

## MINUTES

Mid-Atlantic Soil Test and Plant Analysis Work Group  
February 20-21, 1991  
Southern States Building, 6606 West Broad Street  
Richmond, VA

Wednesday, February 20

### Soil, Plant Tissue, & Manure Sample Exchange Results

Joe Heckman, Crop Science Department, Cook College, New Brunswick, NJ, presented the sample exchange report for the six soil samples, two alfalfa tissue samples, and one cow manure sample. The plant tissue results and interpretation for nutrient applications were discussed first.

### Alfalfa Plant Analysis Discussion:

- Tom Sims - What is the reproducibility of plant N?  
Ray Campbell - About  $\pm 0.2\%$  by combustion. Kjeldahl is a little less.  
Bob Lippert - We use the Kjeldahl in the Clemson lab.  
Ray Tucker - We need to report the methods used for each analysis.  
Greg Evanylo - Suggested that the standard deviations of numbers be included in future reports.  
Gordon Miner - It looks like Mn reproducibility among labs is O.K. The interpretation seems to vary more than the analytical.  
Joe Heckman - In N.J. Coastal Plain some soils have pH 7.0 values down to 3 ft. These are old dairy farms where soils have no argillic horizon. Much alfalfa is grown and Mn deficiencies occur on alfalfa.  
Tom Sims - We need to come up with what kind of reproducibility or standard deviation is found among labs. We could take all the data for all the years in the computer from the Mid-Atlantic Work Group since 1976 and draw up a publication.  
Gordon Miner - We should define the purpose of sample exchange, develop the protocol, and state the objectives.  
Steve Donohue - Recalled that in the beginning of information exchanges (1974 with this group), nitrogen recommendations were close among labs, but no tests were made for N. On the other hand, tests were made for P and K, but interpretation and P-K recommendations varied.  
Greg Evanylo - Perhaps we do need to concentrate more on interpretation.  
Ray Campbell - Sample exchanges should continue so that labs can have an additional check on methods, and the exchange may show up possible advantages of various methods.  
Whole Group - There was consensus that sample exchanges continue.  
Mark Flock - Relative to the Mn interpretation, many soils in Indiana and Ohio with 15 ppm Mehlich 3 Mn have Mn deficient soybeans.

Doug Beegle - Suggested that we need to aim towards explaining our recommendations, i.e., the rationale.

Greg Evanylo - Noted the wide range of boron values for Alfalfa sample 2 (33 to 95).

Ray Campbell - Noted that among labs using plasma for detection, the boron values were close.

Action for 1991 - Ray Campbell and Tom Sims will take past data to work up standard deviations of values within methods among states.

Ray Campbell - We need to work on interpretation of results.

Ray Tucker - Discussed with Tom Sims the differences between Mn interpretation and recommendations were partly due to method of application, i.e., broadcast versus land or foliar.

Dave Martens - Discussed with Ray Tucker and Gordon Miner that the solubility of Mn source is also a factor. Some materials have 60% water solubility, and some 100%.

#### C.E.C. Discussion:

Tom Sims - In Delaware, we use C.E.C. ranges of 0-5, 5-15, and >15 for sludge application criteria. Maybe this is the only practical way to use C.E.C. The EPA specifies  $\text{NH}_4\text{OAc}$  C.E.C. 7.0. There is also the neutral salt "effective C.E.C.", and exchangeable bases plus acidity calculation for C.E.C., each giving a different C.E.C. value. We need to clean up how we do it and summarize. We need a continuous curve on C.E.C. for sludge application criteria.

Ray Tucker - We use exchangeable bases plus acidity and report C.E.C. on every sample.

Tom Sims - EPA people have limited knowledge of these alternative C.E.C. values and the inherent difference. We need to be careful what we report.

Greg Evanylo - C.E.C. appears to be a "hot" topic now. It may not be hot by the time our next meeting agenda is planned.

Tom Sims - I will get a list of how each lab measures C.E.C.

#### Mehlich 3 Exchange:

Joe Heckman obtained a volume of prepared Mehlich 3 solution from Columbus Chemical to provide a uniform extraction medium for all labs to use. Apparently there was some Mg contamination in the solution, since Mg levels were high. Calcium values were fairly consistent among labs.

Joe Heckman - We need to standardize our terminology for interpretation of values, i.e., high, very high, excessive, there is no need to change, just explain meanings.

Doug Beegle - Looking at PA vs MD terminology we see terms like VH vs E, M vs O. We need to define carefully what we mean and have some discussion on what we mean by high for phosphorus.

Steve Donohue - Suggested we review Doyle Peaslee's chapter on phosphorus in the SSSA Soil Testing and Plant Analysis publication.

Tom Sims - Will send out a copy of values being used for the ratings L, M, H, VH, etc.

Organic Matter Differences - NC reports humic matter, DE reports loss on ignition, and GA uses Walkley Black.

#### Mehlich I Exchange:

On P and K, there was good agreement throughout. New Jersey values appeared about double the others and was attributed to a clerical error. The same close results were seen for Ca and Mg.

Mehlich I Cu, Mn, and Zn values were close. The Quakertown soil had very high values on these elements.

Mehlich I (and Mehlich 3) boron values showed good agreement among labs. The Maryland lab values were obtained with the hot water extraction (Joe Buriel) and showed excellent agreement with the Mehlich I values.

#### Soil pH:

Lime recommendations were discussed relative to pH.

Greg Evanylo - At what pH do we recommend lime to get to the pH 6.0 target? The lower pH target farmers tend to let the pH slide too low.

Ray Tucker - We have a continuous curve down to 0.3 ton minimum. We let the farmer decide. If the lime requirement is less than 0.3 ton, it is rounded to zero.

Bob Lippert - The lime rates recommended in SC do not appear to be enough to reach the target pH.

Tom Sims - Does anyone use Ca and Mg levels to help interpret lime need (in SC, on low C.E.C. soils where Ca is low but pH adequate, gypsum is recommended in lieu of lime).

Doug Beegle - The liming target pH is 6.5. On alfalfa, the target pH is 7.0, but the lime recommended will not be enough to reach this.

Mark Flock - Where coarse lime is applied, the soil pH is sometimes too high later where large amounts have been used earlier.

#### Phosphorus:

There was a discussion on reporting "actual" levels of P in the excessive range. In Ohio, P is lost in runoff. In Delaware, there is downward movement of P.

Gordon Miner - Soluble phosphates have been found to move laterally to drainage ways, e.g., large amounts have been measured in drainage water. The problem is at what level should phosphate fertilization be cut off.

Doug Beegle - We do need an ultimate cutoff point, e.g., where to set it in Lancaster Co. PA manured fields.

Greg Evanylo - Is sludge application based on P<sub>2</sub>O<sub>5</sub> levels?

Tom Sims - Does anyone have an environmental test for phosphorus?  
Ray Campbell - We may need middlemen processors for ag wastes in certain counties.

#### Potassium:

The question was asked "Who uses subsoil K to help interpret K fertilization need?" Virginia and SC use subsoil K information. There is a problem in getting people to sample subsoil. Do we need the invention of a better soil sampling tool to get the job done?

#### Rationale of Volumetric Soil Test Measures:

Ray Tucker presented handouts and led the discussion. Ray presented three current methods used; namely, volume of soil: volume of extract, weight of soil: volume of extract, and assumed weight of soil: volume of extract. Because of variations in soil bulk densities, there are errors in the soil: solution ratio introduced except in the volume: volume measure.

Gordon Miner - The soil bulk density (apparent) after crushing and screening is suprisingly similar to the field bulk density - a plus for the volume measure.

Tom Sims and Steve Heckendorn - Discussed the use of bulk density changes in connection with O.M. loss on ignition.

Doug Beegle - Is it worth changing our present system to the volume: volume measure? Must we change our present calibrations?

Jim Woodruff - We need only use a mathematical factor to adjust calibrations. For example,  $\text{mg}/\text{dm}^3 \times 1.6 = \text{lbs per acre}$  as we are presently reporting. For example, where we use 4 ml of soil in 20 ml of extractant, we have a 1.5 soil to solution ratio. Then the ppm we measure in solution times 5 equals the ppm in the soil volume. PPM is the same as  $\text{mg}/1000$ , or  $\text{mg}/\text{liter}$ , or  $\text{mg}/\text{dm}^3$ . We are saying that the bulk density of the soil is 1.25, giving us 5 grams of soil in 20 grams of extractant, giving us a 1:4 soil to solution ratio by weight. We than multiply the ppm in solution times 4 to get ppm in the soil, and then multiply this times 2 to get pounds per acre, assuming 2 million lbs soil per acre. In the volume: volume case we multiply by 5. In the assumed weight: weight case we multiply by  $4 \times 2 = 8$ . Thus to change from one to the other we simply need to multiply  $\text{mg}/\text{dm}^3 \times 8/5$  to equal  $\text{lb}/\text{ac}$ .

Joe Heckman - In the literature there is still inconsistency in reporting.

Tom Sims - Why should we change?

Ray Tucker - If all labs in our area adopted the same extractant and the same measure of reporting, we could generate a large pool of data. I move that we aim for uniformity in procedures and reporting.

Doug Beegle - There is no move to change to Mehlich 3 in North East.

Steve Donohue - Because of time, and budget restraints, we are no closer now than we were several years ago in our plan to change to Mehlich 3.

Soil Test Kits for NO<sub>3</sub>-N (PSNT = Pre-Sidedressing N Test):

Doug Beegle discussed this rapid procedure for testing NO<sub>3</sub> in the field.

Assumptions employed -

1. On most soils all fertilizer N for corn above the starter should be sidedressed.
2. Other factors influence N availability.
3. NO<sub>3</sub> is a good indicator of available N in May & June.
4. A 7-10 day turn around is needed for N tests.
5. Can't get farmers to sample below 12" depth. (On gravelly soils there is a real need to sample deep, but it is not possible.)

Dick Fox's research to correlate soil NO<sub>3</sub>-N with corn yield at 144 locations over 5 years in PA showed that 95% relative yield was obtained (linear plateau method) where soil NO<sub>3</sub> was 25 ppm N. The soils included both organic and inorganic. In no-till, the NO<sub>3</sub> test tends to read low, but later there is a good release of N as the soil warms.

NO<sub>3</sub>-N test calibrations with yield in different areas gave similar critical levels:

PA - 25 ppm	CT - 24 ppm
VT - 25 ppm	IA - 21 ppm

Doug stated that there appears to be no big advantage to testing below the 12" zone. The following points were made regarding NO<sub>3</sub> quick tests and the use of the information for N recommendations:

1. Soil Nitrate - Procedures are similar enough and interpretation the same, so we should move to standardize recommendations.
2. Minimum Spring N fertilizer should be applied. Starter N is OK. Apply manure based on history of field, manure analysis, etc.
3. Sample fields when corn is about 12" tall - at least 1 week before N sidedressing.
4. Sample 12" deep and dry samples quickly - if there is condensation water in the plastic soil bag, the NO<sub>3</sub>-N test will double in about 5 days.
5. Analyze for NO<sub>3</sub>-N in the lab or in the field with quick test kit. The NO<sub>3</sub> electrode works OK, but requires frequent calibration. The field kit results (PSNT) check out well with NO<sub>3</sub>- electrode or cadmium reduction method in the lab.  
The PSNT kit uses aluminum sulfate extract, and NO<sub>3</sub> color test strips which are read on a hand-held meter.

County agents tested 600 samples in the field with PSNT and sent them to the lab for NO<sub>3</sub>-N test with NO<sub>3</sub> electrode. The linear relationship was excellent ( $Y = 5.4 + 0.6X$ ,  $R^2 = 0.81$ ).

Doug presented a table showing NO<sub>3</sub> test levels vs N recommendations for a range of yield goals from 100 to 200 bu/ac for corn. He stated that N recommendations for the low and high NO<sub>3</sub> tests are solid, but for middle NO<sub>3</sub> levels, not solid.

Moisture influences - In wet or dry years the NO<sub>3</sub> test prediction capability may be affected, but a study showed not much affect.

Manure - Manured fields show higher NO<sub>3</sub> than non-manured.

Forage Legumes - Fields coming out of alfalfa are credited with 20 lb/ac N.

Tillage System - Where tilled, more NO<sub>3</sub> is released. In no-till, NO<sub>3</sub> is released more gradually till July. May have to use ultraviolet test on the extract to predict the mineralization release of NO<sub>3</sub>.

#### Boron Soil Test Project:

Larry Shuman presented the results of the comparison of extractable boron using routine soil extraction methods vs the hot water extraction method.

Dr. Shuman presented the data below. Briefly, the means for 100 samples across physiographic regions:

DE - Mehlich 3 - 0.66 mg/dm <sup>3</sup>	vs	HWB - 0.40 mg/dm <sup>3</sup>
MD - Mehlich 3 - 0.62 mg/dm <sup>3</sup>	vs	HWB - 0.22 mg/dm <sup>3</sup>
NC - Mehlich 3 - 0.52 mg/dm <sup>3</sup>	vs	HWB - 0.23 mg/dm <sup>3</sup>
SC - Mehlich 1 - 0.39 mg/dm <sup>3</sup>	vs	HWB - 0.40 mg/dm <sup>3</sup>
GA - Mehlich 1 - 0.26 mg/dm <sup>3</sup>	vs	HWB - 0.21 mg/dm <sup>3</sup>
VA - Mehlich 1 - 0.43 mg/dm <sup>3</sup>	vs	HWB (not yet recored)

As the data show, the Mehlich 1 extractant retrieves about the same amount of B as HWB and the Mehlich 3 gets out a bit more than hot water. Note that if you want lb/ac B, multiply mg/dm<sup>3</sup> X 1.6.

Dr. Shuman also showed many other data and the following relationships:

M1B = 0.011 + 0.959 HWB, r = 0.71

M3B = 0.391 + 0.706 HWB, r = 0.81

The general concensus is that there is no reason not to rely on Mehlich extraction values for B. There was some discussion that work on relating plant tissue B levels to soil levels is desirable.

#### Nitrogen Management for Greens:

Jon Johnson discussed his work with green onions and collards to improve fertilizer N efficiency through leaf tissue N analyses. Where some growers have been applying up to 400 lb/ac

N it appears that with 50 lb/ac preplant N and 20 lb/ac every week, the total N rate can be held to less than 150 lb/ac. The critical leaf N for green onion tops is 3.9% N and for collards, 4.25% N to obtain the visual quality and desired production.

Methods for Determining N Rates on Corn:

Owen Plank lead the discussion on approaches to N rates.

Georgia - 1.2 lb N per bushel of corn potential for dryland.

Auburn - 120 - 150 lb/ac N for dryland  
180 lb/ac N irrigated

Arkansas - 1.0 to 1.05 lb N / bu of corn

Florida - 12 lb N / 1000 plants / acre dryland  
8 lb N / 1000 plants / acre irrigated

Georgia - 1.25 - 1.33 lb N / bu irrigated. Gary Gascho suggests 0.75 to 1 lb N / bu (dryland?).

NC- Kamprath suggests 0.9 to 1 lb N / bu dryland.

Mississippi - 130 lb / ac N dryland

N. Carolina - 120 - 160 lb / ac N dryland  
+ 10% to 15% irrigated

S. Carolina - 100 - 150 lb / ac N dryland  
180 - 120 irrigated

Encourage leaf N monitoring and 4 applications through the irrigation water.

Tennessee - 1.05 - 1.2 lb / bu N  
yield goal      100 - 125 bu = 120 lbs/ac N  
                         150 - 175 bu = 180 lbs/ac N  
                         225 - 250 bu = 270 lbs/ac N

Virginia - Groups I      > 135 bu      = 150 - 175 lbs/ac N  
                 Groups II     110 - 135      = 125 - 150 lbs/ac N  
                 Groups III    95 - 110      = 100 - 125 lbs/ac N  
                 Groups IV     < 95           = 75 - 100 lbs/ac N

Legume Credits

Soybeans - 20 - 40 lb/ac N

Peanuts - 20 - 40 lb/ac N

Alfalfa - 80 - 100 lb/ac N

Other winter legumes (at bloom) - 80 - 100 lb/ac N

Discussions suggested the need for yield goal setting on which to base N rate suggestions.

Jim Woodruff - Presented N rate, earleaf tissue N, and corn yield data from field experiments showing that critical earleaf N is about 2.7% for corn. Two references were cited:

Woodruff, J.R., J.T. Ligon, and B.R. Smith. 1984. Water table depth interaction with nitrogen rates on subirrigated corn. Agron. J. 76:280-283.

Woodruff, J.R. and H.L. Musen. 1985. Corn yield response to starter fertilizer and sulfur in a coastal plain soil. J. Fert. Issues 2:47-52.

Greg Evanylo - How are we recommending to put out N? Split application?

Joe Heckman - Stalk N at the end of the season may correlate with yield in Iowa. Above 2000 ppm NO<sub>3</sub>-N is considered luxury consumption.

Manure:

Ray Campbell - Manure analysis is expanding rapidly.  
Bob Lippert - Few farmers willing to pay \$15.00 per sample for manure analysis.

Additional N comments: Greg Evanylo passed out information from Mark Alley on wheat. If soil test NO<sub>3</sub>-N is below 15 ppm, N is needed at planting.

Ray Campbell - N/S ratio should be less than 15?  
Mark Flock - Michigan State has shifted from the 2' to 12" depth for NO<sub>3</sub>-N sampling. Illinois and Michigan use 1.2 lb/ac N per bushel of corn yield.

Meeting adjourned at 4:30 p.m. February 20.

Thursday, February 21

8:00 a.m. The meeting was opened by Chairman Lippert. A brief presentation of the results of a boron and nitrogen study on canola in SC was given, since canola acreage is growing rapidly.

(Porter, P.M., C.E. Curtis, J.H. Palmer, and L.A. Stanton. 1990. Canola Production in South Carolina. EC 669. Clemson University Cooperative Extension Service, Clemson, SC 29631.)

Bob Lippert discussed a comparison of lime requirement methods (Adam Evans vs Modified Adam Evans being used by SC vs Mehlich). His conclusion was that the restructured lime tables adapted to the modified Adam Evans method gives insufficient lime recommendations to reach the target pH. SC should change over to the Adam Evans standard procedure. The good news is that EPA says that paranitrophenol is not on the toxic hit-list and won't be considered for a long time.

Pour Through Method for Artificial Mixes

Steve Donohue described the method developed by Robert Wright, Horticulture Department Head at VPI. The principle is that water poured into the top of a pot displaces the soil solution. The values measured are about twice what one would find with the 1:1 soil: water paste. One advantage is that this method does not disturb the slow-release materials being used, and the greenhouse industry is moving more toward this method of fertilization.



Ray Campbell - Every year there are seen some salt damage problems where the slow-release materials suddenly break down and release all the material.

Manganese Deficiency on Alfalfa:

Joe Heckman reported on his study of Mn deficiency problems in N.J. Coastal Plain soils with soil pH values around pH 7.0 to depths of 3'. Leaf tissue mn was raised more effectively with foliar applications of 2 lb Mn than with soil broadcast applications of 20 lb Mn using MnSO<sub>4</sub>.

Soil Test Evaluation of Copper and Zinc on sludge - Amended Soil

Gordon Miner stated that heavy metals are increasing in NC soils where poultry and swine manures are being heavily applied. Some 2,000 acres of sludge land also have reached EPA limits. There is an on-going study looking at the uptake of metals by shallow-rooted crops, swisschard and lettuce, and deeper-rooted crops, tobacco and peanuts on 5 fields with a pH range and heavy metal loading. Most of the variation on uptake is due to soil pH. At pH 4.5, swisschard had 1200 ppm Zn, and at pH 6.5, 150 ppm Zn. No toxicity has been observed.

Some data show that Cu and Zn uptake is higher at high pH values from sludge.

Larry Shuman - George O'Conner wrote a paper discussing DTPA as an extractant for heavy metals. DTPA is not suitable for acid soils.

Doug Beegle - We plant to switch to Mehlich 3 by the summer of 1991 so that we can extract heavy metals effectively.

Regional Methods Manual:

Tom Sims discussed the North East Regional Methods Bulletin which will be coming out with standard acceptable methods in the Fall of 1991. Morgan's extract is still being used in the region. Stu Klansner, N.Y. is preparing a bulletin on environmental testing.

Steve Donohue - The Reference Methods for the Southern Region will be out in the next couple of months.

Sample Exchange Schedule and Next Years Plans:

The sample exchange schedule was passed out. Paul Chu will be in charge of the 1992 exchange. A list of suggested topics was cited. Phosphorus and environmental testing were mentioned. The move toward more discussion and open exchange as opposed to strictly formal presentations with limited discussion was encouraged and recommended by the group. For the exchange, cite methods, show sample deviation within lab and also among labs by method.

1992 - The meeting will be held on Wednesday, February 19 and Thursday, February 20. The first day will begin at 8:30 a.m. and the second day at 8:00 a.m., ending at noon and held in the same Southern States conference room.

#### STATE REPORTS

Joe Heckman, NJ - Roy Flannery sends his greetings. The NJ lab was about to be shut down, but Joe Heckman and Harry Moto were able to get support and have been promised a new building location, a new D.C.P., and will change to Mehlich 3. They will work on critical levels of B, Cu, Mn, and Zn for Mehlich 3.

Joe Buriel, MD - Allan Bandel had an important meeting scheduling conflict. Maryland will go on line with computerized recommendations for all counties in 2 months. An ICP is needed, but probably won't come soon because of lack of funding.

Tom Sims, DE - Now using loss on ignition for O.M. The values obtained are 0.3% lower than Walkley Black. A charge of \$5.00 is made. Computer language is being switched from Fortran to Basic. Delaware wants to get an ICP.

Dave Martens, VA - Thanks for setting the date for my next years soil fertility class quiz (which allows me to leave campus for this meeting).

Steve Donohue, VA - Discussed a 35% budget cut for Virginia programs. The lab lost 1.5 positions and now charges \$6.00 per sample for routine and Zn, Mn, Cu, and B.

David Aho, VA - As a result of technician losses, plant analysis is cancelled, and the pour-through greenhouse pot testing is cancelled. Hope to start up next year.

Doug Beegle, PA - Will switch to Mehlich 3. Ann Wolfe will direct and have in one building the environmental, soil, plant, and other testing except manure analysis. Have 2 new ICP instruments. Run 70,000 samples per year at \$6.00 per sample. The charge hasn't hurt the volume of samples. There are nutrient management plans and soil testing programs on 55,000 farms. The manure analyses are contracted out to A&L, MD, NY, and DHIA. PA wants to develop electronically transmitted data for consultants.

Owen Plank, GA - There was a decline in plant tissue samples because of drought. Soil samples run about 135,000 per year. The cotton petiole sampling program is growing. There have been 3 full-time positions lost in Agronomy. Alternative funding is coming from check off programs and other sources.

Clayton Cooper, Nachurs - Alabama and Mississippi State are investigating foliar potassium applications in cotton.

Ray Campbell, NC - Plant sample volume is increasing 5-6% per year. Results can be summarized by crop, county, etc. and will be available in printed handbook. Plant and waste solution samples were about 10,000 last year. A charge of \$4.00 per sample is made.

The meeting was adjourned at 12 noon - a list of participants is below.

These meetings are respectfully submitted by James R. Woodruff, acting secretary for the 1991 meetings.

#### Attendees

Clayton Cooper, Jr.  
Bob Lippert  
Larry Shuman  
Jim Woodruff  
Mark Flock  
Gordon Miner  
M. Ray Tucker  
Tom Sims  
Joe F. Buriel  
Greg Evanylo  
John Hardy

Judy Mason  
David Aho  
Jon R. Johnson  
Doug Beegle  
Steve Donohue  
C. Ray Campbell  
David C. Martens  
Steve Heckendorn  
Joseph R. Heckman  
Paul Chu