Soil Sampling, Testing, and Interpretation

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Professor & Extension Specialist

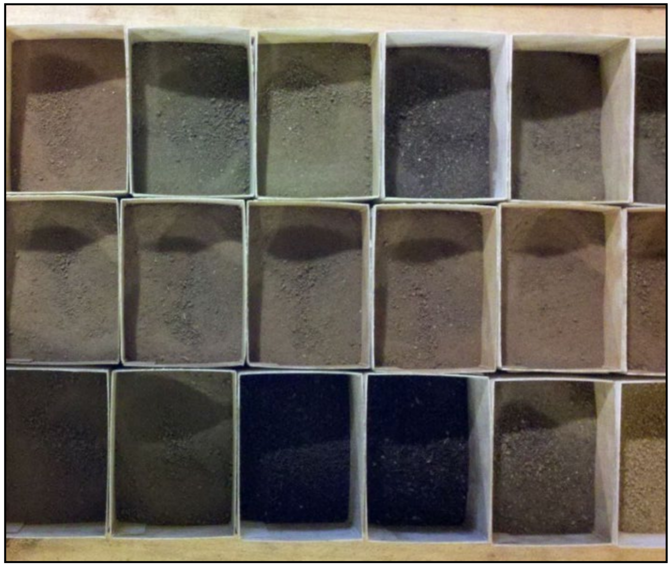
With contributions from:

John Spargo (PSU), Mark Reiter (VT), Amy Shober (UD)

ToorUMD

Goal of Soil Fertility Testing

1. Measure of the **ability** of a soil to supply nutrients for healthy plant growth and identify limitations.



2. Predict the **probability** of a profitable response to nutrients (fertilizer) and lime addition.

Soil Testing

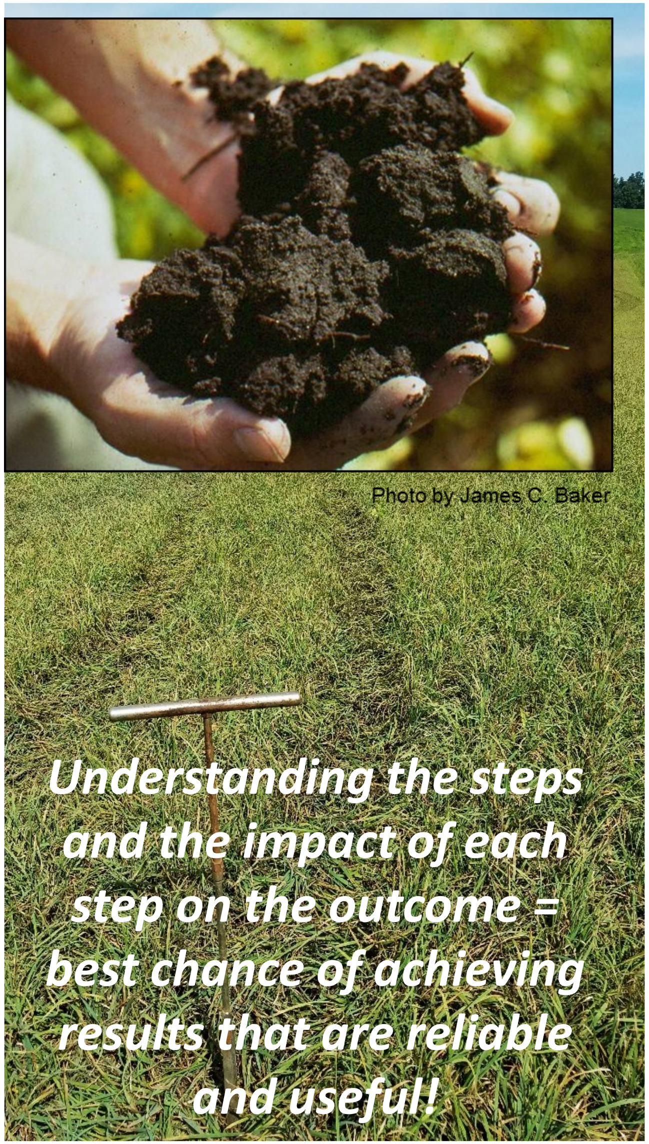


Photo by James C. Baker

Understanding the steps and the impact of each step on the outcome = best chance of achieving results that are reliable and useful!

- Nutrient content (N, P, K and micronutrients)
- Soil pH for lime additions

Four Steps

1. Sample collection
2. Extraction and laboratory analysis
3. Interpretation of results
4. Recommendations

Step 1 – Sample Collection

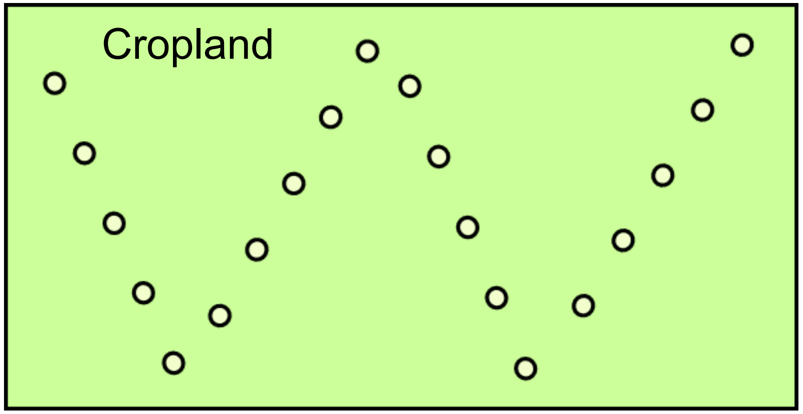
- Goal: to collect a sample that is representative of the area to be tested
- Largest source of error due to lack of representative sample
  - For example, 2.0 g of soil in the lab may represent as much as 20,000,000 lbs of soil in a 10 acre parcel

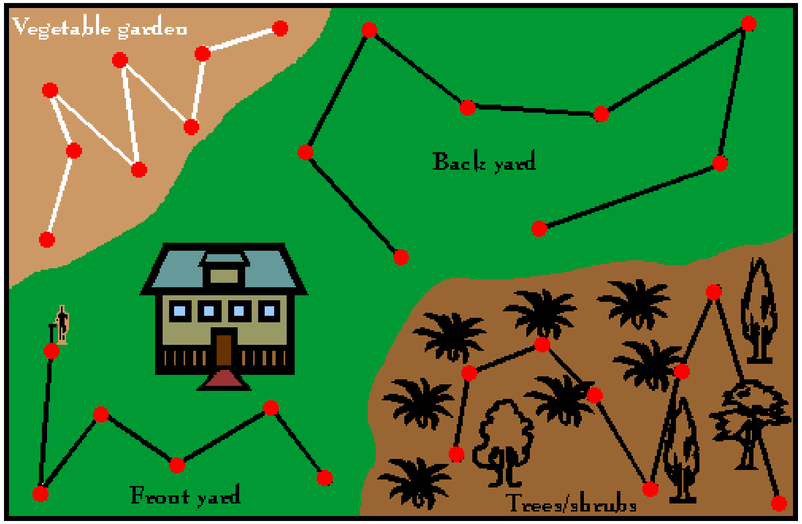
1 acre = 2 million pounds of soil in upper 6 inches

http://www.omafra.gov.on.ca/IPM/english/soil-diagnostics/soil-testing.html

Traditional Approach: ***Unbiased Composite Sampling***

- Best for fairly uniform areas
- Walk field in zig-zag pattern covering whole field
- Collect cores at random locations
- Collect 15-20 cores per field (20 acres)





Why is the Number of Cores Collected Important?

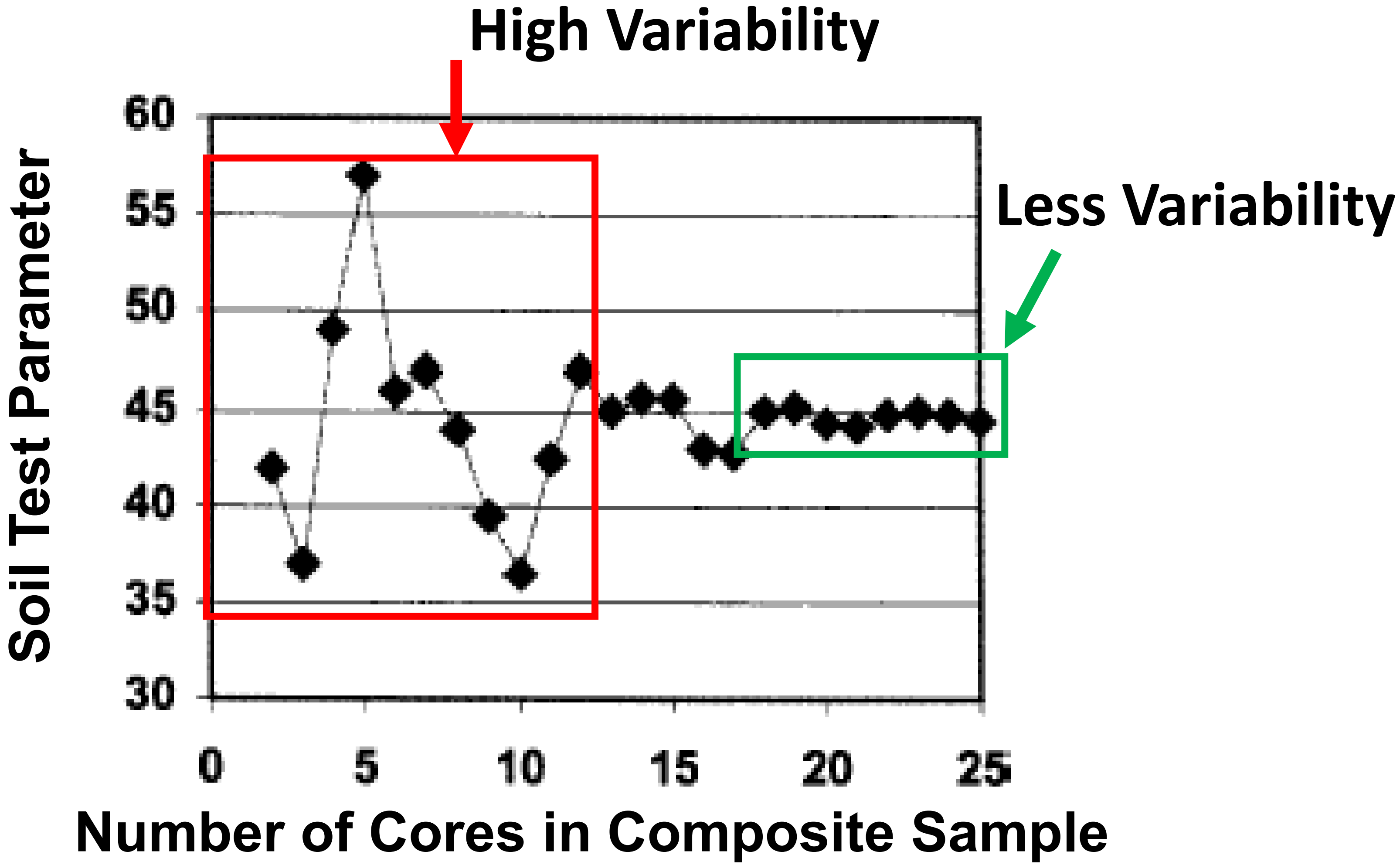
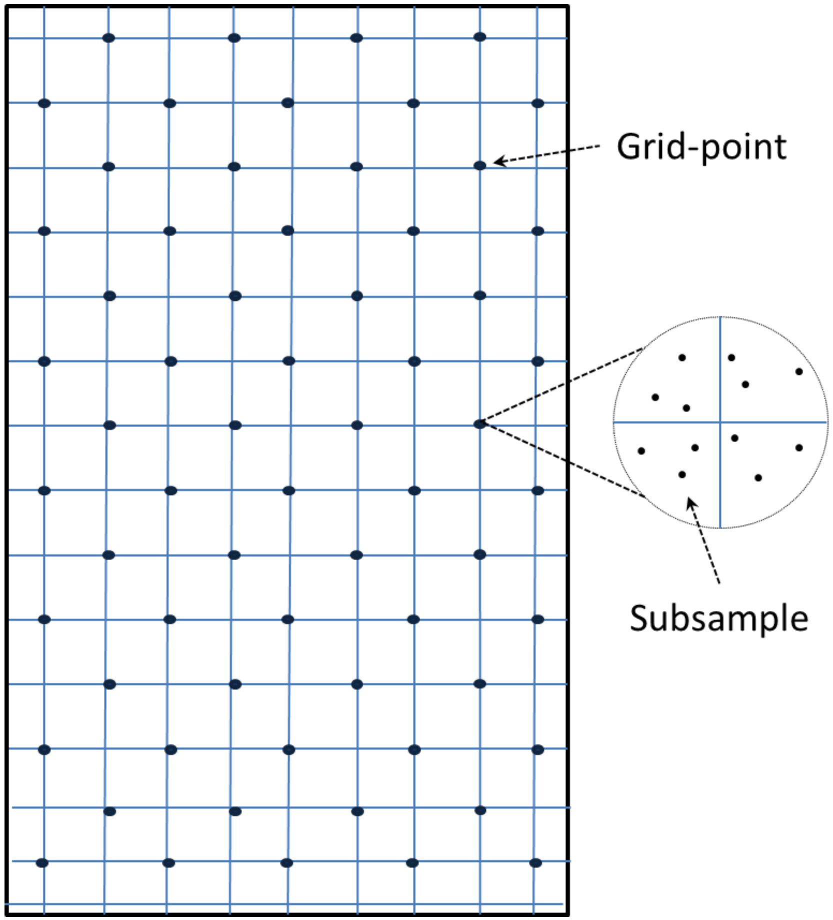


Figure courtesy of Oklahoma State University

Precision Approach: *Grid Point Sampling*

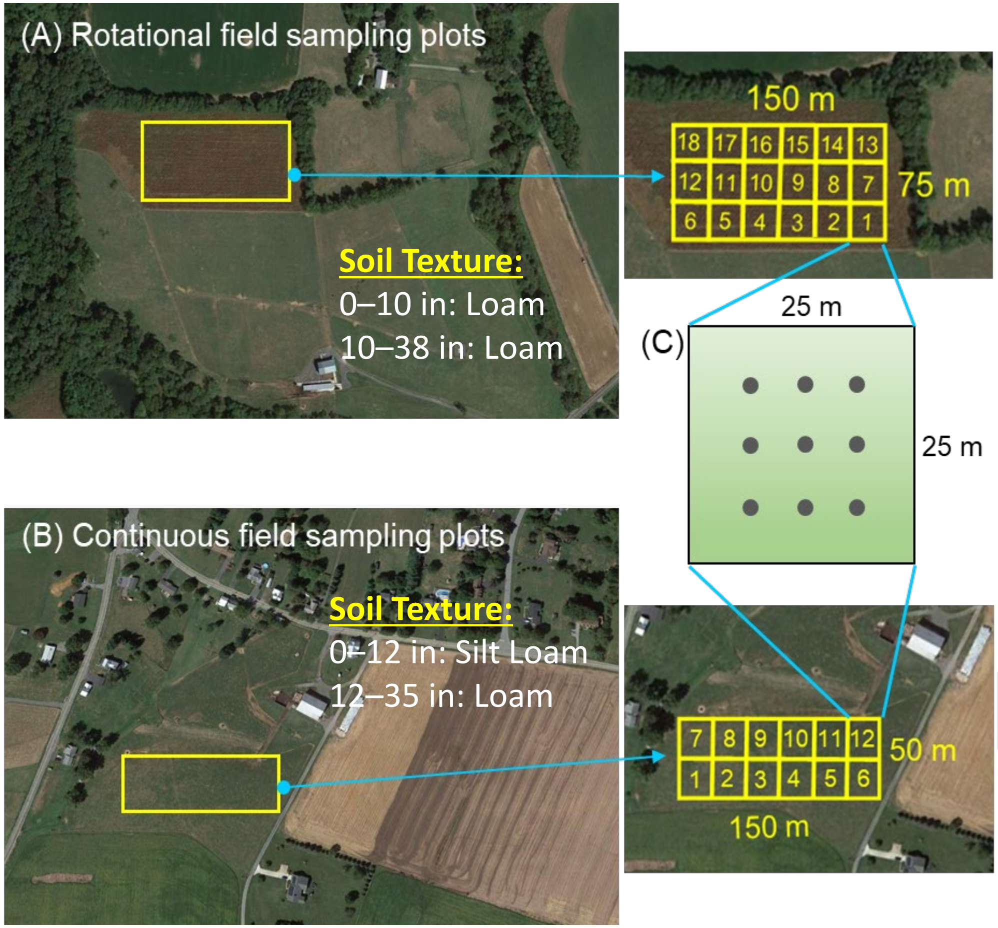
- Field is broken into subunits based on a specified grid pattern; grid size a function of soil variability (~1 to 2.5 ac)
- Collect a composite sample from each grid
- Results & recommendations extrapolated between points for variable rate application
- No need to do it every year. DO once and then every ~5 years if you find high variability



Grid Sampling in Fredrick County

- Located in Fredrick county, MD. Under same management system for ~15 years
- Field 1: 18 grids
- Field 2: 12 grids
- From each grid, 9 soil samples were composited to make 1 sample/grid

- Two soil sampling depths:
    - 0–2 in
    - 0–8 in



(A) Rotational field sampling plots

Soil Texture:
0–10 in: Loam
10–38 in: Loam

(B) Continuous field sampling plots

Soil Texture:
0–12 in: Silt Loam
12–35 in: Loam

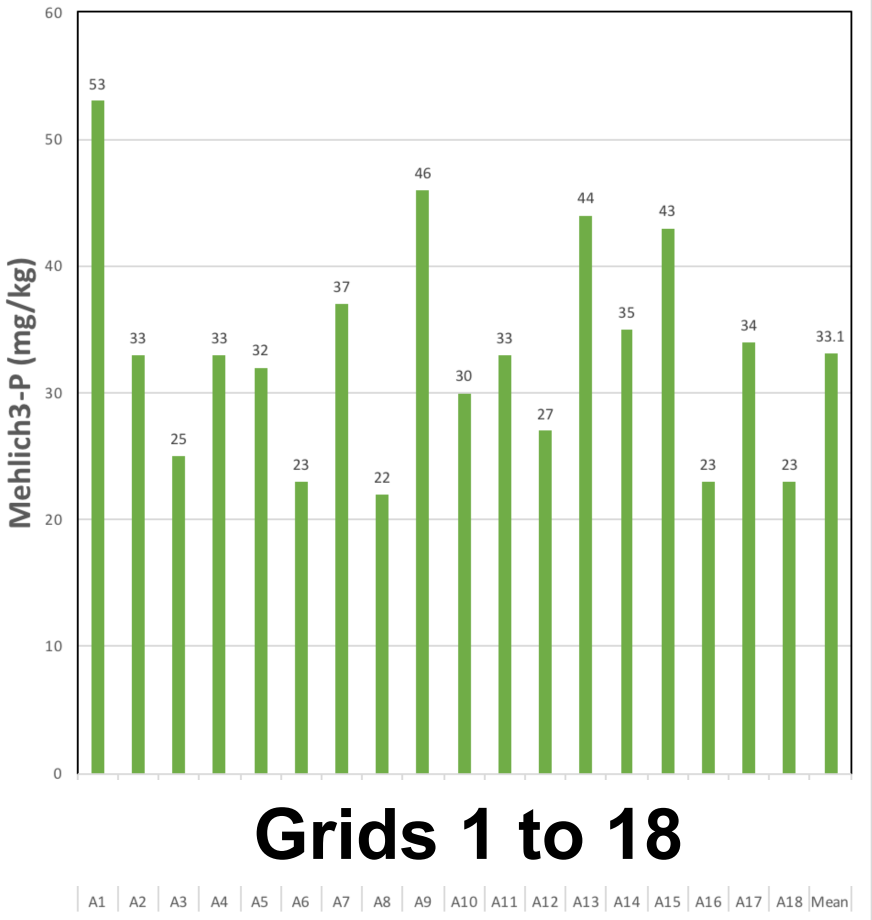
~3 acres

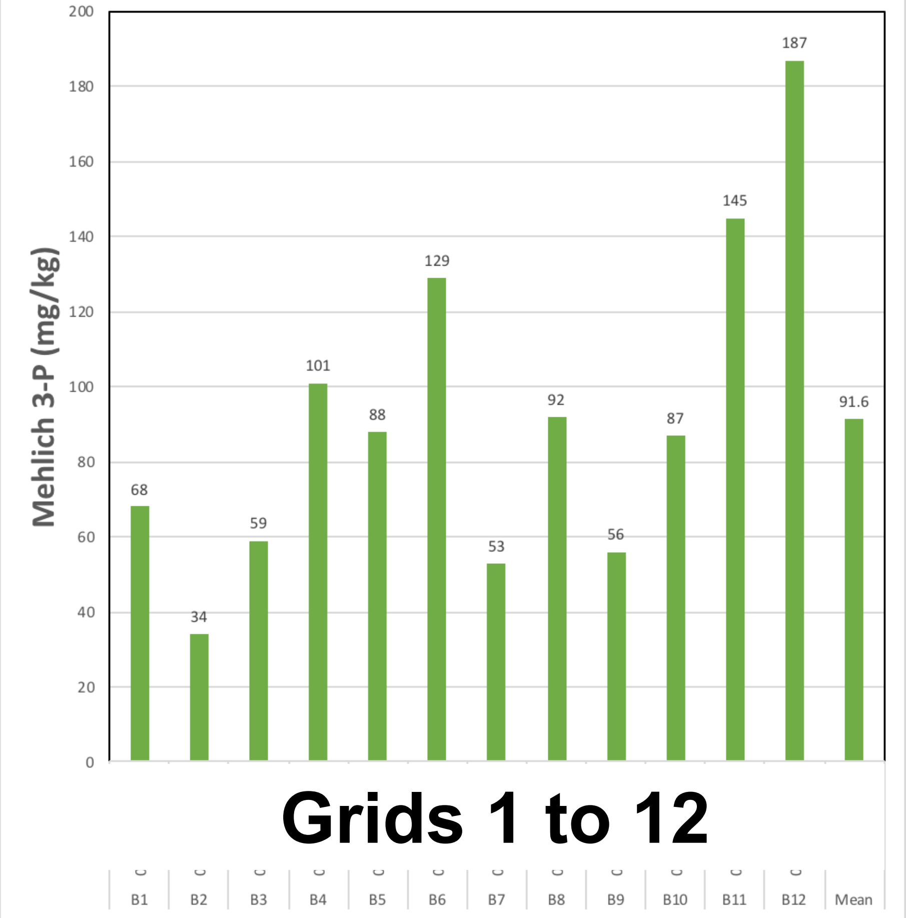
~2 acres

Soil P levels in two fields in Fredrick county

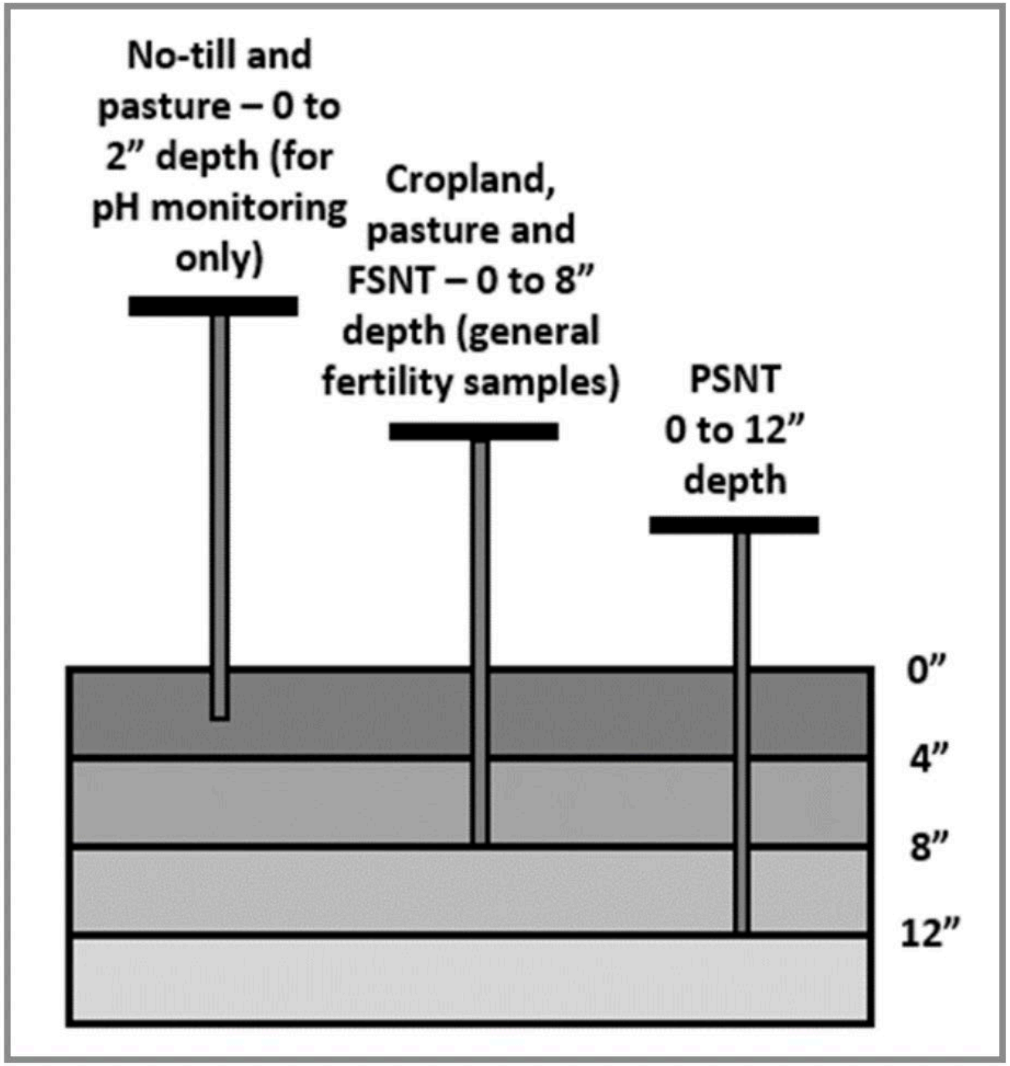
- Mean of 18 grids = 33. 1 mg/kg [Medium FIV]
- Range: 22 to 53 mg/kg [low to medium]

- Mean of 12 grids = 91.6 mg/kg [Optimum]
- Range: 34 to 187 mg/kg [Medium to Excessive]





Soil Sampling Depth



Sample Collection Considerations (con't)

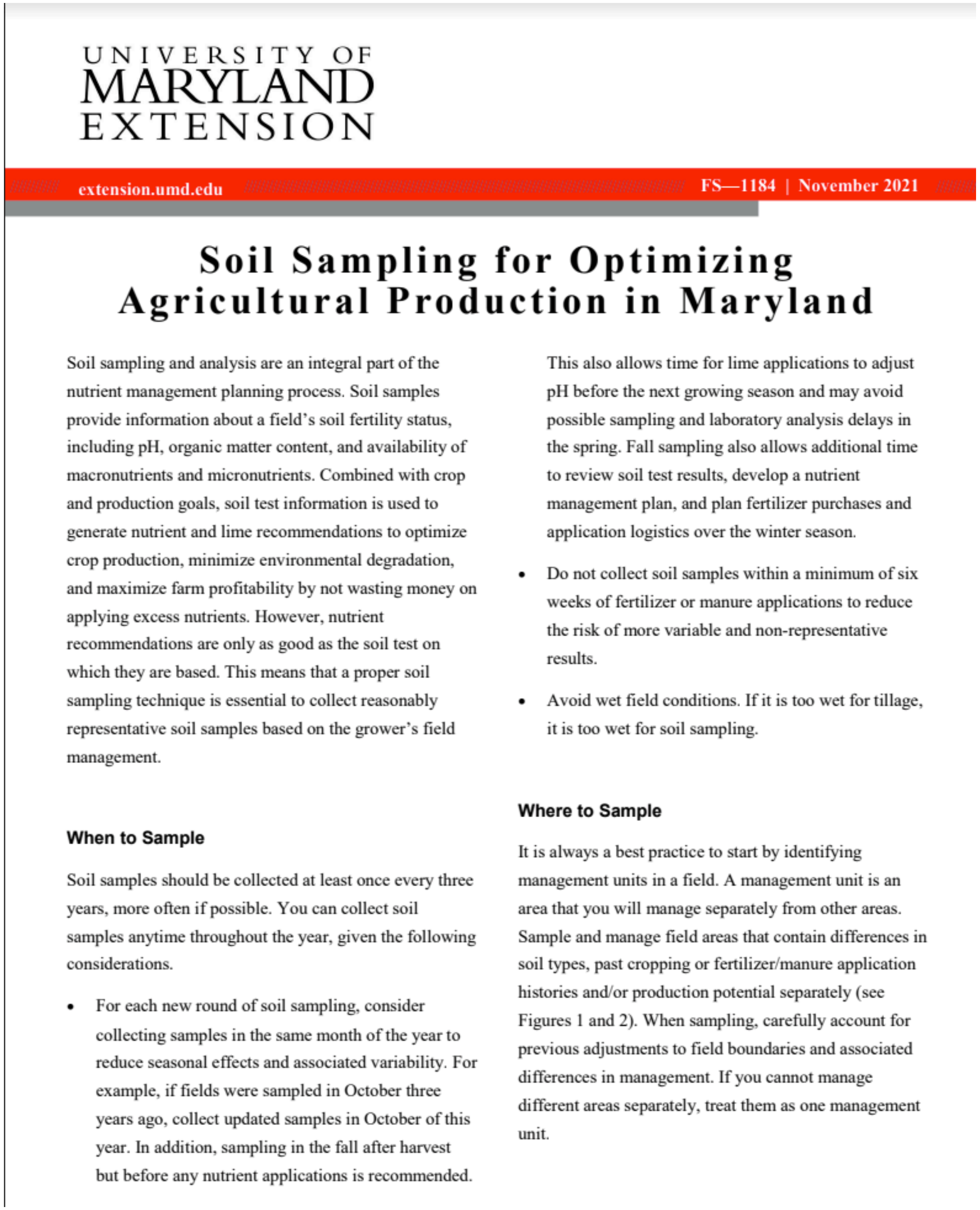
- Including cores from **problem areas** in a composite sample can skew the results.
- Avoid including cores from:
  - Areas that always do poorly
  - Areas where the soil is clearly different
- Submit a separate "troubleshooting" sample

Soil Sampling: *When should you take a soil sample?*

- Samples can be taken any **time** that the ground is not frozen
- Try to sample a given location at the same time each year
  - Avoids impact of seasonal variation
- Samples can be taken when the soil is wet, but avoid “soupy” samples
  - More difficult and costly to transport/ship

Extension factsheet on Soil Sampling!

Kalmbach, B. & G.S. Toor. 2021. Soil Sampling for Optimizing Agricultural Production in Maryland. FS-1184. University of Maryland Extension, College Park, MD



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extension.umd.edu FS—1184 | November 2021

Soil Sampling for Optimizing Agricultural Production in Maryland

Soil sampling and analysis are an integral part of the nutrient management planning process. Soil samples provide information about a field's soil fertility status, including pH, organic matter content, and availability of macronutrients and micronutrients. Combined with crop and production goals, soil test information is used to generate nutrient and lime recommendations to optimize crop production, minimize environmental degradation, and maximize farm profitability by not wasting money on applying excess nutrients. However, nutrient recommendations are only as good as the soil test on which they are based. This means that a proper soil sampling technique is essential to collect reasonably representative soil samples based on the grower's field management.

When to Sample

Soil samples should be collected at least once every three years, more often if possible. You can collect soil samples anytime throughout the year, given the following considerations.

- For each new round of soil sampling, consider collecting samples in the same month of the year to reduce seasonal effects and associated variability. For example, if fields were sampled in October three years ago, collect updated samples in October of this year. In addition, sampling in the fall after harvest but before any nutrient applications is recommended. This also allows time for lime applications to adjust pH before the next growing season and may avoid possible sampling and laboratory analysis delays in the spring. Fall sampling also allows additional time to review soil test results, develop a nutrient management plan, and plan fertilizer purchases and application logistics over the winter season.
- Do not collect soil samples within a minimum of six weeks of fertilizer or manure applications to reduce the risk of more variable and non-representative results.
- Avoid wet field conditions. If it is too wet for tillage, it is too wet for soil sampling.

Where to Sample

It is always a best practice to start by identifying management units in a field. A management unit is an area that you will manage separately from other areas. Sample and manage field areas that contain differences in soil types, past cropping or fertilizer/manure application histories and/or production potential separately (see Figures 1 and 2). When sampling, carefully account for previous adjustments to field boundaries and associated differences in management. If you cannot manage different areas separately, treat them as one management unit.

Step 2 – Extraction and Sample Analysis

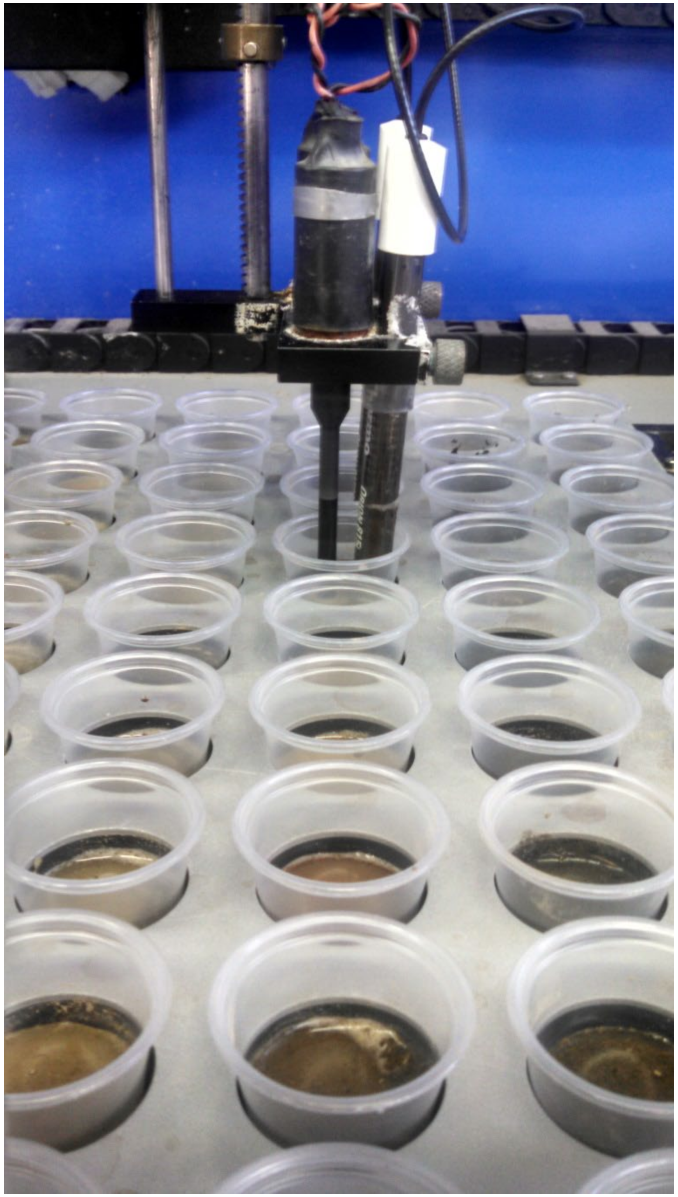
- Most reproducible step in the process, especially if done by a reliable lab that:
  - Uses regionally appropriate methods (extraction and analysis)
  - Employs good QA/QC measures
  - Participates in proficiency testing programs (NAPT, ALP)

What do labs analyze in soil samples?

- In the northeast, routine soil fertility analysis generally includes:
  - pH and exchangeable acidity (lime requirement)
  - Extractable nutrients (such as P, K, Ca, Mg)
  - Cation exchange capacity; and Base saturation
  - Might also include extractable micronutrients
- Additional optional tests:
  - *Nitrate-N; Organic matter; Soil texture*

A) Soil pH

- Soil pH is a fundamental soil chemical property
  - Single most important soil chemical property we can measure
  - Master variable
- Influences mineral solubility, microbial activity, and nutrient availability

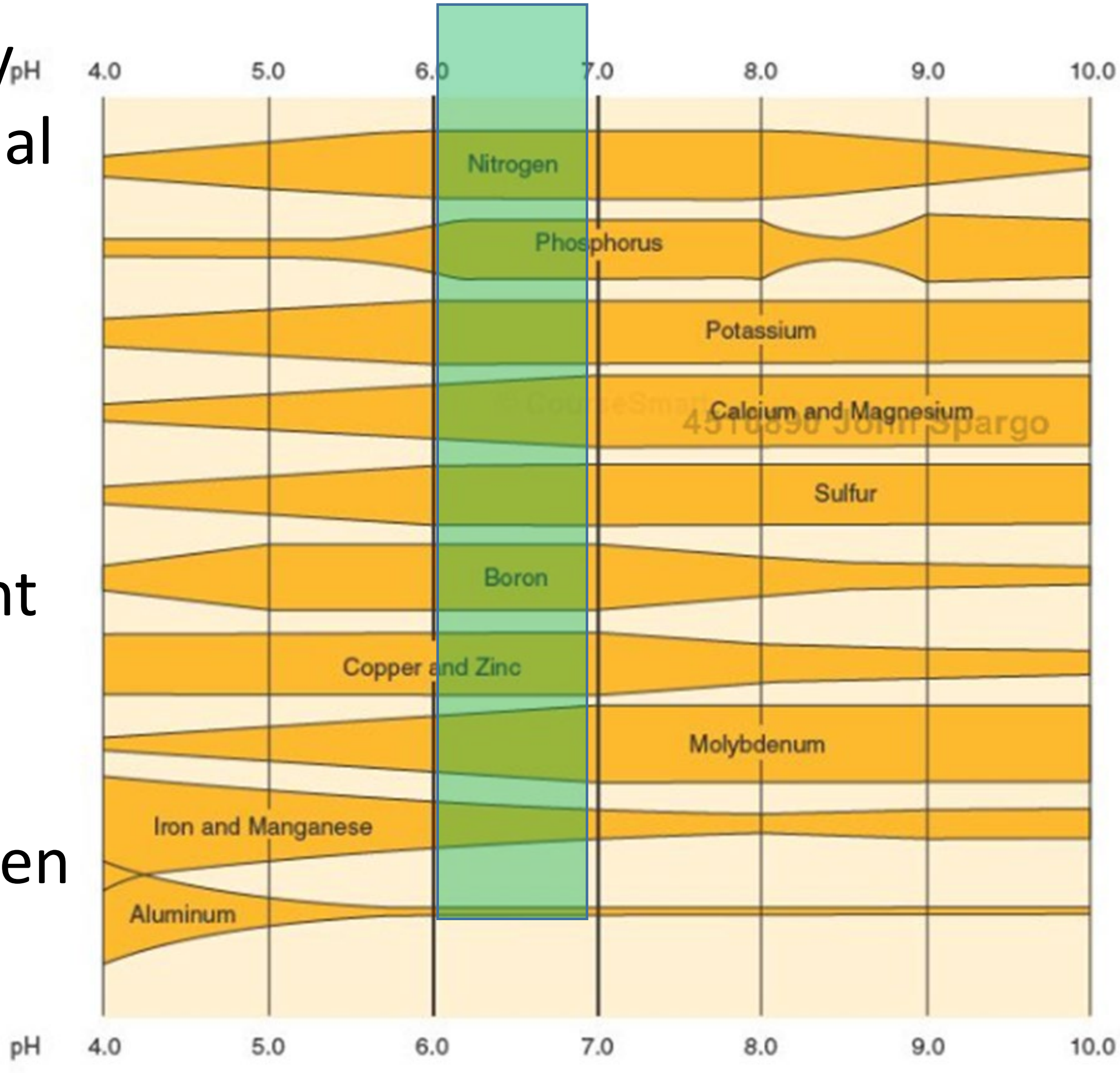


Why soil pH decreases?

- Rainfall adds H and washes other cations
- Plants roots release enzymes and organic acids to make nutrients more available
- Plant roots add CO_2, which combines with H_2O. This adds more H in soil
- Nitrogen fertilizers (urea, ammonium) adds more H

Soil pH and Nutrient availability

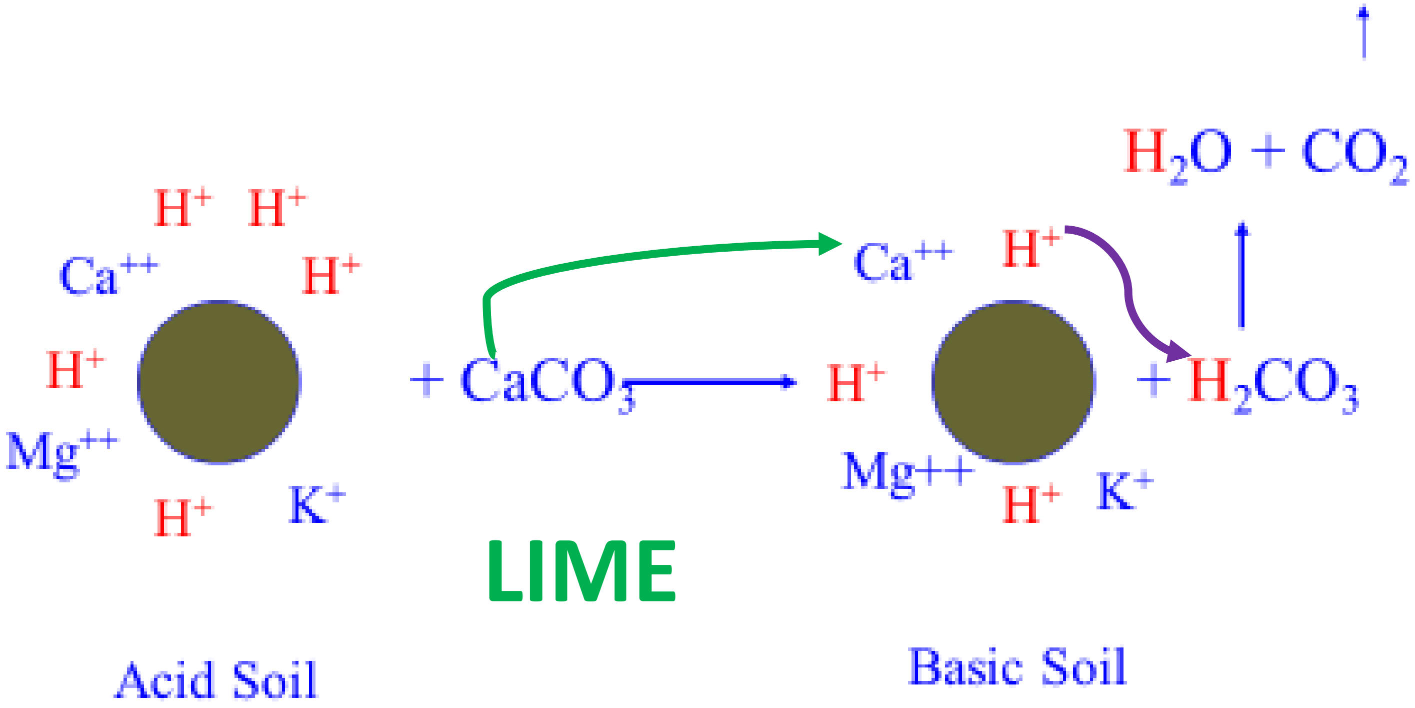
- **Low pH:** low solubility of most of the essential macronutrients
- **High pH:** low availability of micronutrients
- Judicious management of pH (soil acidity) is critical
- Best balance is between pH 6 and 7



Why Lime?

- Lime is added to increase soil pH
- Lime: usually means calcium carbonate
- Supplies calcium
- Neutralizes acidity, raises soil pH

How Does Lime Change pH?



H^+ H^+

Ca^{++} H^+

H^+

Mg^{++}

H^+ K^+

$+ CaCO_3$

LIME

Ca^{++} H^+

H^+

Mg^{++}

H^+ K^+

$+ H_2CO_3$

$H_2O + CO_2$

Acid Soil

Basic Soil

Liming is Critical for Efficient Fertilizer Use

Percent Nutrient Availability			
pH (salt)	**Nitrogen %**	**Phosphorus %**	**Potassium %**
4.0	30	23	33
4.5	53	34	52
5.0	77	48	77
5.5	89	52	100
6.5	100	100	100

Root Depths, pH, and Nutrients

- Field crop roots may eventually get below a limed soil zone
- Pastures should have deeper more extensive roots
    - May find lower pH that helps or hurts nutrient uptake
    - May find nutrients that leached deeper

Wheat

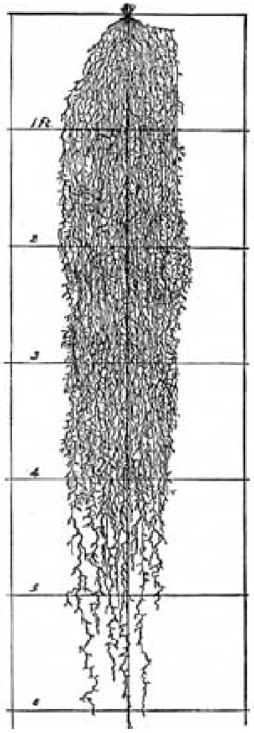


Fig. 73.--Mature root system of winter wheat.

Alfalfa

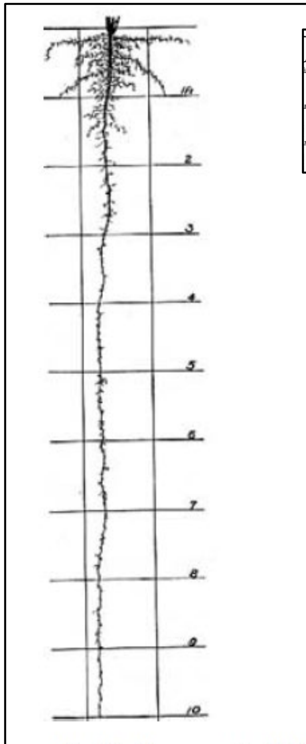
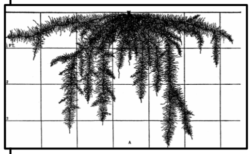


Fig. 95.--Two-year-old alfalfa

Corn

(8 weeks)



B) Extractable Nutrients

- Soil samples are extracted in lab
- Extract available nutrients (P, K, Ca, Mg) plus a portion of what is expected to become available

Common Soil Test Extractants

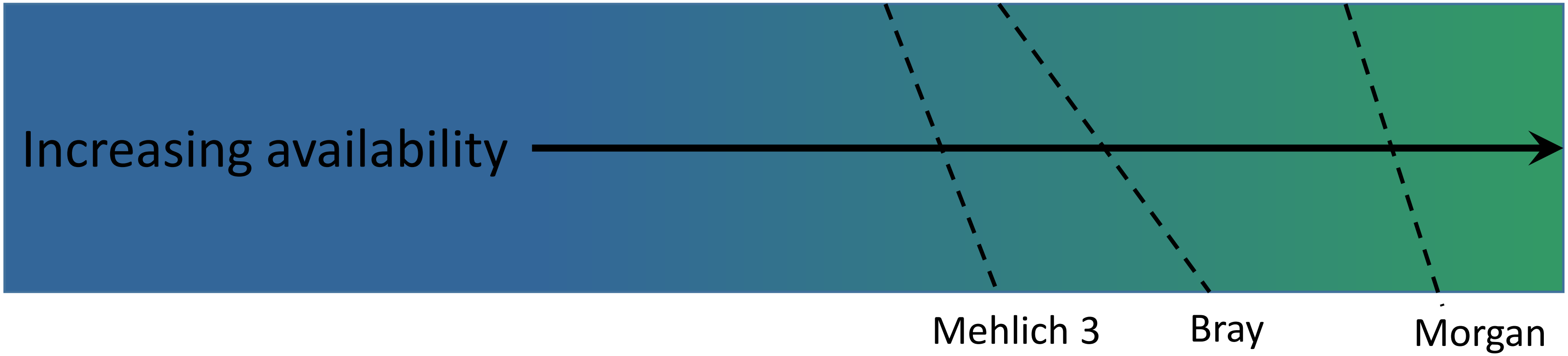
Extractant	**Composition**	**Elements**
★ Ammonium acetate	1 N pH 7.0 ammonium acetate	K, Ca, Mg
★ Bray-P	0.03 M NH_4F + 0.025 M HCl	P
★ Mehlich 1	0.05 M HCl + 0.0125 M H_2SO_4	P, K, Ca, Mg, Mn, Zn, Cu, Fe
★ **Mehlich 3**	**0.015 M NH_4F + 0.2 M CH_3COOH + 0.25 M NH_4NO_3 + 0.013 M HNO_3 + 0.001 M EDTA**	**P, K, Ca, Mg, Mn, Zn, Cu, Fe, B, S**
Modified Morgan	0.62 M NH_4OAc + 1.25 M CH_3COOH at pH 4.8	P, K, Ca, Mg, Mn, Zn, Cu
Olsen	0.5 M $NaHCO_3$ at pH 8.5	P

Soil Nutrient Analysis

A discrete measure of *available* nutrients does not exist…

Unavailable | Available

….rather, nutrient *availability* is more a continuum in soil based on specific conditions affecting solubility of different nutrient *pools*.



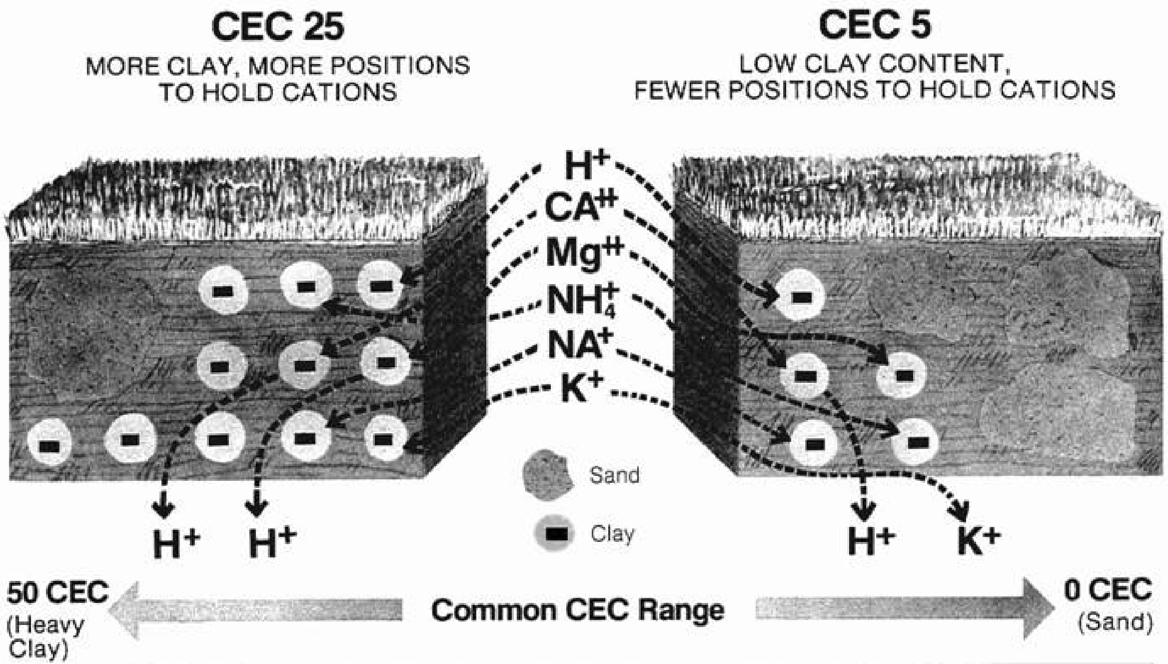
C) Cation Exchange Capacity (CEC)

CEC is an estimate of the soils ability to attract, retain, and exchange various cations such as Ca, Mg, K. It is reported in millequivalents per 100 grams of soil (meq/100g).

A soil with a high CEC will be able to release these nutrients into the soil solution, making them available to plants, when levels of these nutrients become low in the soil.

https://www.spectrumanalytic.com/support/library/ff/CEC_BpH_and_percent_sat.htm

A SCHEMATIC LOOK AT CATION EXCHANGE



SOME PRACTICAL APPLICATIONS	
Soils with CEC 11-50 Range	Soils with CEC 1-10 Range
• High clay content • More lime required to correct a given pH • Greater capacity to hold nutrients in a given soil depth • Physical ramifications of a soil with a high clay content • High water-holding capacity	• High sand content • Nitrogen and potassium leaching more likely • Less lime required to correct a given pH • Physical ramifications of a soil with a high sand content • Low water-holding capacity

D) Base Saturation refer to percent of the soil CEC that is occupied by a particular nutrient, or the sum of a group of nutrients.

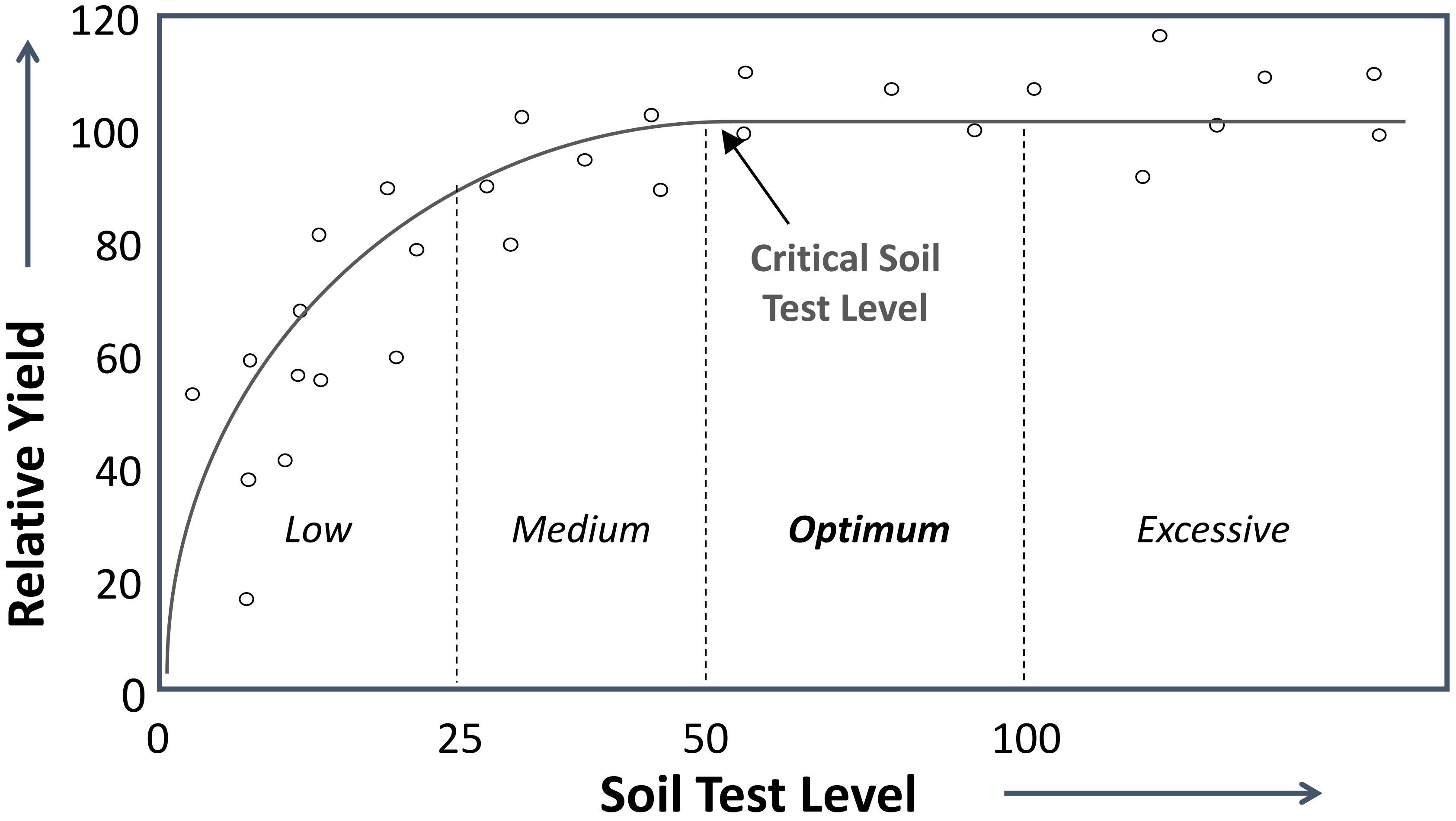
Step 3 – Interpretation of Soil Test Results

- What do the results mean?
- Based on the relationship between the test measurement and some measure of plant performance.
- For productions crops where measure of performance is yield:
  - How many bushels of corn do you get at that concentration of soil phosphorus?

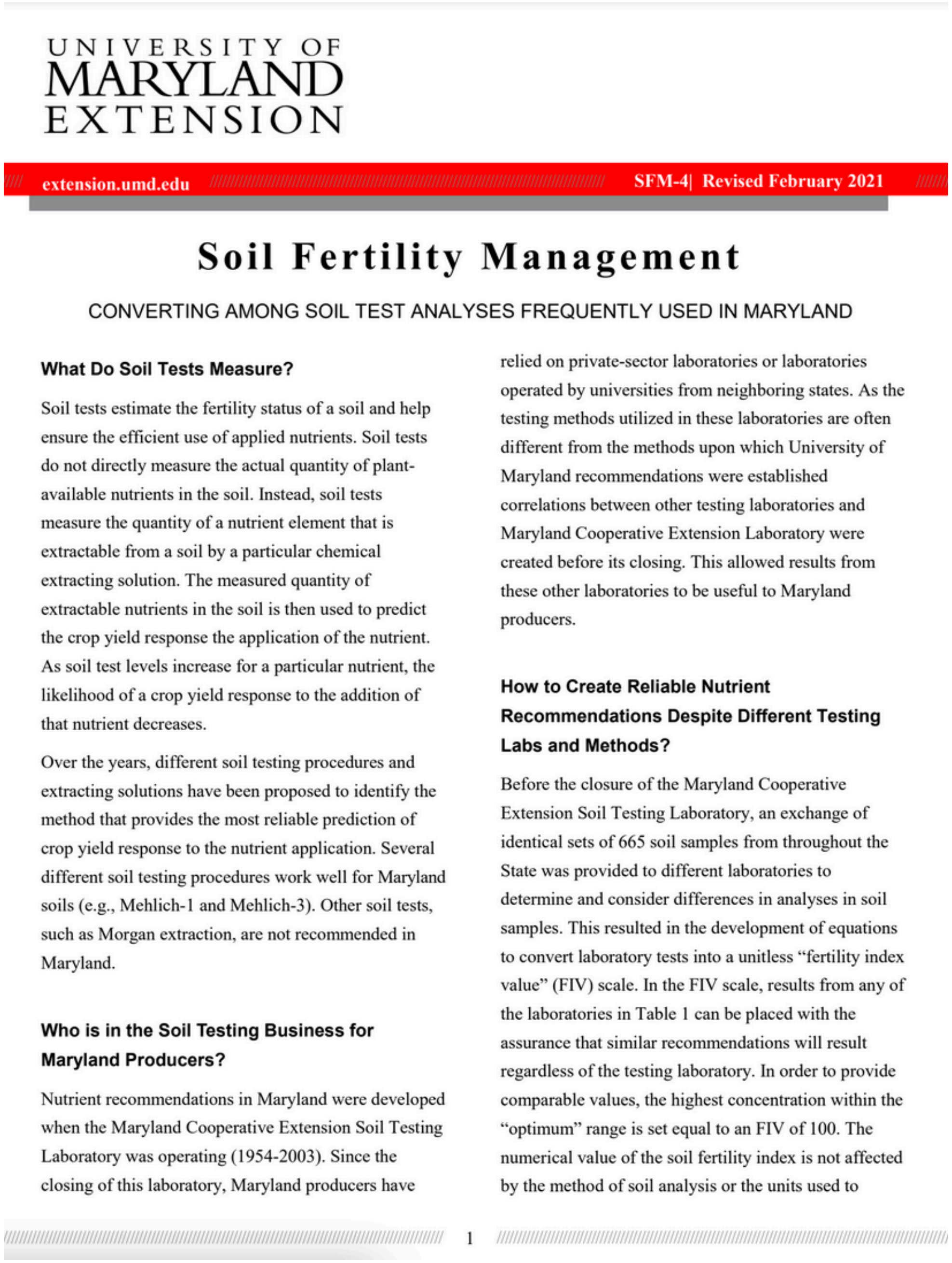
Soil Test Interpretation

Soil Test Levels (FIVs), Soil Test Category and Yield Response

Soil Test Fertility Index Value (FIV)	Soil Test Category	Likelihood of Yield Response
0-25	low	yield response likely
26-50	medium	yield response possible
51-100	optimum	yield response unlikely
>100	excessive	yield response very unlikely



Consult Extension Factsheet SFM–4 for unit conversions



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extension.umd.edu SFM-4| Revised February 2021

Soil Fertility Management

CONVERTING AMONG SOIL TEST ANALYSES FREQUENTLY USED IN MARYLAND

What Do Soil Tests Measure?

Soil tests estimate the fertility status of a soil and help ensure the efficient use of applied nutrients. Soil tests do not directly measure the actual quantity of plant-available nutrients in the soil. Instead, soil tests measure the quantity of a nutrient element that is extractable from a soil by a particular chemical extracting solution. The measured quantity of extractable nutrients in the soil is then used to predict the crop yield response the application of the nutrient. As soil test levels increase for a particular nutrient, the likelihood of a crop yield response to the addition of that nutrient decreases.

Over the years, different soil testing procedures and extracting solutions have been proposed to identify the method that provides the most reliable prediction of crop yield response to the nutrient application. Several different soil testing procedures work well for Maryland soils (e.g., Mehlich-1 and Mehlich-3). Other soil tests, such as Morgan extraction, are not recommended in Maryland.

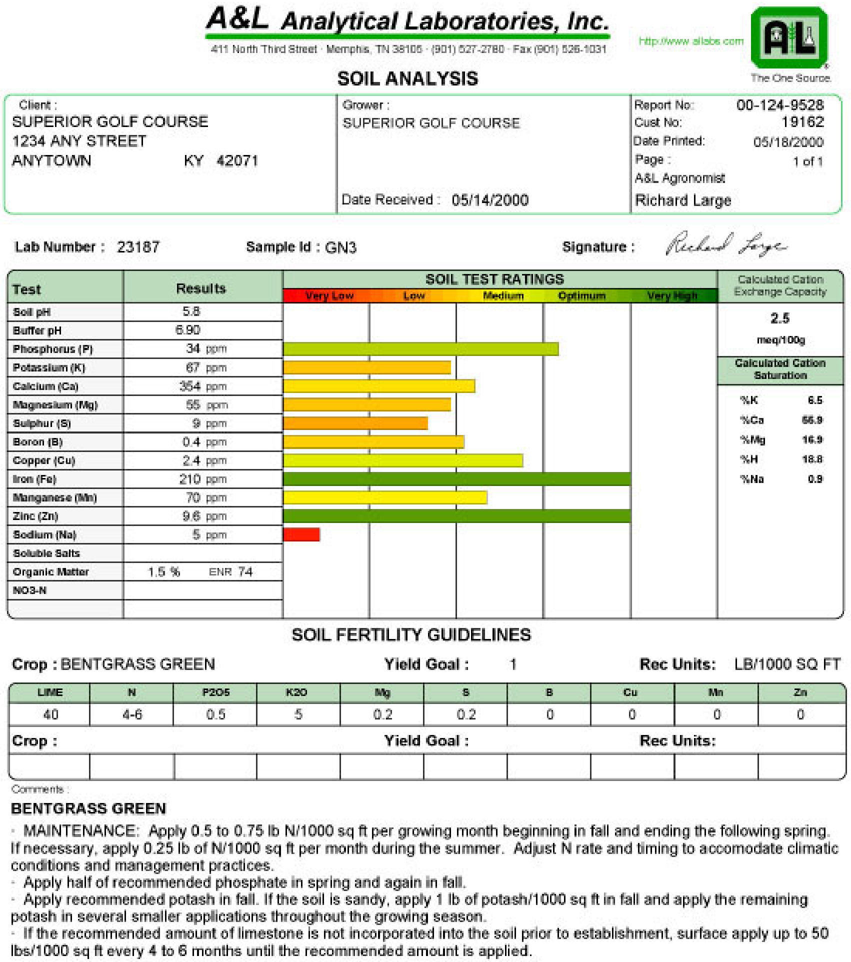
Who is in the Soil Testing Business for Maryland Producers?

Nutrient recommendations in Maryland were developed when the Maryland Cooperative Extension Soil Testing Laboratory was operating (1954-2003). Since the closing of this laboratory, Maryland producers have relied on private-sector laboratories or laboratories operated by universities from neighboring states. As the testing methods utilized in these laboratories are often different from the methods upon which University of Maryland recommendations were established correlations between other testing laboratories and Maryland Cooperative Extension Laboratory were created before its closing. This allowed results from these other laboratories to be useful to Maryland producers.

How to Create Reliable Nutrient Recommendations Despite Different Testing Labs and Methods?

Before the closure of the Maryland Cooperative Extension Soil Testing Laboratory, an exchange of identical sets of 665 soil samples from throughout the State was provided to different laboratories to determine and consider differences in analyses in soil samples. This resulted in the development of equations to convert laboratory tests into a unitless “fertility index value” (FIV) scale. In the FIV scale, results from any of the laboratories in Table 1 can be placed with the assurance that similar recommendations will result regardless of the testing laboratory. In order to provide comparable values, the highest concentration within the “optimum” range is set equal to an FIV of 100. The numerical value of the soil fertility index is not affected by the method of soil analysis or the units used to

Understanding Soil Test Reports



A&L Analytical Laboratories, Inc.

411 North Third Street · Memphis, TN 38105 · (901) 527-2780 · Fax (901) 526-1031

http://www.allabs.com

The One Source.

SOIL ANALYSIS

Client :
SUPERIOR GOLF COURSE
1234 ANY STREET
ANYTOWN KY 42071

Grower :
SUPERIOR GOLF COURSE

Date Received : 05/14/2000

Report No: 00-124-9528
Cust No: 19162
Date Printed: 05/18/2000
Page : 1 of 1
A&L Agronomist
Richard Large

Lab Number : 23187
Sample Id : GN3
Signature : Richard Large

Test	Results
Soil pH	5.8
Buffer pH	6.90
Phosphorus (P)	34 ppm
Potassium (K)	67 ppm
Calcium (Ca)	354 ppm
Magnesium (Mg)	55 ppm
Sulphur (S)	9 ppm
Boron (B)	0.4 ppm
Copper (Cu)	2.4 ppm
Iron (Fe)	210 ppm
Manganese (Mn)	70 ppm
Zinc (Zn)	9.6 ppm
Sodium (Na)	5 ppm
Soluble Salts	
Organic Matter	1.5 % ENR 74
NO3-N	

SOIL TEST RATINGS

Calculated Cation Exchange Capacity
2.5
meq/100g

Calculated Cation Saturation

%K	6.5
%Ca	56.9
%Mg	16.9
%H	18.8
%Na	0.9

SOIL FERTILITY GUIDELINES

Crop : BENTGRASS GREEN
Yield Goal : 1
Rec Units: LB/1000 SQ FT

LIME	N	P2O5	K2O	Mg	S	B	Cu	Mn	Zn
40	4-6	0.5	5	0.2	0.2	0	0	0	0

Crop :
Yield Goal :
Rec Units:

Comments :

BENTGRASS GREEN

- MAINTENANCE: Apply 0.5 to 0.75 lb N/1000 sq ft per growing month beginning in fall and ending the following spring. If necessary, apply 0.25 lb of N/1000 sq ft per month during the summer. Adjust N rate and timing to accomodate climatic conditions and management practices.
- Apply half of recommended phosphate in spring and again in fall.
- Apply recommended potash in fall. If the soil is sandy, apply 1 lb of potash/1000 sq ft in fall and apply the remaining potash in several smaller applications throughout the growing season.
- If the recommended amount of limestone is not incorporated into the soil prior to establishment, surface apply up to 50 lbs/1000 sq ft every 4 to 6 months until the recommended amount is applied.

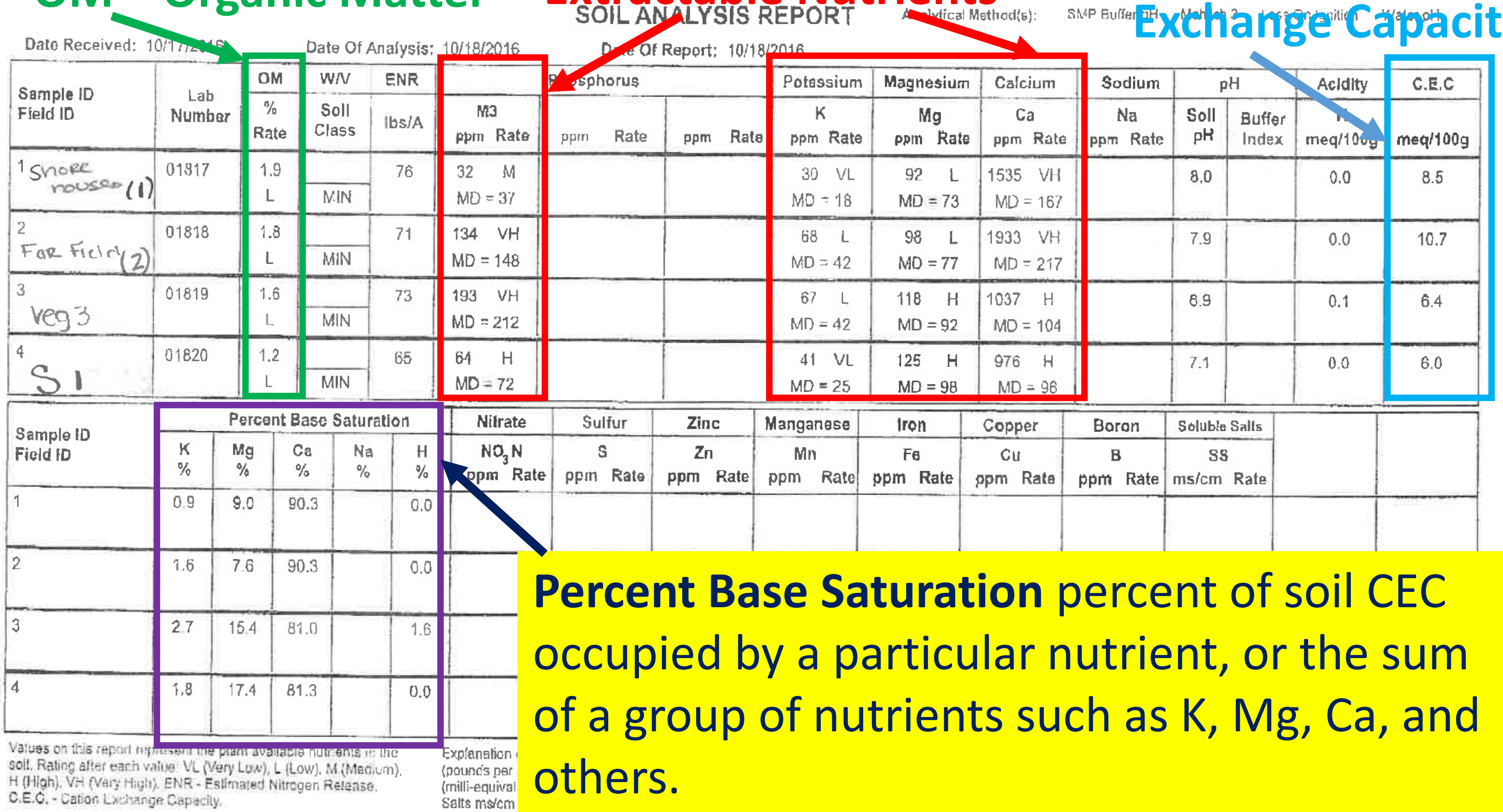
- Contains soil test results, interpretation, and nutrient recommendations

Example soil test report (Waypoint)

OM = Organic Matter

Extractable Nutrients

CEC= Cation Exchange Capacity



SOIL ANALYSIS REPORT

Analytical Method(s): SMP Buffer pH Mehlich 3 Loss On Ignition Water pH

Date Received: 10/17/2016 Date Of Analysis: 10/18/2016 Date Of Report: 10/18/2016

Sample ID Field ID	Lab Number	OM % Rate	W/V Soil Class	ENR lbs/A	M3 ppm Rate	Phosphorus ppm Rate	ppm Rate	Potassium K ppm Rate	Magnesium Mg ppm Rate	Calcium Ca ppm Rate	Sodium Na ppm Rate	pH Soil pH	Buffer Index	Acidity H meq/100g	C.E.C meq/100g
1 Shore housed (1)	01817	1.9 L	MIN	76	32 M MD = 37			30 VL MD = 18	92 L MD = 73	1535 VH MD = 167		8.0		0.0	8.5
2 Far Field (2)	01818	1.8 L	MIN	71	134 VH MD = 148			68 L MD = 42	98 L MD = 77	1933 VH MD = 217		7.9		0.0	10.7
3 veg 3	01819	1.6 L	MIN	73	193 VH MD = 212			67 L MD = 42	118 H MD = 92	1037 H MD = 104		6.9		0.1	6.4
4 S 1	01820	1.2 L	MIN	65	64 H MD = 72			41 VL MD = 25	125 H MD = 98	976 H MD = 96		7.1		0.0	6.0

Sample ID Field ID	Percent Base Saturation K %	Mg %	Ca %	Na %	H %	Nitrate NO_3N ppm Rate	Sulfur S ppm Rate	Zinc Zn ppm Rate	Manganese Mn ppm Rate	Iron Fe ppm Rate	Copper Cu ppm Rate	Boron B ppm Rate	Soluble Salts SS ms/cm Rate		
1	0.9	9.0	90.3		0.0										
2	1.6	7.6	90.3		0.0										
3	2.7	15.4	81.0		1.6										
4	1.8	17.4	81.3		0.0										

Values on this report represent the plant available nutrients in the soil. Rating after each value: VL (Very Low), L (Low), M (Medium), H (High), VH (Very High). ENR - Estimated Nitrogen Release. C.E.C. - Cation Exchange Capacity.

Explanation
(pounds per
(milli-equival
Salts ms/cm

Percent Base Saturation percent of soil CEC occupied by a particular nutrient, or the sum of a group of nutrients such as K, Mg, Ca, and others.

- **Soil pH:** used to check pH status (1-14)
- **Buffer pH:** used to determine lime requirement

Extractable nutrients:

P = Phosphorus

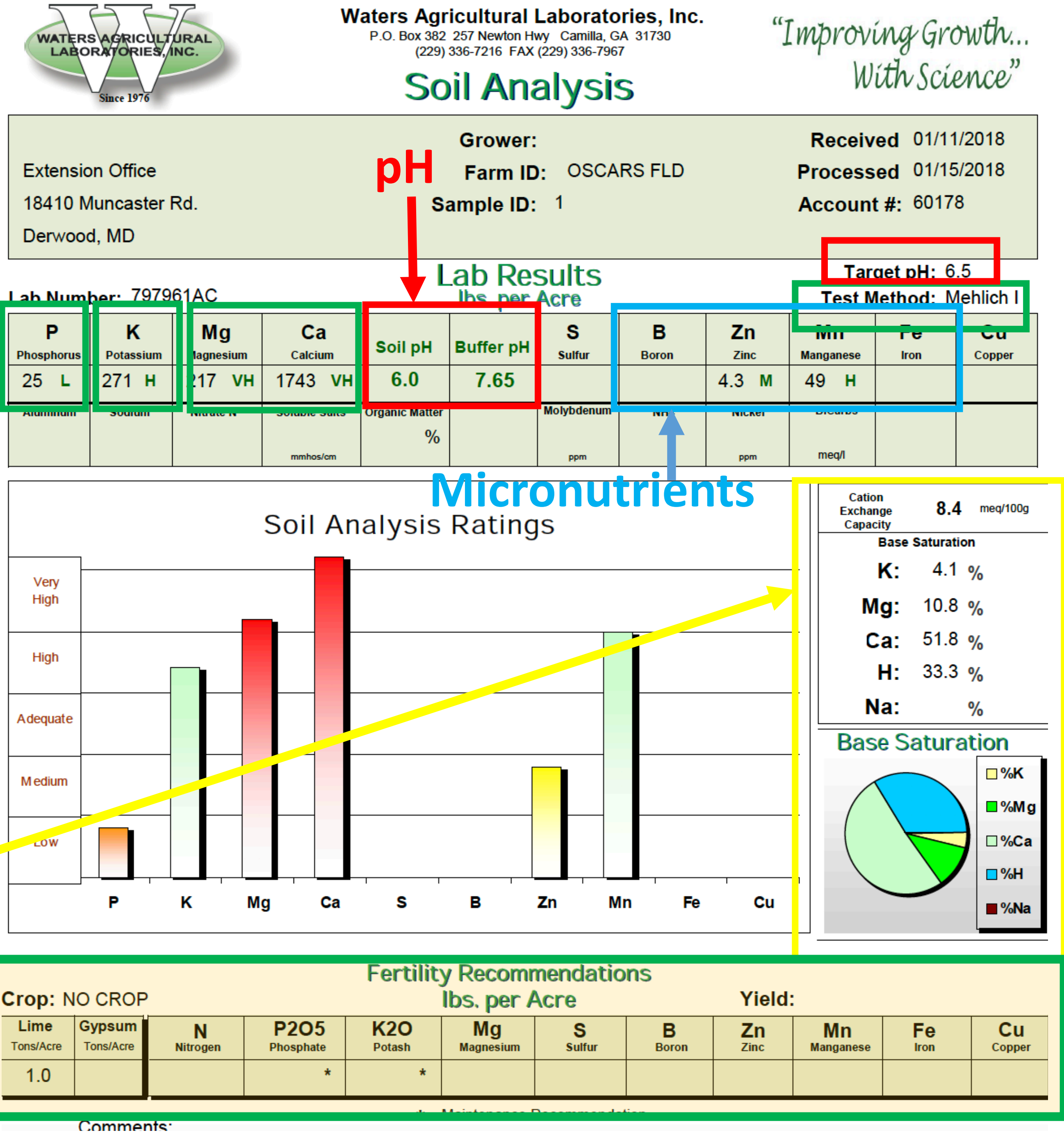
K = Potassium

Mg = Magnesium

Ca = Calcium

Percent Base Saturation

Recommendation: apply lime at 1 ton/acre



Waters Agricultural Laboratories, Inc.
P.O. Box 382 257 Newton Hwy Camilla, GA 31730
(229) 336-7216 FAX (229) 336-7967

Soil Analysis

"Improving Growth... With Science"

Extension Office
18410 Muncaster Rd.
Derwood, MD

Grower:
Farm ID: OSCARS FLD
Sample ID: 1

Received 01/11/2018
Processed 01/15/2018
Account #: 60178

Target pH: 6.5
Test Method: Mehlich I

Lab Number: 797961AC

Lab Results
lbs. per Acre

P Phosphorus	K Potassium	Mg Magnesium	Ca Calcium	Soil pH	Buffer pH	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
25 L	271 H	217 VH	1743 VH	6.0	7.65			4.3 M	49 H		
Aluminum	Sodium	Nitrate-N	Soluble Salts	Organic Matter		Molybdenum	NH	Nickel	Bicarbs		
			mmhos/cm	%		ppm		ppm	meq/l		

Cation Exchange Capacity 8.4 meq/100g

Base Saturation

K:	4.1	%
Mg:	10.8	%
Ca:	51.8	%
H:	33.3	%
Na:		%

Fertility Recommendations
lbs. per Acre

Crop: NO CROP **Yield:**

Lime Tons/Acre	Gypsum Tons/Acre	N Nitrogen	P2O5 Phosphate	K2O Potash	Mg Magnesium	S Sulfur	B Boron	Zn Zinc	Mn Manganese	Fe Iron	Cu Copper
1.0			*	*							

* Maintenance Recommendation

Comments:

pH

Micronutrients

Soil Test Reports

Results

pH, extractable P, K, Mg, etc.

Interpretation

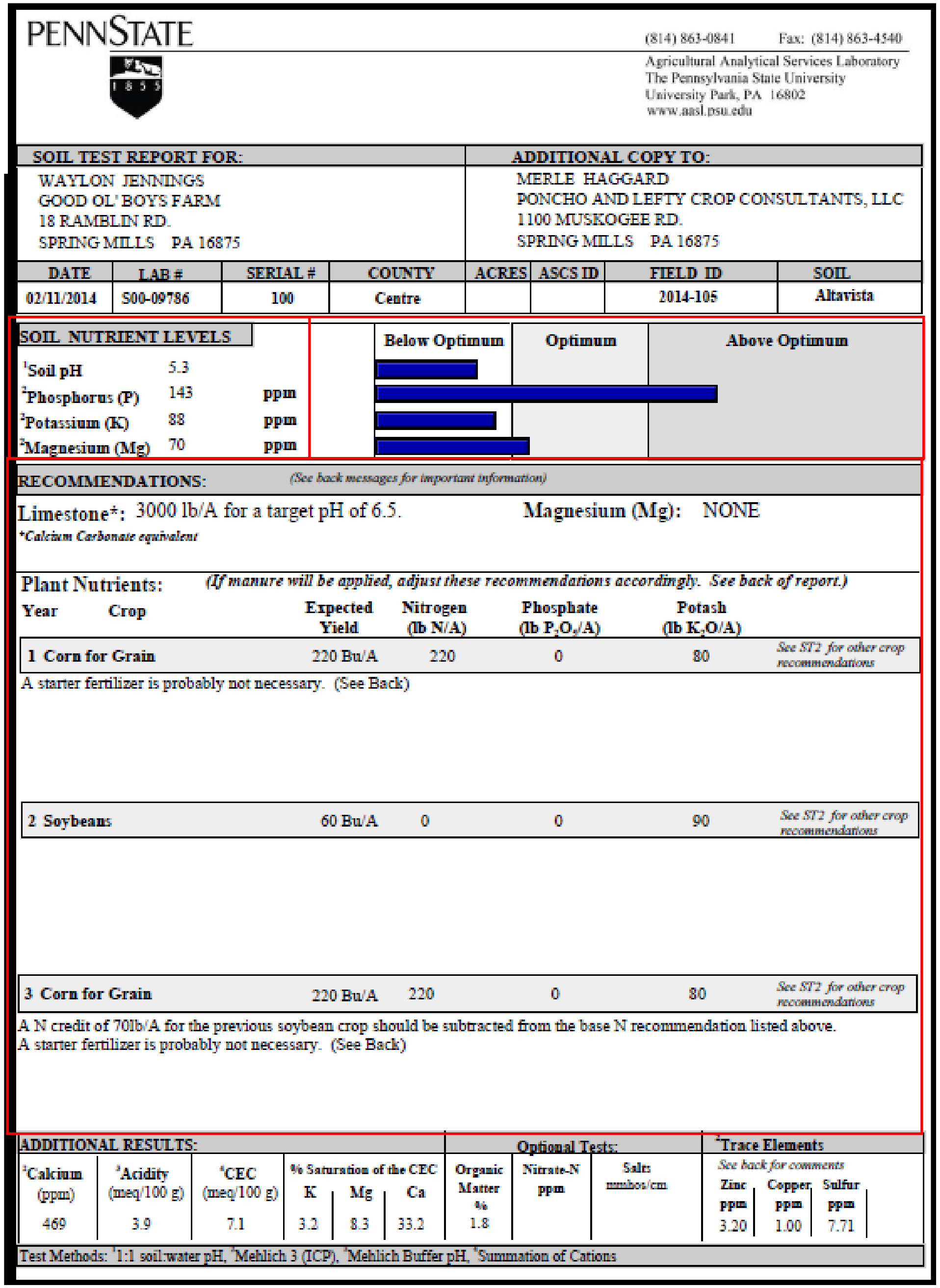
pH and nutrient measurements rated relative to critical level;

crop specific

Recommendations

Lime, N, P, K, Mg;

crop specific



PENNSTATE

1855

(814) 863-0841 Fax: (814) 863-4540

Agricultural Analytical Services Laboratory
The Pennsylvania State University
University Park, PA 16802
www.aasl.psu.edu

SOIL TEST REPORT FOR:	**ADDITIONAL COPY TO:**
WAYLON JENNINGS GOOD OL' BOYS FARM 18 RAMBLIN RD. SPRING MILLS PA 16875	MERLE HAGGARD PONCHO AND LEFTY CROP CONSULTANTS, LLC 1100 MUSKOGEE RD. SPRING MILLS PA 16875

DATE	LAB #	SERIAL #	COUNTY	ACRES	ASCS ID	FIELD ID	SOIL
02/11/2014	S00-09786	100	Centre			2014-105	Altavista

SOIL NUTRIENT LEVELS

			Below Optimum	Optimum	Above Optimum
[1]Soil pH	5.3				
[2]Phosphorus (P)	143	ppm			
[2]Potassium (K)	88	ppm			
[2]Magnesium (Mg)	70	ppm			

RECOMMENDATIONS: *(See back messages for important information)*

Limestone*: 3000 lb/A for a target pH of 6.5. Magnesium (Mg): NONE

**Calcium Carbonate equivalent*

Plant Nutrients: ***(If manure will be applied, adjust these recommendations accordingly. See back of report.)***

Year	Crop	Expected Yield	Nitrogen (lb N/A)	Phosphate (lb P_2O_5/A)	Potash (lb K_2O/A)	
1	Corn for Grain	220 Bu/A	220	0	80	*See ST2 for other crop recommendations*
2	Soybeans	60 Bu/A	0	0	90	*See ST2 for other crop recommendations*
3	Corn for Grain	220 Bu/A	220	0	80	*See ST2 for other crop recommendations*

Year 1: A starter fertilizer is probably not necessary. (See Back)

Year 3: A N credit of 70lb/A for the previous soybean crop should be subtracted from the base N recommendation listed above.
A starter fertilizer is probably not necessary. (See Back)

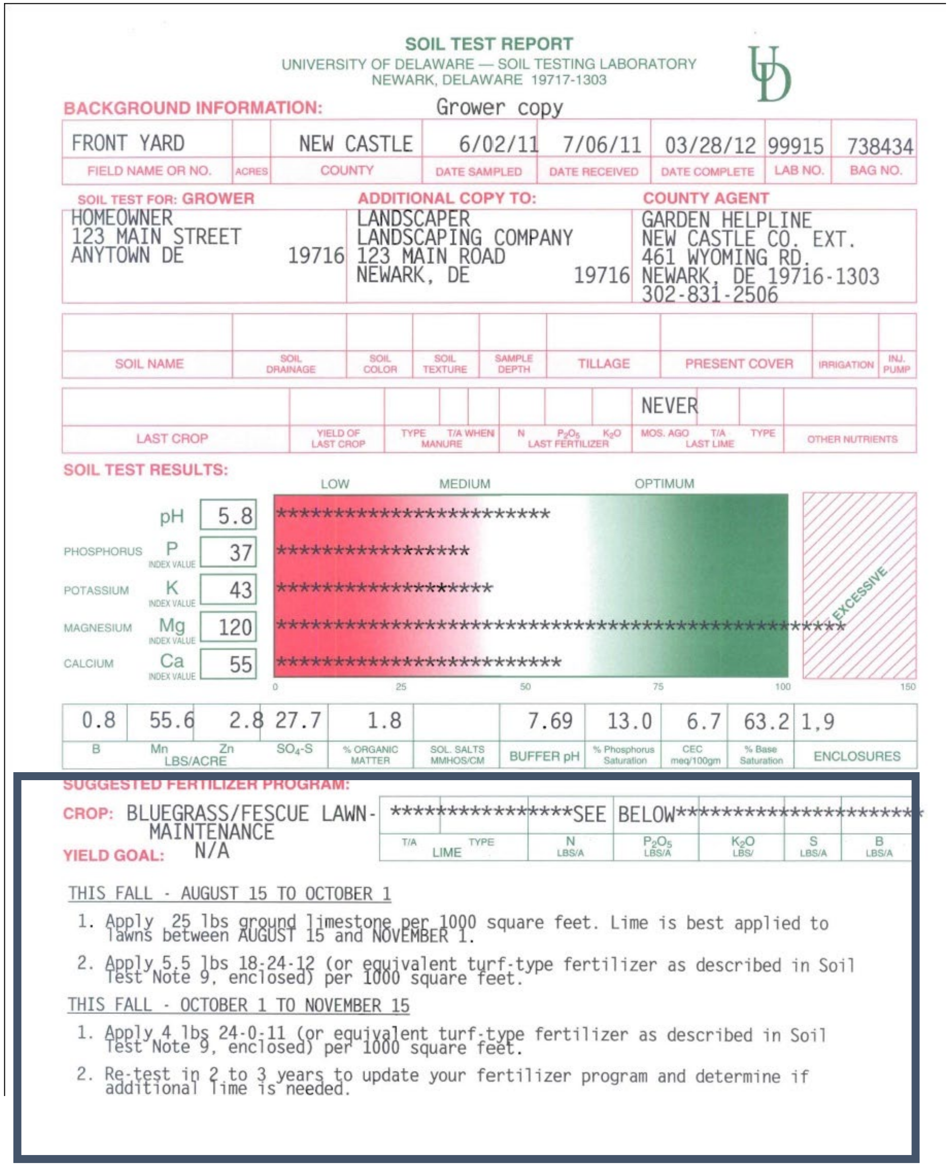
ADDITIONAL RESULTS:						**Optional Tests:**			**[2]Trace Elements** *See back for comments*		
[2]Calcium (ppm)	[3]Acidity (meq/100 g)	[4]CEC (meq/100 g)	% Saturation of the CEC K	Mg	Ca	Organic Matter %	Nitrate-N ppm	Salts mmhos/cm	Zinc ppm	Copper ppm	Sulfur ppm
469	3.9	7.1	3.2	8.3	33.2	1.8			3.20	1.00	7.71

Test Methods: [1]1:1 soil:water pH, [2]Mehlich 3 (ICP), [3]Mehlich Buffer pH, [4]Summation of Cations

Step 4: Recommendations

Often consider:

- Nutritional needs of the plant. Rate of lime (or sulfur, if too alkaline) needed
- Contributions of the soil
- Local growing conditions
- Lime and nutrient source characteristics, cost
- Application method and timing



SOIL TEST REPORT
UNIVERSITY OF DELAWARE — SOIL TESTING LABORATORY
NEWARK, DELAWARE 19717-1303

BACKGROUND INFORMATION: Grower copy

FRONT YARD		NEW CASTLE	6/02/11	7/06/11	03/28/12	99915	738434
FIELD NAME OR NO.	ACRES	COUNTY	DATE SAMPLED	DATE RECEIVED	DATE COMPLETE	LAB NO.	BAG NO.

SOIL TEST FOR: GROWER	ADDITIONAL COPY TO:	COUNTY AGENT
HOMEOWNER 123 MAIN STREET ANYTOWN DE 19716	LANDSCAPER LANDSCAPING COMPANY 123 MAIN ROAD NEWARK, DE 19716	GARDEN HELPLINE NEW CASTLE CO. EXT. 461 WYOMING RD. NEWARK, DE 19716-1303 302-831-2506

SOIL NAME	SOIL DRAINAGE	SOIL COLOR	SOIL TEXTURE	SAMPLE DEPTH	TILLAGE	PRESENT COVER	IRRIGATION	INJ. PUMP

							NEVER			
LAST CROP	YIELD OF LAST CROP	MANURE TYPE	MANURE T/A WHEN	LAST FERTILIZER N	LAST FERTILIZER P_2O_5	LAST FERTILIZER K_2O	LAST LIME MOS. AGO	LAST LIME T/A	LAST LIME TYPE	OTHER NUTRIENTS

SOIL TEST RESULTS:

LOW MEDIUM OPTIMUM EXCESSIVE

	pH	5.8
PHOSPHORUS	P INDEX VALUE	37
POTASSIUM	K INDEX VALUE	43
MAGNESIUM	Mg INDEX VALUE	120
CALCIUM	Ca INDEX VALUE	55

0 25 50 75 100 150

0.8	55.6	2.8	27.7	1.8		7.69	13.0	6.7	63.2	1,9
B	Mn LBS/ACRE	Zn	SO_4-S	% ORGANIC MATTER	SOL. SALTS MMHOS/CM	BUFFER pH	% Phosphorus Saturation	CEC meq/100gm	% Base Saturation	ENCLOSURES

SUGGESTED FERTILIZER PROGRAM:

CROP: BLUEGRASS/FESCUE LAWN-MAINTENANCE
YIELD GOAL: N/A

*****************SEE			BELOW**********************				
LIME T/A	LIME TYPE	N LBS/A	P_2O_5 LBS/A	K_2O LBS/	S LBS/A	B LBS/A	

THIS FALL - AUGUST 15 TO OCTOBER 1

1. Apply 25 lbs ground limestone per 1000 square feet. Lime is best applied to lawns between AUGUST 15 and NOVEMBER 1.
2. Apply 5.5 lbs 18-24-12 (or equivalent turf-type fertilizer as described in Soil Test Note 9, enclosed) per 1000 square feet.

THIS FALL - OCTOBER 1 TO NOVEMBER 15

1. Apply 4 lbs 24-0-11 (or equivalent turf-type fertilizer as described in Soil Test Note 9, enclosed) per 1000 square feet.
2. Re-test in 2 to 3 years to update your fertilizer program and determine if additional lime is needed.

Sample Analysis Results

- Soil Test Results may be reported in different units and, sometimes, different forms
    - Fertility Index Values or FIVs (UD or UM)
    - Parts per million (ppm)
    - Pounds per acre (lbs/ac)
    - P vs P_2O_5; K vs K_2O
- Know which methods and units your lab is using, especially if comparing results from different labs

Summary

- Soil pH affects nutrient availability:
  - *Best pH range is 6–7. Apply lime to acidic soils.*
- Soil sampling :
  - *No. of cores, depth critical to get good soil test values.*
- Soil test reports:
  - *Regular soil testing critical for diagnosing problems. Interpreting soil test reports not that complicated.*

Take Home Messages

1. Soil variability is the number one source of error in soil testing.
2. Public laboratories use relevant soil test methods
3. Soil test interpretations and fertility recommendations are based on local/regional field calibration
4. Become knowledgeable/ read reports

A Few Words About Manure

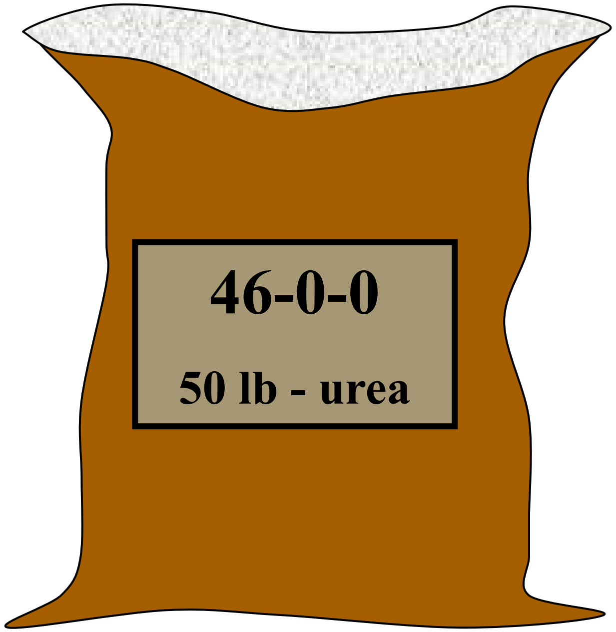
Manure: *A Complex Nutrient Source*

- A mixture of metabolic waste & solid waste from the digestive system
  - **Metabolic waste is soluble**
    - Urea (mammals), Uric acid (birds)
  - **Feces is a mixed bag**
    - Undigested feed
    - Microbe bodies
    - Cell wall debris from animal gut

Manure: *A Complex Nutrient Source (Con't)*

- Manure is a complex mixture
  - **Soluble nutrient forms**
    - urea, ammonium, nitrate
  - **Labile organic nutrient forms**
    - break down quickly when added to soil
  - **Stable organic nutrient forms**
    - break down slowly (month to years)
  - **Mineral forms of nutrients of varying stability**

What can go wrong?



- There are many uncertainties with manure

- Nutrient ratios may not necessarily match crop needs

There is uncertainty in using manure

- What type of animal is the manure from?

How did you apply the manure?

- Was any bedding used? What type of bedding?

- How much manure do you have?

- What is the nutrient content? How and when did you sample?

How much did you apply? Have you calibrated?

Did you incorporate the manure? How long after application?

Calibration of Equipment

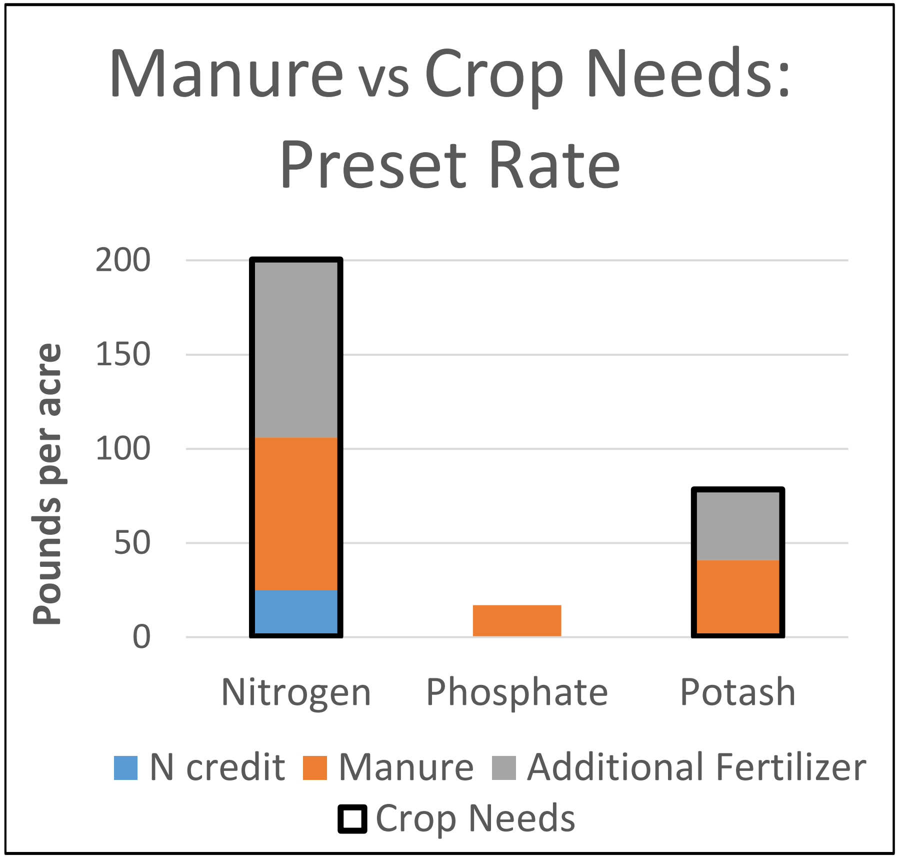
- EB-254 "Uniform Lime and Fertilizer Spreading"
- SFG EC-1 "Calibration of Manure Spreaders: Uniformity, Spread Patterns and Effective Swath Width"
- SFG EC-2 "Calibration of a Manure Spreader Using the Weight-area Method"
- SFG EC-3 "Calibration of a Liquid Manure Spreader Using the Load-area Method"
- SFG EC-4 "Calibration of a Manure Spreader Using the Load-area Method (with Drive-on Scales)"
- SFG EC-5 "Calibration of a Manure Spreader Using the Load-area Method (with Estimation of Density and Load Weight)"

Manure as Nutrient Source

Manure versus crop needs:

Scenario 1:

- Corn grain
    - Goal: 200 Bu/acre
- Nutrient needs (N-P-K):
    - 200-0-78
- Dairy liquid injected at 4000 gal/A
    - Nutrient content (N-P-K):
        - 81-17-41



Fertilizer need:

N = 200 – 81 (added with manure) – 25 (N credit) = 94

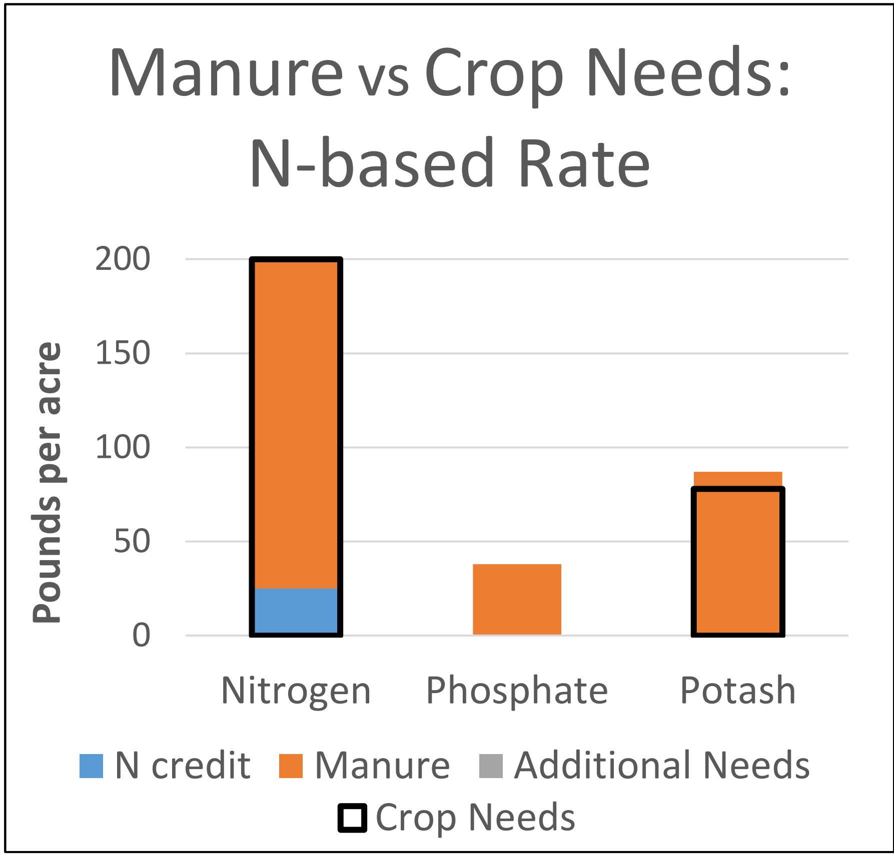
P = 0 – 17 (added with manure) = -17 (not needed)

K = 78 – 41 (added with manure) = 37

Manure versus crop needs:

Scenario 2:

- Corn grain
  - Goal: 200 Bu/acre
- Nutrient needs (N-P-K):
  - 200-0-78
- Dairy liquid injected at rate to fully supply N
  - Nutrient content (N-P-K):
    - 175-28-87



Fertilizer need:

N = 200 – 174 (added with manure) – 25 (N credit) = 0

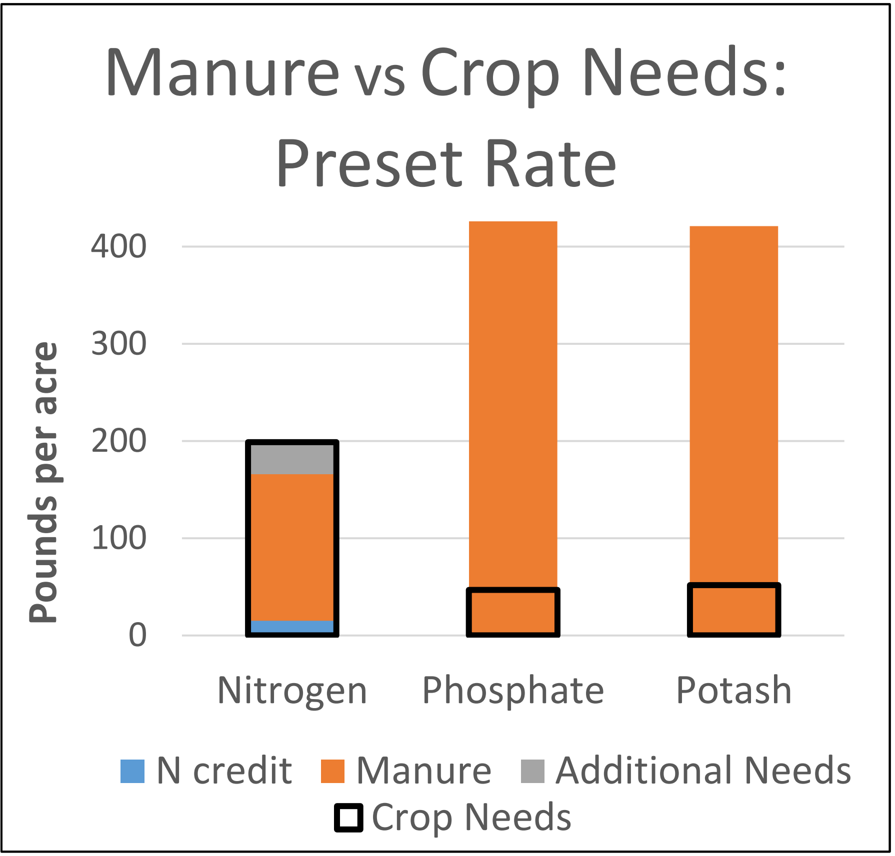
P = 0 – 28 (added with manure) = -28 (not needed)

K = 78 – 87 (added with manure) = -9 (not needed)

Manure versus crop needs:

Scenario 3:

- Corn grain
  - Goal: 200 Bu/acre
- Nutrient needs (N-P-K):
  - 200-47-52
- Poultry litter at 5 tons/acre into no-till
  - Nutrient content (N-P-K):
    - 151-426-421



Fertilizer need:

N = 200 – 151 (added with manure) – 25 (N credit) = 24

P = 47 – 426 (added with manure) = -379 (not needed)

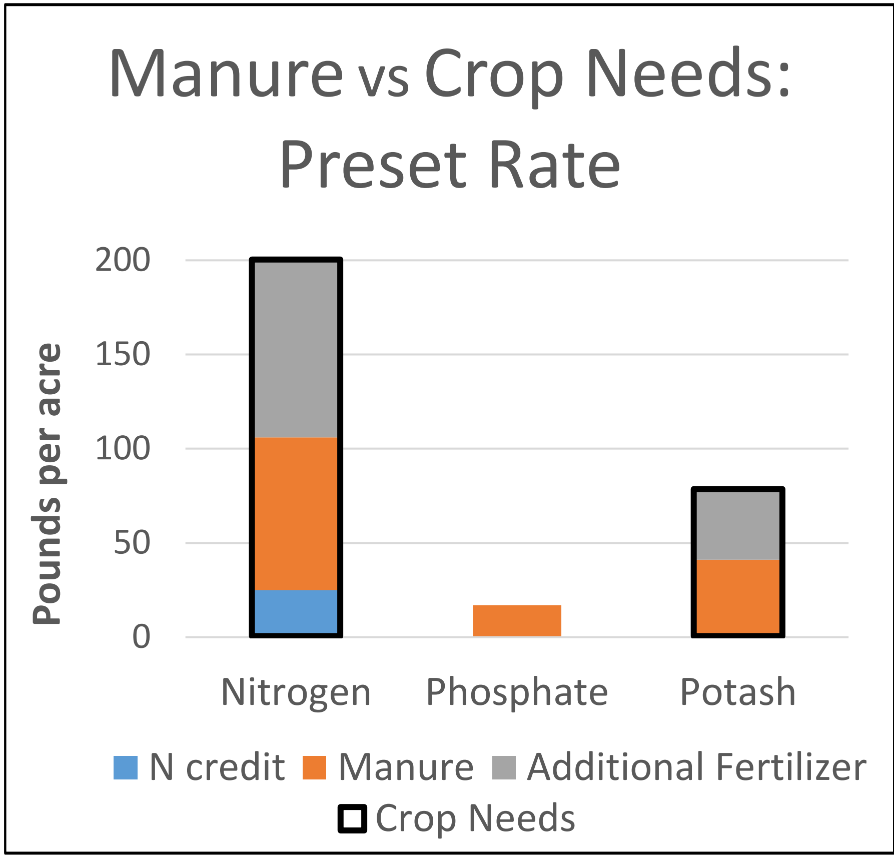
K = 52 – 421 (added with manure) = -369 (not needed)

Best Scenario: Use a combination of N sources (some manure, some fertilizer)

Manure versus crop needs:

Scenario 1:

- Corn grain
  - Goal: 200 Bu/acre
- Nutrient needs (N-P-K):
  - 200-0-78
- Dairy liquid injected at 4000 gal/A
  - Nutrient content (N-P-K):
    - 81-17-41



Fertilizer need:

N = 200 – 81 (added with manure) – 25 (N credit) = 94

P = 0 – 17 (added with manure) = -17 (not needed)

K = 78 – 41 (added with manure) = 37

Rational Use of Manure: *What can you do?*

- **Take regular manure and soil samples:**
  - Take representative samples, mix well
  - Keep an eye on your soil FIV-P levels
- Calibrate your equipment. Keep records of application rates
- Incorporate quickly to conserve N
- Use manure on corn fields
- Use other proven manure management BMPs
  - *Estimate crop N needs, realistic yields, legume credits*

Questions?

Email: gstoor@umd.edu

🐦 **ToorUMD**