Activities of the Mid-Atlantic Soil Test Work Group

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July 30, 1979

The Mid-Atlantic Soil Test Work Group arose out of a meeting organized by Maywood Snyder of Southern States Cooperative and Bill Pickett of FCX Cooperative in June, 1975 in which soil testing and soil fertility representatives from land-grant institutions in the Mid-Atlantic region were invited to discuss differences in fertilizer recommendations. These differences, while sometimes justified because of differences of philosophy, cause problems for farmers living near state borders who send samples periodically to two labs (their own state lab and the neighboring states lab). At this meeting, differences in recommendations were identified and discussed, and the ground work was laid for resolving these differences.

Since the first meeting, the group has met on an annual basis for a total of six meetings to address various subjects related to soil testing and crop fertilization and liming. The following is a brief description of the activities and accomplishments of the Mid-Atlantic Soil Test Work Group.

1. Nitrogen, Phosphorus, Potassium Fertilizer Recommendations

At the initial meeting in 1975, it was found that nitrogen recommendations were fairly consistent throughout the region. However, phosphate and potash recommendations differed considerably, as is shown in Table 1. Part of the reason for the differences was due to the fact that very few states agreed on the numerical range for the soil test level designations "Low", "Medium" and "High" (See figures 1 and 2. While most states agreed to the definition for these test levels, (i.e., Low - frequent response to applied fertilizer, Medium - occasional response to applied fertilizer, High - no or minimal response to applied fertilizer), some states had set the separation points between Low - Medium and Medium - High on the high side for insurance purposes. Because of this, recommendations were subsequently compared at given extractable nutrient levels.

After considerable work, a set of standard recommendation guidelines was developed and the states in the region gradually moved toward these recommendations. However, by 1978, considerable differences still existed in the recommendations in the region. At this time, it was decided to review recommendations again and make comparisons at "strategic" soil test levels . These soil test levels were 1) the zero lb/A extractable nutrient level - to indicate the maximum amount of fertilizer recommended by each state, 2) the soil test level of no further crop response - to indicate the maintenance fertilizer rate each state was using, and 3) the soil test level above which no further fertilizer would be recommended. The extractable nutrient values each state was using for each strategic soil test level was compared (Tables 2 and 3) and then a standard set of strategic soil test levels and fertilizer recommendations were developed (Table 4). These recommendations were designed for gradual implementation by the states in the Mid-Atlantic region and represent a significant step toward uniformity in this area.

2. Laboratory Procedures

Laboratory procedures used by the states in the Mid-Atlantic Soil Test Work Group are listed in Table 5. While most states used the same extractant (i.e. Double Acid), soil extraction techniques and sample scoop sizes differed considerably (Tables 6 and 7). Since differences in extraction techniques and scoop size can have a significant effect on the amount of nutrients extracted from soil, efforts were made toward more uniformity in this area. From this work, a standard soil:solution ratio (1:5 on a volume: volume basis) and a standard scoop size (5ml-thimble shaped) were adopted for phosphorus, potassium, calcium, and magnesium using the double acid extraction method.

3. Soil Sample Exchanges

Soil sample exchanges were conducted by the group in an effort to identify differences in nutrient extraction between laboratories using the same lab methods. As mentioned previously, comparison of test results at Low, Medium, and High was not feasible because of differences in the extractable nutrient ranges for these soil test levels between the various states. Comparing results using the unit "lb/A" was also not feasible since states differed in their "volume weight" assumption (i.e. the amount of soil assumed to be in a scoop of soil with the same volume). Most states do not weigh a given amount of soil for testing but rather use a scoop of a certain volume to obtain a certain weight (called "assumed weight"). As an example, Virginia, West Virginia, and Maryland all assume a volume weight of 5 grams of soil for their scoops. However, scoop sizes were 4, 5 and 4.7 ml, respectively, for the three states.

Because of problems in comparing soil test results at Low, Medium, and High or lbs/A, the units "milligrams per cubic decimeter (mg/dm^3)" were selected for the sample exchanges which involve no "assumptions" in soil volume weight -- i.e.,no biases in test results due to differences in the actual reporting of the results. Also, a standard soil scoop was purchases by each state for the exchanges.

The results of the 1978 sample exchange are presented in Tables 8, 9, and 10. The differences in soil pH averaged over the three soil samples used in the study for the seven states using the double acid extraction method was 0.3 units showing the relatively close agreement and accuracy of this test. Test comparison results for phosphorus and potassium were not as close as soil pH (Tables 9 and 10) and may have been due, in part, to differences in sample shaking equipment, shaking speed, filter paper used, etc. In general, these differences were not large enough for most states to change the test results a letter grade -- e.g. from Low to Medium.

Sample exchanges are continuing on a yearly basis within the states in the work group to help identify and resolve differences in laboratory procedures and techniques.

4. Other Activities

Trace elements, sulfur, and lime testing methods and recommendations have also been compared and evaluated by the Mid-Atlantic Soil Test Work Group in an effort to identify and resolve, where possible, differences in this area. Trace element efficiencies, in general, are localized to certain areas or soils of certain states. An example is copper deficiency on the organic soils of North Carolina. Also, the unique properties of some of the trace elements mandate that difficult test methods be employed for different soils in the region. Because of these factors, differences in trace element test methods and recommendations will and should vary from state to state in the Mid-Atlantic region.

Differences in lime test methods and recommendations also varied from state to state, due primarily to differences in soils as well as philosphy in making recommendations. Future research by member states may help resolve some of these differences.

SUMMARY

The Mid-Atlantic Soil Test Work Group, formed in 1975 to resolve differences in fertilizer recommendations in the Mid-Atlantic region, has made considerable accomplishments in several areas. Through the cooperative work of this group, a standard set of nitrogen, phosphorus, and potassium fertilizer recommendations was developed for use in the region and progress was made in the area of standardization of laboratory techniques. Work is continuing in an effort to identify and resolve further differences in recommendations and lab procedures in this region.

Table 1. P_2O_5 and K_2O Recommendations - Corn (100 bu/A) - Mid-Atlantic Soil Test Work Group. 1975.

State	P			K		
	L	M	H	L	M	H
	— P_2O_5, lb/A —			— K_2O, lb/A —		
DEL	110	80	50	120	40	0
MD	110	80	35	110	70	50
WVA	100	80	50	100	80	60
NC	135	45	0	165	60	0
SC	150	65	40	120	70	30
KY	120	30	0	120	60	0
VA	70	45	30	70	45	30

Table 2. Comparison of P Recommendations and Soil Test Breakoff Points for Corn (100 bu)* 1978.

	NC	SC Clayey	SC Sandy, C. Loamy, F. Loamy	VA	WVA	MD	NJ	DEL	PENN
Max. lbs P_2O_5/A Recommended at 0 Soil Test P	165	100	80	100	120	110	110	120	160
Soil Test P level (mg/dm^3) of No Further Crop Response	23	13	19	22	32	16-30	30	30?	40-45
Lbs P_2O_5/A Recommended at Point of No Further Crop Response	60	50	50	40	50	80-50	45	45	45
Soil Test P Level (mg/dm^3) Above Which No Further P_2O_5 Recommended	45	50	75	68	**	**	**	45	60

*All states except PENN use double acid procedure to extract P. PENN uses Bray P_1.
**Starter fertilizer (0-20 lb/A) recommended at very high soil test levels.

Table 3. Comparison of K Recommendations and Soil Test Breakoff Points for Corn (100 bu)* 1978.

	NC	SC Clayey, F. Loamy	SC Sandy C. Loamy	VA	WVA	MD	NJ	DEL	PENN (CEC=10)
Max. lbs K_2O/A Recommended at 0 Soil Test	155	100	80	100	120	110	110	105	200
Soil Test K Level (mg/dm^3) of No Further Crop Response	45	45	45	110	76	>60	60-70	60	50-60
Lbs K_2O/A Recommended at Point of No Further Crop Response	75	50	50	40	40	80	80	50	100
Soil Test K Level (mg/dm^3) Above Which No Further K_2O Recommended	140	120	120	194	150	**	**	110	110

*All states except PENN use double acid procedure to extract K. PENN uses 1N NH_4OAc.
**Starter fertilizer (0-20 lb/A) recommended at very high soil test levels.

Table 4. Standard N*, P_2O_5 and K_2O Fertilizer Recommendations-Mid-Atlantic Soil Test Work Group. 1978.

Ext. P, lb/A	P_2O_5 Recommended, lb/A	Ext. K, lb/A	K_2O Recommended, lb/A	
mg/dm³		mg/dm³	CEC = 0-5	CEC > 5
0	150	0	100	150
32-40 20-25	50	80 50	60	—
80 50	0	120 75	—	60
		160 100	0	—
		240 150		0

* N Recommendations--Corn (100 bu/A) - 120 lbs/A; Small Grains - 15-30 lb/A (Fall), 20-100 lb/A (Spring).

Table 5. Lab Procedures Used For Extraction of P, K, Ca, Mg by States in the Mid-Atlantic Region.

NJ	DEL	MD	NC	SC	WVA	VA	KY	PENN
D.A.*	D.A.	D.A.	D.A.	D.A.	D.A.	D.A.	Bray P_1** NH_4OAc	Bray P1 NH_4OAc

* D. A. - double dilute acid extracting procedure. Consists of 0.05 N HCl and 0.025N H_2SO_4.

** Bray P_1 - for extraction of phosphorus; NH_4OAc (ammonium acetate) - for extraction of potassium, calcium, and magnesium.

Table 6. Comparison of Soil Scoops and Soil Extraction Techniques for Determining Phosphorus and Potassium.

	Phosphorus								Potassium							
	NC	SC	VA	W VA	MD	NJ	DEL	KY	NC	SC	VA	W VA	MD	NJ	DEL	KY
Scoop:																
size (ml)	5	4	4	5	4.7	5	5	2	5	4	4	5	4.7	5	5	4.5
diameter (mm)	19	21.5	20	22	19	22.5		15.6	19	21.5	20	22	19	22.5		22
depth (mm)	21	11	12	13	15	12.5		10	21	11	12	13	15	12.5		11.5
shape	* tapered	cyl	cyl	cyl	cyl	cyl	cyl	cyl	* tapered	cyl	cyl	cyl	cyl	cyl	cyl	cyl
composition	SS**	copper	SS	metal	metal	SS	metal	metal	SS**	copper	SS	metal	metal	SS	metal	metal
volume weight, g/cc	--	1.25	1.25	1.00	1.06	1.25	--	1.00	--	1.25	1.25	1.00	1.06	1.25	--	1.11
Volume of Extractant (ml):	25	20	20	20	20	25	25	20	25	20	20	20	20	25	25	25
Extraction Bottle:																
size (ml)	60	60	60	60	60	65	150	60	60	60	60	60	60	65	150	60
diameter (mm)	44	38	38	37	45	45		44	44	38	38	37	45	45		44
depth (mm)	82	55	63	73	80	60		82	82	55	63	73	80	60		82
shape	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl
Shaking of Extract:																
time (min.)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
length of stroke (cm)	3.8	4.0	3.8	2	rotary	3	8.9	3.8	3.8	4	3.8	2	rotary	3	8.9	3.8
oscillations/min.	180	200	180	260	200	200	72	280	180	200	180	260	200	200	72	218
filter paper #	What. 1	What.2	What.1	S&S 595	What.1	2	S&S 595	What.2	What.1	What.2	What.1	S&S 595	What.1	2	S&S 595	What.1

*Round bottom
**Considering going to plastic

Table 7. Comparison of Soil Scoops and Soil Extraction Techniques for Determining Calcium and Magnesium.

	Calcium								Magnesium							
	NC	SC	VA	W VA	MD	NJ	DEL	KY	NC	SC	VA	W VA	MD	NJ	DEL	KY
Scoop:																
size (ml)	5	4	4	5	4.7	5	5	4.5	5	4	4	5	4.7	5	5	4.5
diameter (mm)	19	21.5	20	22	19	22.5		22	19	21.5	20	22	19	22.5		22
depth (mm)	21	11	12	13	15	12.5		11.5	21	11	12	13	15	12.5		11.5
shape	* tapered	cyl	cyl	cyl	cyl	cyl	cyl	cyl	* tapered	cyl	cyl	cyl	cyl	cyl	cyl	cyl
composition	SS**	copper	SS	metal	metal	SS	metal	metal	SS**	copper	SS	metal	metal	SS	metal	metal
volume weight, g/cc	--	1.25	1.25	1.00	1.06	1.25	--	1.11	--	1.25	1.25	1.00	1.06	1.25	--	1.11
Volume of Extractant (ml):	25	20	20	20	20	25	25	25	25	20	20	20	20	25	25	25
Extraction Bottle:																
size (ml)	60	60	60	60	60	65	150	60	60	60	60	60	60	65	150	60
diameter (mm)	44	38	38	37	45	45		44	44	38	38	37	45	45		44
depth (mm)	82	55	63	73	80	60		82	82	55	63	73	80	60		82
shape	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl	cyl
Shaking of Extract:																
time (min.)	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
length of stroke (cm	3.8	4	3.8	2	rotary	2	8.9	3.8	3.8	4	3.8	2	rotary	3	8.9	3.8
oscillations/min.	180	200	180	260	200	200	72	218	180	200	180	260	200	200	72	218
filter paper #	What.1	What.2	What.1	S&S 595	What.1	2	S&S 595	What.1	What.1	What.2	1	S&S 595	What.1	2	S&S 595	What.1

*Round bottom
**Considering going to plastic

Table 8. Determination of Soil pH by State Soil Testing Laboratories in the Mid-Atlantic Region.*

Sample No.	VA	NJ	DEL	MD	NC	SC	WVA	$\bar{x}$
1	5.6	5.6	5.5	5.6	5.5	5.8	5.5	5.6
2	6.8	6.7	6.6	6.6	6.5	6.6	6.7	6.6
3	5.7	5.8	5.7	5.7	5.6	5.9	5.7	5.7
$\bar{x}$	6.0	6.0	5.9	6.0	5.9	6.1	6.0	6.0

*Data from 1978 Mid-Atlantic sample exchange.

Table 9. Determination of Phosphorus (P) by State Soil Testing Laboratories in the Mid-Atlantic Region.*

Sample No.	VA	NJ	DEL	MD	NC	SC	WVA	$\bar{x}$
	P, mg/dm^3							
1	44†	41	34	26	41	43	24	36
2	28	25	20	18	28	28	21	24
3	18	17	15	13	20	15	13	16
$\bar{x}$	30	28	23	19	30	29	19	25

*Data from 1978 Mid-Atlantic sample exchange

†To convert from mg/dm^3 to lbs/acre, multiply values in table by 1.6.

Table 10. Determination of Potassium (K) by State Soil Testing Laboratories in the Mid-Atlantic Region.*

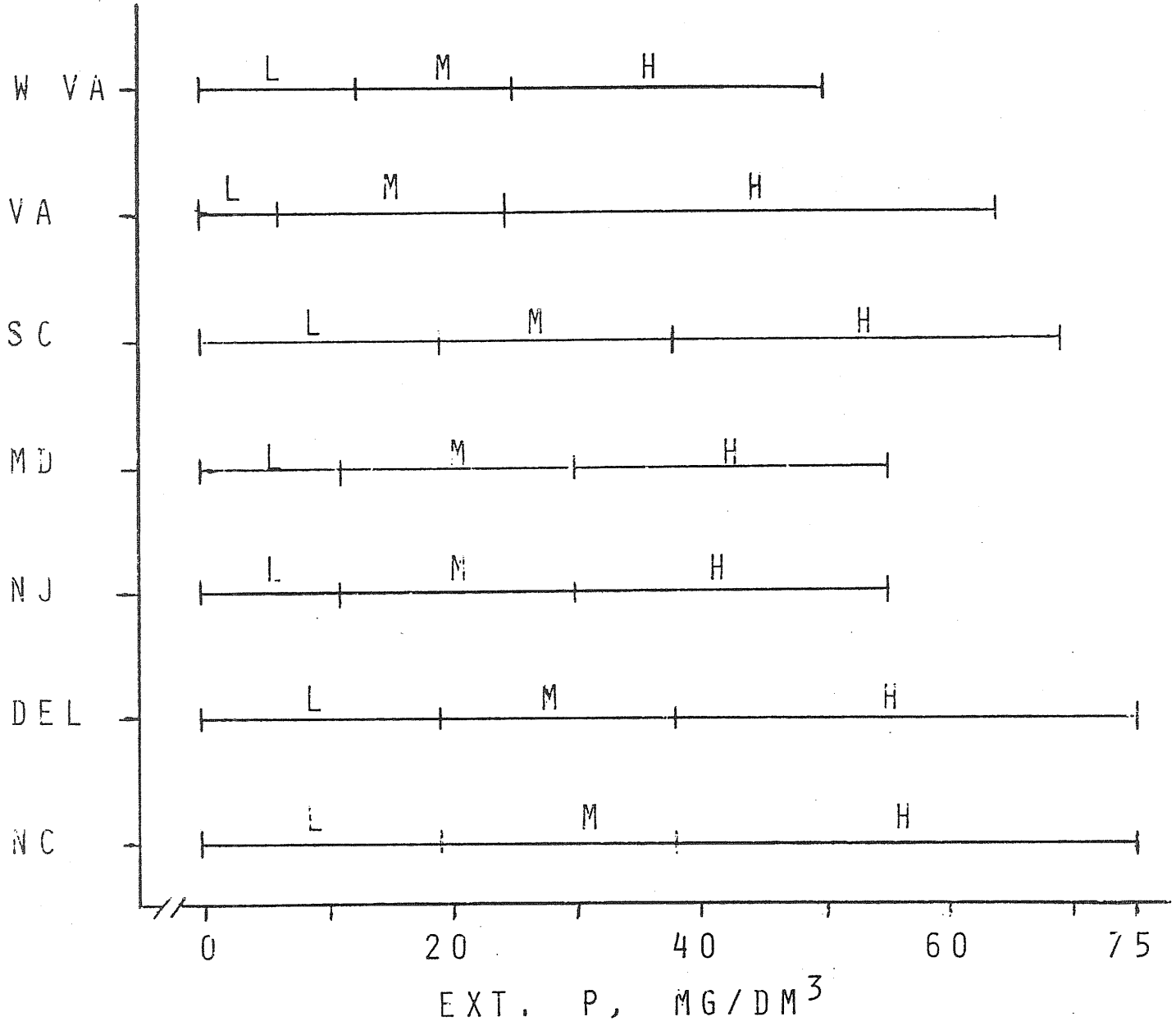
Sample No.	VA	NJ	DEL	MD	NC	SC	WVA	$\bar{x}$
	K, mg/dm^3							
1	66†	68	58	52	71	74	63	65
2	111	108	95	87	138	108	114	109
3	126	135	129	108	155	133	118	129
$\bar{x}$	101	104	94	82	121	105	99	101

*Data from 1978 Mid-Atlantic sample exchange.

†To convert from mg/dm^3 to lbs/acre, multiply values in table

FIGURE 1

DIFFERENCES IN L, M, H INDEX SYSTEM FOR P AMONG MID-ATLANTIC STATES 1975.



$MG/DM^3 \xrightarrow{x\ 1.6}$ LB/A, 7.06" PLOW DEPTH

$MG/DM^3 \xrightarrow{x\ 1.78}$ LB/A, 7.87" (20 CM) PLOW DEPTH

FIGURE 2

DIFFERENCES IN L, M, H INDEX SYSTEM FOR K AMONG MID-ATLANTIC STATES