Title: Evaluating Mehlich III Extractant for Extracting Available Nutrients for Missouri Soils using Inductively Coupled Plasma Spectrometry.

Investigators: Manjula Nathan, Department of Agronomy, University of Missouri
Peter Scharf, Department of Agronomy
Yichang Sun, MU Soil and Plant Diagnostic Service Laboratories
Dave Dunn, Delta Regional Soil Testing Lab

Objectives:

1. To determine the relationship between the Ammonium acetate and Mehlich III extractable K, Ca, Mg, Na for Missouri soils using Inductively Coupled Plasma (ICP) Spectrometry and Atomic Absorption (AA) Spectrometry.

2. To determine the relationship between the Bray I and Mehlich III extractable P using ICP and the colorimetric methods for Missouri soils.

3. To determine the relationship between the DTPA and Mehlich extractable Zn, Fe, Cu and Mn for Missouri soils using ICP and AA.

4. To relate the nutrient extracted by above methods with greenhouse yield response.

Procedures:

- Soil samples received by the soil testing labs collected throughout the state of Missouri will be used in this study. Samples collected from Sanborn field from the manured and non-manured plots as well from the farmer fields will also be analyzed. All nutrients will be analyzed both by the current MU soil test analytical procedures (colorimetry or AA) and by ICP.

- Soil samples will be analyzed for plant available K, Ca, Mg and Na by the Ammonium Acetate extraction (routine method used by MU Soil Testing Labs) and Mehlich III extractant using ICP and AA. These soil samples will also be analyzed for extractable P by Bray I extraction and Mehlich III extraction using ICP and colorimetric methods.

- Soil samples will be analyzed for plant available Zn, Fe, Cu and Mn by the DTPA extraction (routine method used by MU Soil Testing Labs) and Mehlich III extractant using ICP and AA.

- The relationship between the plant available nutrients estimated by Mehlich III extraction and the standard soil test procedures used by MU Soil Testing labs will be studied. The nutrient extracted by both procedures will be also related to the yield response using the yield data collected by Drs. John Lory’s and Peter Scharf’s (CO-PI) greenhouse study on “Soil Specific Phosphorus and Potassium Recommendations – Critical Values”.
**Current Status and Importance of Research:**

Mehlich III 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 MU labs.

Research has shown significant correlation between Mehlich III extractable-P and Bray 1-P when determined colorimetrically. Mehlich III extractable-P when determined by ICP on Missouri soils was about 30 percent greater than by colorimetry (Nathan and Sun, 1997). Research was conducted at the University of Missouri, Iowa State University (Mallarino et al., 2003), University of Minnesota Soil Testing Laboratories and Colorado State University (Nathan et al, 2002) to verify the concept that ICP measures organic forms of P, which are not detected by colorimetric determination. This work summarized the comparison of Mehlich III extractable P by ICP and colorimetric determination on manured, non-manured soils, soils spiked with ATP, and poly molecular P. Mallarino (2003) from Iowa Ste University, has published their findings based on field calibration of the Mehlich-III soil P test with Colorimetry and ICP Emission Spectroscopy for Iowa soils.

The preliminary studies were conducted by Nathan and Sun (1998) comparing Mehlich III extractable nutrients using ICP, AA and colorimetric methods with standard procedures currently used by the University of Missouri soil testing labs. Their studies revealed that the Mehlich III and Bray P I extracted identical quantities of P when measured by colorimetry. However, more P was measured by ICP on Mehlich III extracts than colorimetric measurement. The same was observed in manured and non-manured soils. Mehlich III extracted approximately the same amount of K as Ammonium acetate when measured by Atomic Absorption Spectroscopy, but less K was measured by ICP.

Mehlich III extracted more Zn, Fe and Cu than DTPA. Although the ICP measured nutrient amounts varied relative to standard method, the correlation between the methodologies was great enough to suggest that the fertilizer recommendations could be adapted to Mehlich III extraction using simpler linear relationships for most measured nutrients. However, the major limitation in extrapolating these findings to use MU fertilizer recommendations calculations that are based on the standard methods to provide recommendations for Mehlich III extractable soil test nutrients is, the data was not correlated with any yield response.

**Timetable:**

April to June 2004     Soil sample collection

July to Sept 2004     Soil sample analysis in soil testing laboratory. Sample collection and analysis of soil and plant tissue from the “Soil Specific Phosphorus and Potassium Recommendations- Critical values” greenhouse study conducted by Dr. Peter Scharf.

Oct – Dec 2004     Relate the soil test values from the Mehlich III extraction and the standard
procedures used by MU soil testing lab to the yield response and plant tissue test data. Analyze research results.


Feb – June, 2004 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 III extractant for determining the plant available nutrients for Missouri soils. When combined with additional field studies this data will be used to develop fertilizer recommendation based on the Mehlich III extractant. This will help in improving the use of MU soil test recommendations by producers using commercial soil testing labs that are using Mehlich III extractant. This will improve the quality of soil test based fertilizer 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 personal by field day presentations, grower meetings, regional and national meetings.

**References:**


### Budget

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<thead>
<tr>
<th>CATEGORIES</th>
<th>YEAR 2004</th>
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<tbody>
<tr>
<td><strong>A. Salaries</strong></td>
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<tr>
<td>Senior Lab Technician (30%)</td>
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<td><strong>B. Fringe Benefits</strong></td>
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<tr>
<td>Fringe for Lab Technician (25%)</td>
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<tr>
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<td><strong>E. Other Direct Costs</strong></td>
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<td>Field supplies</td>
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<td><strong>TOTAL REQUEST</strong></td>
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**Justification:**

Salaries and Fringe Benefits: Funds are requested to support a senior lab technician for 4 months based on an annual salary of $23,350, 25% fringe benefits.

Travel: Covers cost of travel to farm research centers and selected field sites representing all soil regions in Missouri and for presentations.

Laboratory Reagents and Supplies: Covers cost of laboratory reagents for ICP, AA, sample containers, and other materials used in soil and plant tissue analyses.

Field: Soil samplers, sample bags and other field supplies.
MANJULA V. NATHAN

Director of Soil and PlantDiagnostic Service Laboratory Tel.: (573) 882-3250 (work)
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Dept. of Agronomy Email: nathanm@missouri.edu
University of Missouri
23 Mumford Hall
Columbia, MO 65211

Manjula V. Nathan
Extension Asst. Professor, Dept. of Agronomy
Director of MU Soil Testing and Plant Diagnostic Service Labs
University of Missouri
23 Mumford Hall, Columbia, MO 65211
Phone: (573) 882-3250
FAX: (573) 884-4288
Email: nathanm@missouri.edu

Education

Ph.D. in Agronomy (1989), South Dakota State University
Major: Soil Fertility Minor: Chemistry
M.Phil. in Agric. (1981), University of Peradeniya, Sri Lanka
Major: Soil Chemistry Minor: Statistics
B.S. (Hons.) in Agric. (1978), University of Peradeniya, Sri Lanka
Major: Agronomy Specialization: Soil Science

Employment History

Lab Director/Extension Asst. Professor, MU 1995 - to date
Lab Manager/ Extension Associate, MU 1994 - 1995
Associate Soil Scientist, NDSU 1992 - 1994
Postdoctoral Associate, UMN 1990 - 1992
Postdoctoral Research Fellow: MU 1989 - 1990
Graduate Research Assistant, SDSU 1985 - 1989
Asst. Lecturer, Univ. of Peradeniya, Sri Lanka 1978 - 1979

Professional Service and Activities

Chair and State representative for NCR -13 Committee on Soil and Plant Analysis
Soil Testing and Plant Analysis Council (1994 to date)
Coordinator of Missouri Soil Testing Association Accreditation Program (1994 – to date)
North American Proficiency Testing Program QA/QC Committee (2000 to date)
North American Proficiency Testing Oversight Committee of SSSA – S 890 (2002 to date)
Official Soil Testing Method Verification Committee of SSSA– S 889 (1996 to date)
Soil Testing and Plant Analysis Committee of SSSA -S 877 (2003 – to date)
Editorial Board for Communications in Soil Science and Plant Analysis Journal (2002 to date)
National Science Foundation Graduate Fellowship Panelist (2001 - 2003)
External grant reviewer for US and Canadian Federal Funding Organizations (FIPSE, USDA and CAAS).

Membership and Affiliations

American Society of Agronomy
Soil Science Society of America
Soil Testing and Plant Analysis Council
Sigma Delta Epsilon
Gamma Sigma Delta
AOAC International

Honors and Awards

• 2002- Honored Member of “Who Is Who in Agriculture Higher Education” (WWAHE).
• 2001: Honored Member of the Lexington, KY "Who Is Who" chapter.
• 1989: First place in Graduate Student Poster Competition at the North Central Branch ASA Meetings, University of Missouri, Columbia, MO
• 1989: Plant Science Graduate Student Scholarship from South Dakota State University.
• 1988: Graduate Student Award from North Central Extension-Industry Soil Fertility Conference.
• 1987: Graduate Incentive Award from ALTRUSA International Foundation.
• 1981: Scholarship to attend training in "Cropping systems with special reference to soil fertility management" at ICRISAT, Hyderabad, India.
• 1979: Scholarship for M. Phil. degree from the Overseas Development Administration of the British Government.
• 1976: Agricultural and Cultural Seminar in Obihiro Chikusan University, Hokkaido, Japan representing the Faculty of Agriculture Student body, University of Peradeniya, Sri Lanka.

Publications

Refereed: 8       Abstracts: 17       Extension publications: 42       Proceedings and others: 37

Selected Refereed:


Recent Abstracts


Most Recent Extension Publications


Most Recent Proceedings, Presentations, and Others


Peter Clifton Scharf

Education

<table>
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<th>Degree</th>
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<tr>
<td>Ph.D.</td>
<td>May 1993</td>
<td>Virginia Polytechnic Inst. and State University</td>
<td>Crop &amp; Soil Environmental Sciences</td>
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<td>July 1988</td>
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<td>University of Wisconsin</td>
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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


Sample Extension Publications


Peter Clifton Scharf

Education

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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


Sample Extension Publications


Yichang Sun
Senior Research Lab Technician, Dept. of Agronomy
MU Soil Testing and Plant Diagnostic Service Labs
University of Missouri
22 Mumford Hall, Columbia, MO 65211
Phone: (573) 882-7218
FAX: (573) 884-4288
Email: sunyi@missouri.edu

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


Abstracts


CURRICULUM VITAE
DAVID J. (Dave) DUNN
University of Missouri
Delta Center, P. O. Box 160
Portageville, MO 63873
Phone (573) 379-5431
dunnd@missouri.edu

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

Iowa State University, Ames, Iowa

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:


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


Agricultural Bulletins:


Crop Management Computer Programs:

Invited Workshops:

Submitted Abstracts and Proceedings:


