

Title: Evaluation of Modified Mehlich Buffer Tests for Determining Lime Requirement in Missouri Soils

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Peter Scharf, Division of Plant Sciences, University of Missouri
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David Dunn, Supervisor, Delta Research Soil Testing Lab, University of Missouri**

Objectives:

1. To compare the Modified Woodruff Buffer test method with the Modified Mehlich Buffer test for determining the lime requirement for Missouri soils.
2. To determine if the Modified Mehlich Buffer is an effective alternative to the Modified Woodruff Buffer test for Missouri soils.
3. Compare the Lime Recommendations using Modified Mehlich and Modified Woodruff Buffer for Missouri soils.
4. To Determine the Lime Recommendations Equations for Modified Mehlich Buffer for Missouri Soils for the pH ranges of 5.5 to 6.0; 6.0 to 6.5 and 6.5 -7.0.
5. Implementing the Change in Lime Recommendation Test in the University of Missouri Soil Testing Labs.

Procedures:

- Soil samples received by the soil testing labs collected throughout the State of Missouri will be used in this study. Twenty soil samples collected from different soil regions in Missouri that represent major agricultural areas were used in the soil incubation study. All the twenty samples used in the incubation study were estimated for lime requirement by the currently used Modified Woodruff Buffer test and the alternate Modified Mehlich Buffer test method.
- *Incubation Study:*
Soils were amended with reagent grade CaCO_3 at rates of 0, 1/3, 2/3, 1 and 1 1/3 and 2 times the estimated lime requirement from the Modified Woodruff method and incubated in the dark for 3 weeks with the following wetting and drying cycle.
 1. Add water to each soil to bring to field capacity.
 2. Cover with parafilm and incubate at room temperature (20 degree +/- 5 degree $^{\circ}\text{C}$) in the dark for three weeks.
 3. Remove parafilm and incubate in dark for 1 week.
 4. Mix soil by hand and return to the cups.
 5. Repeat steps 1 to 4 for a total of three times.

Need for additional research to be conducted in YR 2006 based on the YR 2005 research findings:

1. Incubation study as described above to get the lime recommendation to raise the soil pH to 5.5 to 6.0 range for Missouri soils.

2. Soil pH will be regressed with CaCO₃ added to raise the pH to the 5.5 to 6.0 range and actual lime requirement will be estimated.
3. Compare Modified Mehlich and Woodruff Buffer tests for soils received from throughout the state of Missouri by the University of Missouri Soil testing labs.
4. Compare the lime recommendations generated by both Modified Mehlich and Woodruff buffer tests for Missouri soils.
5. Based on the findings of this research implement changes in the buffer tests used by the University of Missouri Soil Testing Labs.

Data Analysis:

Woodruff and Mehlich buffer pH will be regressed against actual lime requirement to evaluate effectiveness of each test for estimating the lime requirement for Missouri soils. Based on the lime requirement equations obtained to raise the soil pH for Missouri soils for the 5.5 to 6.0; 6.0 to 6.5 and 6.5 to 7.0 ranges, lime requirement will be calculated for both buffer tests and compared by linear regression. Regression analysis will be run on bulked data to predict lime requirement from buffer pH alone (simple linear) and from pHs (salt pH) and buffer pH (multi linear).

Current Status and Importance of Research:

The Mehlich III extractant is being increasingly used by soil testing labs for rapid nutrient analysis using ICP technology. The universal extractant Mehlich III, which extracts multiple elements simultaneously, has the potential to replace one or more of the standard extractants currently used by the University of Missouri labs. Research was done to compare Mehlich III extractable nutrients with Ammonium Acetate Extractable cations and DTPA extractable micronutrients in Missouri soils and the correlation between Mehlich extractable nutrients and yield response are being determined.

In Missouri, the Modified Woodruff Buffer test is used to determine the lime requirement in soils. Though this method has been proven to work for Missouri soils it uses para-nitrophenol as one of the reagents which is a hazardous substance. Para-nitrophenol can cause serious health effects on humans when breathed in or when absorbed by skin. Thus the waste produced by the Woodruff buffer test needs to be treated as a hazardous waste. Also, since Missouri is the only state in the nation which uses the Woodruff Buffer test, by evaluating the other buffer tests used, data and lime recommendations developed for Missouri can be compared with similar information from the other states.

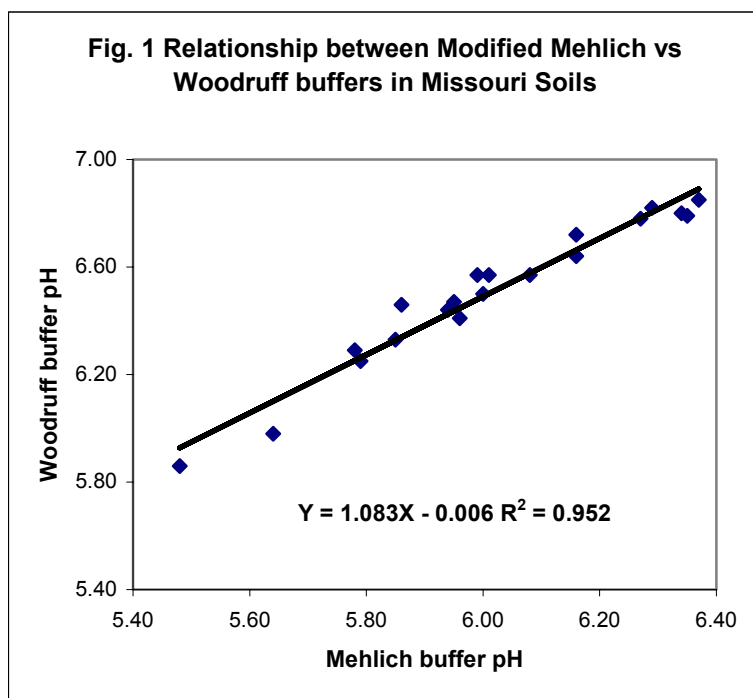
The SMP buffer test is commonly used throughout the U.S. for determining lime requirement. This is the method listed as the recommended procedure for lime requirement in the publication: *Recommended Chemical Soil Test Procedures by the North Central Region*. This method also uses para-nitrophenol. In addition, even though the SMP buffer test is commonly used throughout the U.S. for determining lime requirement, the SMP buffer solution contains potassium chromate, a carcinogen, and poses a health risk to laboratory technicians who perform this test. Additionally, all waste generated by the test must be collected for proper disposal. An alternative to the SMP test is the Mehlich Buffer test. Although the Mehlich buffer contains

barium chloride, another toxic and regulated compound, calcium chloride (CaCl_2) has been shown to be an effective and safe substitute.

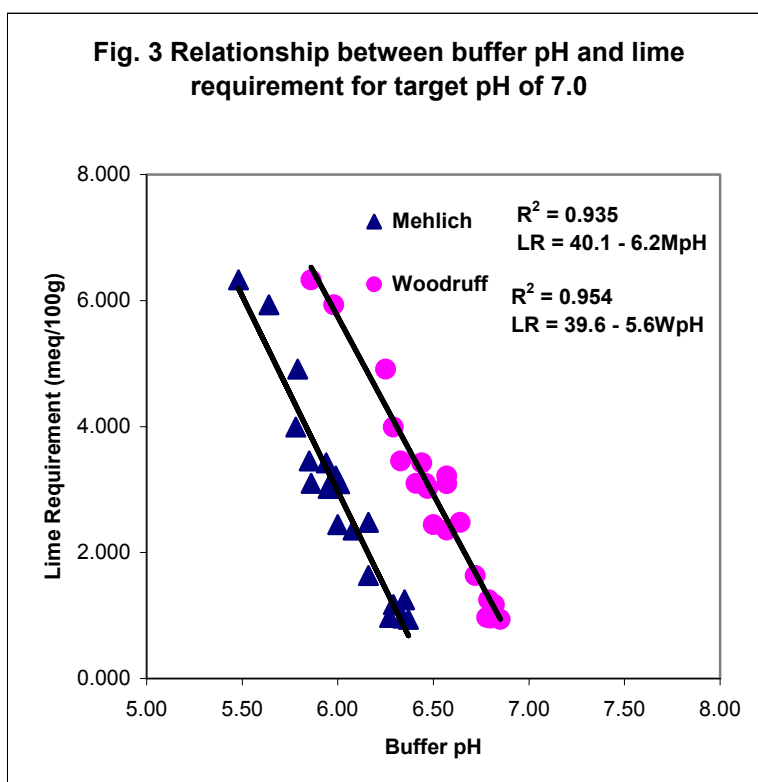
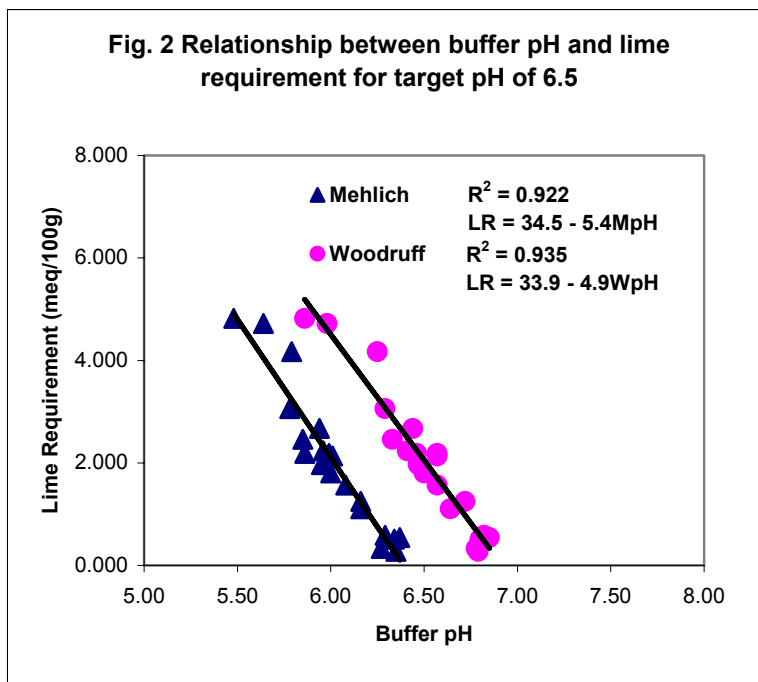
Studies have been conducted to develop alternative methods for making lime recommendations without the use of hazardous chemicals. Hoskins from University of Maine evaluated the Mehlich Buffer for Maine soils (Hoskins, 2005) and the modification of the buffer to replace the BaCl_2 with a non-hazardous chemical. He found CaCl_2 to be a suitable substitute for BaCl_2 and developed the Modified Mehlich Buffer (Hoskins, 2005) for evaluating lime requirement in soils. A recent study carried out at Pennsylvania State University by Wolf and Beegle (2005) compared SMP buffer with Modified Mehlich buffer and concluded that the Mehlich buffer is a better predictor of lime requirement on Pennsylvania soils than the SMP buffer and, additionally, does not contain any hazardous components. They also reported that the Mehlich buffer calibration on Pennsylvania soils was similar to Mehlich buffer calibrations in North Carolina and Maine. They concluded that the Mehlich buffer test is a feasible alternative to the SMP buffer test for determining lime requirement on acid soils of the Northeast and other regions of the U.S.

Similar studies on comparisons of Modified Woodruff with Modified Mehlich buffers for Missouri Soils (Nathan, Sun and Scharf, 2005); SMP and Modified Mehlich buffers for Wisconsin Soils (Laboski and Peters, 2005) and evaluation of Modified Mehlich buffer for Virginia Soils (Mullins, 2005) have been conducted. Research findings from these researchers strongly suggest Modified Mehlich buffer to be a better alternative to the other buffers used in these states.

A preliminary research study was conducted on “Comparison of Modified Woodruff Buffer in Missouri Soils” in year 2005 from a grant obtained from the Fertilizer and Ag. Lime Board (Nathan et. al., 2005). The research revealed a good correlation ($R^2=0.952$) between the modified Woodruff and Mehlich buffers for Missouri soils. Fig.1.



Relationship between the buffer pH and lime requirement is for both buffers after incubation in the soil after treated with different CaCO_3 treatments to achieve target pH of 6.5 and 7.0 is presented are presented in Fig 2 and 3.



Both buffers (Mehlich and Woodruff) are found to be equally good in predicting the lime requirement for Missouri soils. (Fig 2 and 3). Based on our findings, Modified Mehlich buffer seems to be a viable alternative to Woodruff buffer in determining the lime requirement in Missouri soils. However, an additional incubation study to obtain the lime requirement equation for target pH to 5.5 – 6.0 is needed to come up with the complete set of lime recommendation equations for Modified Mehlich Buffer test in Missouri soils. In addition, bulk comparison of soil samples received by both the MU soil testing labs, using Modified Mehlich buffer and Woodruff buffers; and lime requirement estimations by both buffers in these soils is required before this new buffer test could be adopted and implemented in Missouri.

Continuing this research now is very timely, and essential to implement the changes based on additional research. Also studies have been conducted to compare Mehlich extractable nutrients with the standard procedures used by University of Missouri soil testing labs, and conversion factors have been developed for providing fertilizer recommendation based on the Mehlich III extractant.

Timetable:

Feb - May 2006	Soil sample collection
May – June 2006	Sample analysis, selection and processing
July - Sep. 2006	Application of treatments and conducting incubation study. Moisture adjustment every four weeks. Sample analysis.
October 2006	Sample collection from incubation experiment and processing of samples and analysis
November 2006	Relate the soil test values from modified Mehlich III buffer and the modified Woodruff buffer used by MU soil testing lab Analyze research results.
Dec. - Jan, 2006	Submit annual report to Fertilizer Lime Control.
Feb. - June, 2007	Summarize results, statistical analysis and write a manuscript article to be published.

Strategy for Application/Transfer of Knowledge:

The results from this project will be used to evaluate the use of Mehlich buffer test for Missouri soils. When combined with additional field studies this data will be used to develop lime recommendations based on the Mehlich Buffer test. This will help in use of a lime requirement method that does not use hazardous substances in the lab, and also will eliminate the problem producing hazardous waste for disposal. Also it will help if the University of Missouri uses a lime requirement test that can be compared with other states. In addition, it will improve the quality of soil test based lime recommendations used in Missouri. This information will be incorporated into University of Missouri recommended soil test procedures, research and extension publications and will be disseminated to the growers, researchers and industry personsals by field day presentations, grower meetings, regional and national meetings.

References:

1. Brown, J. R. and R. R. Rodriguez. 1983. Soil Testing, A guide for conducting soil tests in Missouri. Missouri Cooperative Extension Service.

2. Hoskins, B. 2005. Modification of Mehlich Lime Buffer Test for Maine. *In: Symposium on Update of Soil Liming Recommendations. Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI ASA Abstracts.*
3. Laboski, C.A.M., and J. B. Peters. 2005. Evaluation of Alternate Buffers to SMP for Lime Recommendations in Wisconsin. *Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI*
4. Mehlich, A. 1939. Use of triethanolamine acetate-barium hydroxide buffer for the determination of some base exchange properties and lime requirement of soil. *Soil Sci. Amer. Proc.* 3: 162-166.
5. Mehlich, A. 1953. Rapid determination of cation and anion exchange properties and pH of soils. *J. Assoc. Off. Agr. Chem.* 36:445-457.
6. Mehlich, A. 1976. New buffer pH method for rapid estimation of exchangeable acidity and lime requirement of soils. *Commun. Soil Sci. Plant Anal.* 7: 637-652.
7. Mullins, G. 2005. Evaluation of Mehlich for Buffer for Virginia Soils. Paper presented at the Southern Region Research and Extension Group meeting at Oklahoma state University, Stillwater, OK. June 6, 2005.
8. Mullins, G. 2005. Evaluation of Mehlich for Buffer for the Determining Lime Recommendations for Virginia Soils. *Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI.* P. 251.
9. Nathan, M. V., Mallarino, A, Eliasan, R and R. Miller. 2002. ICP vs. Colorimetric Determination of Mehlich III Extractable Phosphorus. *International Symposium on Soil & Plant Analysis. Edmonton, Alberta, Canada. Commun. Soil Sci. Plant Anal.* 33:2432.
10. Nathan, M. V., and Y. Sun. 1998. Comparison of Mehlich III Extractable Nutrients using ICP, AA, and Colorimetry for Manured and Unmanured Soils. *Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI.* P. 251.
11. Nathan, M. V., Sun, Y. and P, Scharf. 2005. *Annual Soil Fertility Research Report, Fertilizer and Lime Board Research Reports.*
12. Watson, M. E. and J. R. Brown. 1998. pH and lime requirement tests. *In: Recommended Chemical Soil Test Procedures for the North Central Region. North Central Regional Publication No. 221 (revised). J. R. Brown (ed) Columbia, MO. Missouri agricultural Experiment Station SB 1001, University of Missouri.*
13. Wolf, A. and D. Beegle. 2004. Comparison of SMP and Modified Mehlich Buffer Tests for Determining Lime Requirement on Pennsylvania Soils. *Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI.*
14. Wolf, A. and D. Beegle. 2005. Evaluation of Mehlich Buffer pH Method in Pennsylvania. *In: Symposium on Update of Soil Liming Recommendations. Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI.*

Budget

CATEGORIES	YEAR 2006
A. Salaries	
Senior Lab Technician (30%)	\$7,450
Student Labor 400 hrs at \$7.25 per hour	\$2,900
B. Fringe Benefits	
Fringe for Lab Technician (25%)	\$2,248
TOTAL SALARIES AND FRINGE BENEFITS	\$12,598
C. Travel	
Travel to field sites for sample collection	\$400
To present research findings at the State, Regional & National Meetings	\$1,500
TOTAL TRAVEL COSTS	\$1,900
D. Equipment	\$0
TOTAL EQUIPMENT COSTS	\$0
E. Other Direct Costs	
Laboratory reagents and supplies	\$3,500
Field supplies	\$150
TOTAL OTHER DIRECT COSTS	\$3,650
TOTAL REQUEST	\$18,148

Justification:

Salaries and Fringe Benefits: Funds are requested support of a senior lab technician for 4 months based on an annual salary of \$24,833, 30% fringe benefits and for hourly labor for temporary student lab assistant.

Travel: Covers cost of travel to farm research centers and selected field sites representing all soil regions in Missouri and for presentations and to present the research work in state, regional and national meetings.

Laboratory Reagents and Supplies: Covers cost of laboratory reagents, sample containers, and other materials used in incubation study and soil analyses.

Field: soil samplers, sample bags, sample storage containers and other field supplies.

Membership and Affiliations

American Society of Agronomy
Soil Science Society of America
Soil Testing and Plant Analysis Council

Association of Official Agricultural Chemists

Publications

Refereed: 10 Abstracts: 17 Extension publications: 47 Proceedings and others: 50

Publications

Refereed:

1. Nelson, K. A., Motavalli, P. P., and M. Nathan. 2005. Response to No-Till Soybean [*Glycine max* (L.) Merr.] to Timing of Preplant and Foliar Potassium Applications in a Claypan Soil. In *Agron. J.* 97:832- 838.
2. Nathan, M. 2005. Reagents and Standards. Chapter 5. *In*. Quality Assurance and Quality Control Procedure Manual for Soil Testing Labs. Ed. Maurice Watson. North American Proficiency Program Publication. Oregon State University Publication. (In print).
3. Motavalli, P. P., J. Lory, M. Nathan and C. Fulcher. 2002. Increased access to soil and plant testing database: Opportunities and Issues. *Commun. In Soil Sci. and Plant Anal.* 33: 1157 – 1171.
4. Combs, S. M. and M. V. Nathan. 1998. Soil Organic Matter. *In* Recommended Chemical Soil Test Procedures for North Central Region. Ed. J. R. Brown. Chapter 12:53-58. Missouri Ag. Expt. Station SB 1001, Univ. of Missouri-Columbia.
5. Nathan, Manjula.V. and G.I. Malzer. 1994. Dynamics of Ammonia Volatilization from Turkey Manure and Urea applied Soil. *Soil Sci. Soc. Am. J.* 58: 985-990.
6. Vivekanandan, M. and P.E. Fixen. 1991. Cropping system effects on Mycorrhizal infection, early growth and phosphorus uptake of corn. *Soil Sci.Soc. Am. J.* 55:136-140.
7. Vivekanandan, M. J. R. Brown, J. Williams, T. Clevenger, R. Belyea and M.E. Tumbleson. 1991. Tolerance of forage legumes to lime stabilized sludge. *Commun. Soil and Plant Anal.* 22: 449-463
8. Vivekanandan, M*. and P.E. Fixen. 1990. Effect of large manure applications on soil P intensity. 1990. *Commun. Soil Sci. Plant Anal.* 21: 287-297.

**Note: Last name changed from Vivekanandan to Nathan*

Abstracts

1. Nelson, K., Motavali, P., Stevens, W., Kendig, A., Nathan, M., and D. Dunn. 2005. Soybean Response to Weed Control with Glyphosate as Affected by Foliar Applied Potassium Sources and Rates. Annual Meetings Abstracts. ASA-SSSA- CSSA, Salt Lake City, UT.

2. Nelson, K., Motavalli, P., and M. Nathan. 2003. Response of no-till soybean to timing of pre-plant and foliar potassium applications in a clay pan soil. Annual Meetings Abstract. ASA, SSSA, CSSA. Madison, WI.
3. Nathan, M. V., Mallarino, A., Eliasan, R and R. Miller. 2002. ICP vs. Colorimetric Determination of Mehlich III Extractable Phosphorus. International Symposium on Soil & Plant Analysis. Edmonton, Alberta, Canada. Commun. Soil Sci. Plant Anal. 33:2432.
4. Nathan, M. Starbuck, C. and Y. Sun. 2001. Making recommendations Based on Laboratory Analysis of Compost: Science or Art? Annual Meetings Abstract. ASA, SSSA, CSSA. Madison, Wisconsin.
5. Motavalli, P. P., Lory, J. A., Nathan, M. V. and C.L. Fulcher. 2000. Increased Access to Soil Testing Data Base Through the Worldwide Web: Opportunities and Issues. Annual Meetings Abstracts. ASA, CSSA, SSSA. Madison, WI. P. 352.
6. Nathan, M. V., and Y. Sun. 1998. Comparison of Mehlich III Extractable Nutrients using ICP, AA, and Colorimetry for Manured and Unmanured Soils. Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI. P. 251
7. Nathan, M. V. and Y. Sun. 1997. Comparison of Mehlich III Extractable Nutrients with Bray PI, Ammonium acetate Extractable Cations, and DTPA Extractable Nutrients in Missouri Soils. 1997 International Soil and Plant Analysis Symposium in "The Promise of Precision – Past, Present and Future." Minneapolis, MN, USA. Aug. 2-7, 1997.
8. Nathan, M. V. and S. A. Abernathy. 1997. Reevaluation of Soil Organic Matter Determination by Loss-on-Ignition for Missouri Soils. P. 298. Annual Meetings Abstracts. ASA. CSSA. SSSA. Madison, WI.

Extension Guides and Fact Sheets

1. Nathan, M., 2005. Steps in Fertilizing Garden Soil: Vegetables and Annual Flowers. Extension Publication G 6950. University of Missouri Extension Publications.
2. Nathan, M., J. Stecker, E. Ervin, L. Jett, M. Warmund and P. Scharf. 2001. Commercial Fruits, Vegetables and Turf Soil Test Interpretations and Fertilizer Recommendation Guide.
3. Nathan, M., Stecker, J., and Y. Sun. 2001. Soil Testing Guide. University of Missouri Soil Testing Lab Publication. (Electronic Publication).
4. Nathan, M. and B. Freesenberg. 2001. Soil Testing for Lawns. MU Guide G6954. University of Missouri Extension Publications.
5. Stecker, J., M. Nathan, E. Ervin, L. Jett, and C. Starbuck. 2000. Lawn and Garden Soil Test Interpretations and Fertilizer Recommendation Guide. College of Agriculture, Food and Natural Resources, University of Missouri Miscellaneous Publication. MP 733.
6. Ervin, E., and M. Nathan. 2000. Soil Testing for Lawns. MU Guide G6954. University of Missouri Extension Publications.
7. Nathan, M., and J. Stecker. 1999. Fact Sheets on Interpretation Guide on (i) Domestic (ii) Livestock (iii) Poultry and (iv) Irrigation water analysis. University of Missouri Soil Testing Lab Publication.
8. Lory, J. A., Scharf, P., and M. Nathan. 1998. Interpreting Missouri soil Test Reports. MU Guide G 9112. University of Missouri Extension Publications.
9. Nathan, M. V. 1998. Quick Reference Guide for University of Missouri Soil & Plant Testing Services. University of Missouri Soil Testing Lab Publication. Sept. 1998.

10. Nathan, M. and J. Stecker. 1998. Fact Sheets on Interpretation and Recommendation Guide on (i) Compost, (ii) Greenhouse Media. University of Missouri Soil Testing Lab Publication.
11. Jennings, J. A., Lory, J. A., Scharf, P., and M. V. Nathan. 1996. Interpreting Missouri Soil Test Reports. MU Guide G9112. University of Missouri Extension Publications.

Extension Manuals:

1. Nathan, M. 2005. Chapters: (i) Soils; (ii) Plant Nutrition; (iii) Soil Testing. In: Master Gardner Core Manual, University of Missouri Extension Publication (in print).
2. Nathan, M., Scharf, P., Lory, and D. Crocker. 2004. Soil Test Interpretations and Recommendations Hand Book. Division of Plant Science Extension, College of Agriculture, Forestry and Natural Resources, University of Missouri-Columbia.

Peter Clifton Scharf

Education

<i>Degree</i>	<i>Date</i>	<i>Institution</i>	<i>Major</i>
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

Professional Experience

2002 to present *Associate Professor* in the Agronomy Department of the University of Missouri. Responsible for applied research and extension in the area of nutrient management.

1995 to 2002 *Assistant Professor* in the Agronomy Department of the University of Missouri.

Areas of Interest

- field-specific, soil-specific, and variable-rate fertilizer recommendations
- minimizing environmental impacts of agricultural practices
- optimizing crop management

Skills

ability to communicate effectively, to cooperate with others, and to manage projects and people

- outstanding laboratory, field, project design, and data analysis skills
- excellent natural science background
-

Sample Research Publications

Scharf, Peter C. and William J. Wiebold. 2003. Soybean yield responds minimally to nitrogen applications in Missouri. Online. Crop Management doi:10.1094/CM-2003-1117-01-RS.

Scharf, Peter C., John P. Schmidt, Newell R. Kitchen, Kenneth A. Sudduth, S. Young Hong, John A. Lory, and J. Glenn Davis. 2002. Remote sensing for N management. J. Soil Water Cons. 57:518-524.

Scharf, Peter C., William J. Wiebold, and John A. Lory. 2002. Corn yield response to nitrogen fertilizer timing and deficiency level. Agron. J. 94:435-441.

Scharf, Peter C. 2001. Soil and plant tests to predict optimum N rates for corn. J. Plant Nutr. 24:805-826.

Sample Extension Publications

Scharf, Peter. 2003. Nitrogen prices are up again: How should that affect management decisions? Integrated Pest and Crop Management 13:25-26.

Scharf, Peter, Kevin Bradley, Shawn Conley, and Bill Wiebold. 2003. Risk of atrazine carryover damage to wheat and soybean. Integrated Pest and Crop Management 13:140.

Scharf, Peter and John Lory. 2003. Calibrating corn color from aerial photographs to predict sidedress nitrogen need. *Crop Decisions* Jan/Feb 2003 p. 26-28.

Yichang Sun

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Education

Ph.D. in Soil Science (1995), University of Missouri-Columbia
 Major: Plant Nutrition and Soil Fertility
 M. S. in Agronomy (1990), Kansas State University
 Major: Soil Fertility and Plant Nutrition
 B.S. in Agronomy (1982), Jilin Agricultural University, P.R. China
 Major: Agrichemistry Specialization: Soil Science

Employment History

Senior Research Lab Technician, UMC	1995 - to date
Graduate Research Assistant, UMC	1990 - 1995
Graduate Research Assistant, KSU	1988 - 1990
Visiting Scholar, KSU	1986 - 1988
Teaching Instructor, JAU	1982 - 1986

Membership and Affiliations

American Society of Agronomy	
Soil Science Society of America	Gamma Sigma Delta

Honors and Awards

- 1992: Received C. E. Marshall Award.
- 1986: Research Award from the scientific and Technological Commission of Jilin.
- 1986: Research Award from the Department of Commerce of the People's Republic of China.

Publications

Refereed

1. Yichang S., J. L. Havlin, and G. M. Paulsen. 1989. Evaluation of nutrient deficiencies in wheat seedlings by chlorophyll fluorescence. *Journal of Plant Nutrition*, 12(6): 769 –782.
2. Zucheng Z. and Yichang S. 1985. Application storage of chemical fertilizers. Jilin Academic Press, Changchun, 170p.

3. Zucheng Z., Zhenyu J., Hongyu W., and Yichang S. 1985. Fates of solid nitrogen fertilizers in dryland soils. *Environmental Science*. 6: 1-7.
4. Hongyu W., Zucheng Z., Zhenyu J., and Yichang S. 1984. Relationship between mineral N and alkali-hydrolysable N in dryland soils in Jilin. *Compilations of data of soil survey in Jilin*. 2:23-25.
5. Zhenyu J., Zucheng Z., Hongyu W., and Yichang S. 1984. Loss pathways and Preventive measures of solid nitrogen fertilizers applied to dryland soils. *Compilations of data of soil survey in Jilin*. 2: 18 – 22.
6. Zucheng Z., Hongyu W., Zhenyu J., and Yichang S. 1984. Main parameters in the formula of applying N fertilizers for maize based on soil test. *Journal of Jilin Agricultural University*. 4: 15 – 19.

Abstracts

1. Nathan, M. Starbuck, C. and Y. Sun. 2001. Making recommendations Based on Laboratory Analysis of Compost: Science or Art? Annual Meetings Abstract. ASA, SSSA, CSSA. Madison, Wisconsin.
2. Nathan, M. V., and Y. Sun. 1998. Comparison of Mehlich III Extractable Nutrients using ICP, AA, and Colorimetry for Manured and Unmanured Soils. Annual Meetings Abstracts. ASA, CSSA, SSA, Madison, WI. P. 251
3. Nathan, M. V. and Y. Sun. 1997. Comparison of Mehlich III Extractable Nutrients with Bray PI, Ammonium acetate Extractable Cations, and DTPA Extractable Nutrients in Missouri Soils. 1997 International Soil and Plant Analysis Symposium in “The Promise of Precision – Past, Present and Future.” Minneapolis, MN, USA. Aug. 2-7, 1997.

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EDUCATION:

Degree: M.S. Geology (with emphasis in soils development) 1985
Institution: Iowa State University
Professor: Dr. Carl F. Vondra

Degree: B.S. Geology, 1980
Institution: Iowa State University

PROFESSIONAL EXPERIENCE:

Supervisor: Soil Testing Lab 1997-present
University of Missouri-Delta Center, Portageville, Missouri

Lab Tech II, Soil Testing Lab 1991-1997
Iowa State University, Ames, Iowa

Lab Tech II, Power Plant 1985-1991
Iowa State University, Ames, Iowa

PROFESSIONAL SERVICE:

1998- present University of Missouri Soil Testing Lab Advisory Committee.

1997- present University of Missouri Soil Test Recommendations Review Committee.

1997- present University of Missouri Soil Fertility Working Group.

1999-2001 Editor of Missouri Rice Research Update.

PROFESSIONAL SOCIETY MEMBERSHIPS:

American Society of Agronomy
Soil Science Society of America

Rice Technical Work Group

RECENT PUBLICATIONS:**Refereed Publications:**

Stevens, W.E., S.A. Berberich, P.A. Sheckell, C.C. Wiltse, M.E. Halsey, M.J. Horak, and D.J. Dunn. 2004. Optimizing pollen confinement in corn grown for regulated products. *Crop Science*. *In review*.

Stevens, G. and D. Dunn. 2004. Fly ash as a liming material. *J. Environmental Quality* 33: XX (Jan-Feb issue).

D. Dunn, G. Stevens, M. Aide, and J. Horn. 2002. Effect of soil pH and zinc on rice cultivars in Missouri. *Trans. Missouri Acad. of Sci.* pg.33-36

Stevens, G., A. Wrather, H. Wilson, and D. Dunn. 2002. Soil sampling fields with four types of soil probes. Online. *Crop Management*. doi:10.1094/CM-2002-1025-01-RS.

Stevens, G., D. Dunn, and B. Phipps. 2001. How to diagnose soil acidity and alkalinity problems in crops: a comparison of soil pH test kits. [Online] *J. of Extension*. 39:4, Available at <http://www.joe.org/joe/2001august/tt3.html> (Verified 23 Oct. 2001).

Dunn, D., B. Phipps, G. Stevens, and A. Phillips. 2001 Effect of CaSO₄ (gypsum) on cotton lint yields, soil fertility, and physical properties of heavy clay soils in Missouri. *Proc. Missouri Acad. of Sci.* 35:1-5.

Agricultural Bulletins:

Stevens, G., P. Motavalli, P. Scharf, M. Nathan, and D. Dunn. 2002. Crop nutrient deficiencies and toxicities, Integrated Pest Management Plant Protection Program, IMP1008.

Crop Management Computer Programs:

Stevens, G., R. Massey, and D. Dunn. 2000. NITROMAX- program for maximizing economic returns on nitrogen fertilizer. University of Missouri Commercial Agric. Program and Ext./Outreach. Avail. at <http://agebb.missouri.edu/commag/crops/fert/nitro/index.htm> (Verified 18 Jul. 2002).

Stevens, G., D. Reinbott, R. Massey, and D. Dunn. 2001. PROFITMETER-interactive program for calculating cropping system costs. University of Missouri Commercial Agric. Program and Ext./Outreach. Avail. on diskettes.

Invited Workshops:

Stevens, G. and D. Dunn. 2000. The basis for and verification of Missouri soil test recommendations. Soil management workshop. Beltwide Cotton Conf., San Antonio, TX, Jan 10-13.

Submitted Abstracts and Proceedings:

Stevens, G., and D. Dunn. 2002. Soil fertility research at the University of Missouri-Delta Center . Southern Soil Fertility Conf. Memphis, Tennessee, October 8-9. In Press.

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