromatic Data. *Journal of Terrestrial Observation*. Accepted September 2005.

Carter, P.G. C.J. Johannsen and B.A. Engel. 2005. "Recognizing Patterns Within Cropland Vegetation: A Crop Anomaly Classification System," *Journal of Terrestrial Observation*, Purdue University, 10 pp. Accepted November 2005.

Johannsen, C.J. 2005. Conducting Remote Sensing Seminars across the United States, I-Light Symposium Proceedings, Abstract: p 14, Presentation: pp 77-81. Information Technology, Purdue University.

Using Remote Sensing to Determine Weed Densities and N Stress in Corn

Principal Investigators: William Johnson, Kevin Gibson
Department of Botany and Plant Pathology, Purdue University, West Lafayette, IN 47906, phone: (765) 494-4656; fax: (765) 496-0363; email: wgjohnso@purdue.edu

Abstract: Remote sensing imagery is being used to determine weed densities and to assess N stress in corn. Goal is to determine the effect of weed removal and N application timing on weed growth and herbicide-resistant corn yields. Environmental concerns associated with N fertilizer and soil-applied herbicides are likely to limit their use in the future and growers will increasingly adopt post-emergence management strategies. However, weed-corn competition for N can occur early in the season and weed accumulation of N may suppress corn yields. If successful, this information could be used to provide farmers with data necessary to make more informed decisions regarding fertilizer and herbicide applications.

Economics of Knowledge Intensive Agriculture for Crop Farms

Principal Investigator: Jess Lowenberg-DeBoer

Department of Agricultural Economics, Purdue University, West Lafayette, IN 47906, phone: (765) 494-4230; fax: (765) 494-9176; email: lowenbej@purdue.edu

Abstract: Research in 2005 focused on developing better ways for growers and those who advise them to use information from combine yield monitors and other site-specific sources. Monte Carlo studies demonstrated that it is possible to draw reliable information to guide farm input use and agronomic decisions from the large plot, low replication trials many farmers find logistically attractive. Work is underway with funding from the USDA/CSREES Sustainable Agriculture Research and Extension (SARE) program to test the reliability of large block, low replication trials with farmers in Indiana, Illinois, Kentucky, Arkansas and Arizona. In November a Yield Monitor Analysis Workshop was held to test techniques that allow farmers to calibrate, clean and rectify their own yield monitor data, and to set up and analyze meaningful on-farm comparisons using advanced spatial statistical models.

Publications:

Erickson, Bruce, Fulgence Mishili, and Jess Lowenberg-DeBoer. Value of More Uniform Nitrogen Application Across the Toolbar. *Purdue Agricultural Economics Report*, February 2005.

Erickson, B. J., F. J. Mishili, and J. M. Lowenberg-DeBoer. Value of More Uniform Nitrogen Application Across the Toolbar. *Crop Management*, July 2005. doi:10.1094/CM-2005-0714-01-RS
<http://www.plantmanagementnetwork.org/sub/cm/research/2005>

Griffin, Terry W., Jason P. Brown, and Jess Lowenberg-DeBoer. Yield Monitor Data Analysis: Data Acquisition, Management, and Analysis Protocol. August, 2005. Available at www.purdue.edu/ssmc.

Griffin, T.W., Glenn Fitzgerald, D.M. Lambert, J. Lowenberg-DeBoer, E.M. Barnes, and Robert Roth. 2005. "Testing Appropriate On-Farm Trial Designs and Statistical Methods for Cotton Precision Farming," Proceedings of the Beltwide Cotton Conference, January 4 – 7, 2005, New Orleans, LA.

Griffin, T., D. Lambert and J. Lowenberg-DeBoer, "Economics of Lightbar and Auto-Guidance GPS Navigation Technologies," paper presented at the 5th European Conference on Precision Agriculture, June 9-12, 2005 Uppsala, Sweden.

Griffin, T.W. and D.M. Lambert. 2005. Teaching Interpretation of Yield Monitor Data Analysis: Lessons Learned from Purdue's 37th Top Farmer Crop Workshop. *Journal of Extension Education* 43(3). Available at: <http://www.joe.org/joe/2005june/iw5.shtml>

Lowenberg-DeBoer, Jess. Is Partnering Worth It? *Croplife*, 2005.

Lowenberg-DeBoer, J., Dayton Lambert, Terry Griffin and Gary Malzer, "Risk Management for Site-Specific Nitrogen Application," paper presented at the Southern Agricultural Economics Association Annual Meeting, Little Rock, AR, Feb. 5-9, 2005.

Automated Measurement and Mapping of Soil Properties

Principal Investigator: Mark Morgan

Department of Agricultural and Biological Engineering, Purdue University, West Lafayette, IN 47906, phone: (765) 494-1180; fax: (765) 496 1115; email: mmorgan@purdue.edu

Abstract: Rapid measurement and mapping of soil properties has shown potential for improving site-specific management. A model combining geo-statistics, agronomics and economics is being used to demonstrate the potential benefit of high resolution soil pH maps when combined with variable-rate lime application. Similar modeling and data analysis is under development for nutrients potassium and nitrogen. In addition, sensing systems are being investigated for mapping other soil properties including: potassium, nitrogen, and soil mechanical impedance at various depths in the profile. These sensors will ultimately provide the basis for accurate control of variable rate tillage and chemical application.

Publications:

Adamchuk, V.I., E. Lund, B. Sethuramasamyraja, M.T. Morgan, and A. Dobermann. 2005. Direct measurement of soil chemical properties on-the-go using ion selective electrodes. *Computers and Electronics in Agriculture* 48(3):272-294.

Using Soil Electrical Conductivity to Delineate Soil Management Zones

Principal Investigator: Gary Steinhardt

Department of Agronomy, Purdue University, West Lafayette, IN 47906, phone: (765) 494-8063; fax: (765) 496-2926; email: gsteinhardt@purdue.edu

Abstract: The use of soil electrical conductivity (EC) as a means of delineating soil management zones is being investigated. Bare soil areas have been established at the Purdue Agronomy Center for Research and Education in an area with a good Order II soil map, and EC and soil moisture information is being collected weekly (weather permitting). At the Davis-Purdue Agricultural Center in East-Central Indiana, work is in progress to investigate how site-specific long-term yield monitor data correlates with Order I soil survey information. 120 acres of an Order 1 survey have been completed at the Davis Farm.

Automatic Guidance and Site-Specific Applications for Tillage Systems, Fertility Placement and Crop Response

Principal Investigator: Tony Vyn

Department of Agronomy, Purdue University, West Lafayette, IN 47906, phone: (765) 496-3757; fax: (765) 496-2926; email: tvyn@purdue.edu.

Abstract: Primary research and extension emphasis in 2005 was on RTK automatic guidance systems for strip tillage and nutrient banding for corn (Indiana) and for wheat (Western Australia – Sabbatical leave project with the O.E.C.D.). Our cropping systems group continued to investigate soil spatial variability caused by vertical and horizontal stratification of soil phosphorus and potassium in long-term conservation tillage systems with either broadcast or deep-banded fertilizer applications. We assisted Dr. Craig Daughtry of USDA-ARS in using satellite images to quantify crop residue cover and adoption of conservation tillage practices in Indiana.

Publications:

Omonode, R.A., and T. Vyn. 2006. Spatial dependence and relationships of electrical conductivity to soil organic matter, phosphorus, and potassium. *Soil Science* (in press).

I. Conti. 2005. No-till soybean responses to phosphorus and potassium placement and associated crop management in prior corn. MS Thesis, Agronomy Department.

A. Kline. 2005. Corn response to deep banding of phosphorus and potassium in high yield production systems. MS Thesis, Agronomy Department.

Relevant Presentations:

Vyn, T.J. 2005. Practical applications for Auto-Steer. Info-Ag 2005 (Information Agriculture Conference) in Springfield, IL. July 20-21.

Vyn, T.J. 2005. Fertilizer band and crop row placement in conservation tillage: An automatic guidance frontier? CSBP Fertilizer Seminar. Bibra Lake (Perth), Western Australia, Sept. 21.

Vyn, T.J. 2005. Automatic guidance and wheat row position: Implications of on-row versus off-row seeding. Western Australia Department of Agriculture Seminar, Geraldton, WA, Dec. 2.

Using Remote Sensing to Detect and Manage Weeds in Mint

Principal Investigator: Stephen C. Weller

Department of Horticulture and Landscape Architecture, Purdue University, West Lafayette, IN 47906, phone: (765) 494-1333; email: weller@purdue.edu

Abstract: Mint is an ideal candidate for site-specific weed management as it has a low growth habit and patchy weed infestations. Research is currently focusing on techniques to analyze remotely sensed images and convert them into weed (or pest) maps with a minimal amount of ground referencing. Spectral vegetation indices are being used to help differentiate peppermint from problem weed species.