Understanding Soil Tests

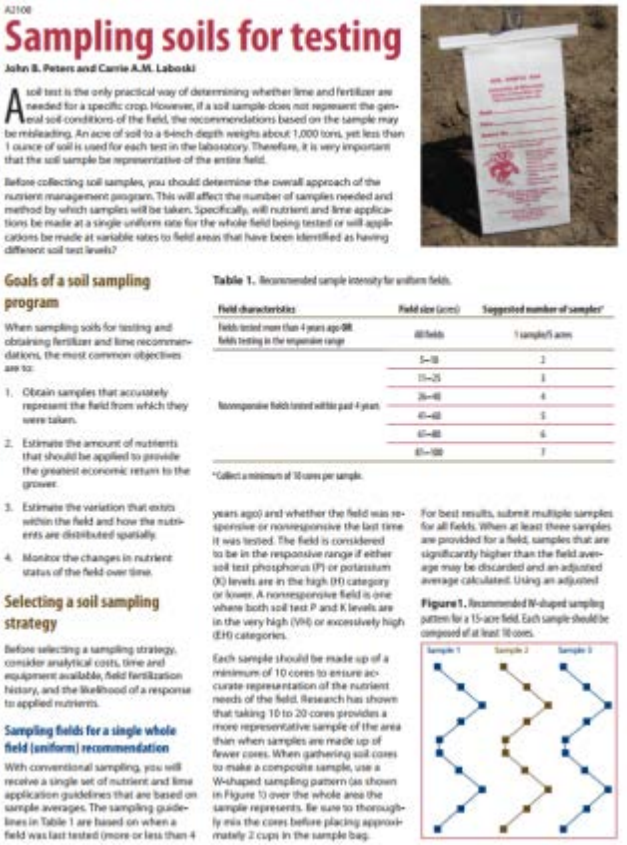
Kim Meyer, CCA

Resource Recovery Manager

Madison Metropolitan Sewerage District

Understanding Soil Tests

- A2100: Sampling soils for testing
- Basic Soil Sampling for WI Agriculture: youtube.com/user/uwipcm/videos



A2100

Sampling soils for testing

John B. Peters and Carrie A.M. Laboski

A soil test is the only practical way of determining whether lime and fertilizer are needed for a specific crop. However, if a soil sample does not represent the general soil conditions of the field, the recommendations based on the sample may be misleading. An acre of soil to a 6-inch depth weighs about 1,000 tons, yet less than 1 ounce of soil is used for each test in the laboratory. Therefore, it is very important that the soil sample be representative of the entire field.

Before collecting soil samples, you should determine the overall approach of the nutrient management program. This will affect the number of samples needed and method by which samples will be taken. Specifically, will nutrient and lime applications be made at a single uniform rate for the whole field being tested or will applications be made at variable rates to field areas that have been identified as having different soil test levels?

Goals of a soil sampling program

When sampling soils for testing and obtaining fertilizer and lime recommendations, the most common objectives are to:

1. Obtain samples that accurately represent the field from which they were taken.
2. Estimate the amount of nutrients that should be applied to provide the greatest economic return to the grower.
3. Estimate the variation that exists within the field and how the nutrients are distributed spatially.
4. Monitor the changes in nutrient status of the field over time.

Selecting a soil sampling strategy

Before selecting a sampling strategy, consider analytical costs, time and equipment available, field fertilization history, and the likelihood of a response to applied nutrients.

Sampling fields for a single whole field (uniform) recommendation

With conventional sampling, you will receive a single set of nutrient and lime application guidelines that are based on sample averages. The sampling guidelines in Table 1 are based on when a field was last tested (more or less than 4 years ago) and whether the field was responsive or nonresponsive the last time it was tested. The field is considered to be in the responsive range if either soil test phosphorus (P) or potassium (K) levels are in the high (H) category or lower. A nonresponsive field is one where both soil test P and K levels are in the very high (VH) or excessively high (EH) categories.

Table 1. Recommended sample intensity for uniform fields.

Field characteristics	Field size (acres)	Suggested number of samples*
Fields tested more than 4 years ago OR fields testing in the responsive range	All fields	1 sample/5 acres
Nonresponsive fields tested within past 4 years	5–10	2
	11–25	3
	26–40	4
	41–60	5
	61–80	6
	81–100	7

*Collect a minimum of 10 cores per sample.

Each sample should be made up of a minimum of 10 cores to ensure accurate representation of the nutrient needs of the field. Research has shown that taking 10 to 20 cores provides a more representative sample of the area than when samples are made up of fewer cores. When gathering soil cores to make a composite sample, use a W-shaped sampling pattern (as shown in Figure 1) over the whole area the sample represents. Be sure to thoroughly mix the cores before placing approximately 2 cups in the sample bag.

For best results, submit multiple samples for all fields. When at least three samples are provided for a field, samples that are significantly higher than the field average may be discarded and an adjusted average calculated. Using an adjusted

Figure 1. Recommended W-shaped sampling pattern for a 15-acre field. Each sample should be composed of at least 10 cores.

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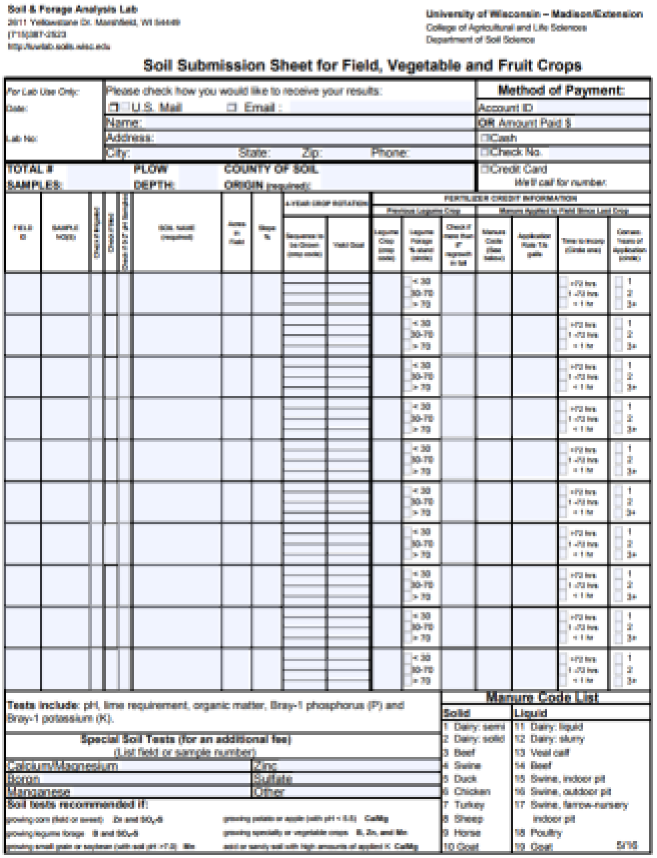
Understanding Soil Tests

- Fill out the submission sheet in it’s entirety for accurate fertility recommendations
  …unless you use SnapPlus


Soil & Forage Analysis Lab

University of Wisconsin – Madison/Extension
College of Agricultural and Life Sciences
Department of Soil Science

Soil Submission Sheet for Field, Vegetable and Fruit Crops

For Lab Use Only:
Date:
Lab No:

Please check how you would like to receive your results:
☐ U.S. Mail ☐ Email :
Name:
Address:
City: State: Zip: Phone:

Method of Payment:
Account ID
OR Amount Paid $
☐Cash
☐Check No.
☐Credit Card
We'll call for number.

TOTAL # SAMPLES: PLOW DEPTH: COUNTY OF SOIL ORIGIN (required):

FERTILIZER CREDIT INFORMATION

Tests include: pH, lime requirement, organic matter, Bray-1 phosphorus (P) and Bray-1 potassium (K).

Special Soil Tests (for an additional fee)
(List field or sample number)

Calcium/Magnesium | Zinc
Boron | Sulfate
Manganese | Other

Soil tests recommended if:

Manure Code List

Solid	Liquid
1 Dairy: semi	11 Dairy: liquid
2 Dairy: solid	12 Dairy: slurry
3 Beef	13 Veal calf
4 Swine	14 Beef
5 Duck	15 Swine, indoor pit
6 Chicken	16 Swine, outdoor pit
7 Turkey	17 Swine, farrow-nursery indoor pit
8 Sheep	18 Poultry
9 Horse	19 Goat
10 Goat	

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Understanding Soil Tests

- What does the lab test for in routine soil samples?
  - Soil pH
  - Organic matter %
  - Phosphorus ppm
  - Potassium ppm
  - Buffer pH
  - They do not test for nitrogen

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Understanding Soil Tests

County:	Account No:
Dane	BN02887
Field: 1	
Acres: 10.0	
Soil Name/Subsoil group:	
McHenry	
Plow Depth:	Previous Crop:
6.00	
Slope:	Irrigated: / Tiled:
8.0	No / No

NUTRIENT RECOMMENDATIONS

Cropping Sequence	Yield Goal	Crop Nutrient Need N	P_2O_5	K_2O	Fertilizer Credits Legume N	Manure N	P_2O_5	K_2O	Nutrients to Apply N	P_2O_5	K_2O
	- per acre -	---------- lbs/a ----------			--- lbs/a ----	---------- lbs/a ----------			---------- lbs/a ----------		
Corn, grain	191-210 bu	***	0	105	0	0	0	0	***	0	105
Soybean, grain	56-65 bu	0	0	130	0	0	0	0	0	0	130
(no crop)	n/a	0	0	0	0	0	0	0	0	0	0
(no crop)	n/a	0	0	0	0	0	0	0	0	0	0

The lime required for this rotation to reach pH 6.3 is 2 T/a of 60-69 lime or 1.5 T/a of 80-89 lime.

*** Please use the new Wisconsin Nitrogen Application Rates table to determine the N Application rate. Table included at end of report.

TEST INTERPRETATION

LABORATORY ANALYSIS | **LAB USE** | **MISC**

Sample ID	Soil pH	O.M. %	Phosphorus PPM	Potassium PPM	60-69 Lime Req T/a	Calcium PPM	Magnesium PPM	Boron PPM	Manganese PPM	Zinc PPM	Sulfate Sulfur	Sulfur Avail Index	Texture Code	Sample Density	Buffer Code	Total CEC	% Base Saturation %K	%Ca	%Mg	Tot %	%H
Adjusted Avg:	6.2	2.3	104	64																	
N	6.0	2.2	108	63	1.9								2	0.99	7.2						
S	6.4	2.4	99	64									2	0.96	7.1						

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Understanding Soil Tests

Crop	Target pH
Alfalfa	**6.8**
Red Clover, Soybean	**6.3**
Pastures, Corn (silage or grain), Wheat	**6.0**

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Understanding Soil Tests

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Acres: 10.0	
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McHenry	
Plow Depth:	Previous Crop:
6.00	
Slope:	Irrigated: / Tiled:
8.0	No / No

NUTRIENT RECOMMENDATIONS

Cropping Sequence	Yield Goal	Crop Nutrient Need N	P_2O_5	K_2O	Fertilizer Credits Legume N	Manure N	P_2O_5	K_2O	Nutrients to Apply N	P_2O_5	K_2O
	- per acre -	---------- lbs/a ----------			--- lbs/a ----	---------- lbs/a ----------			---------- lbs/a ----------		
Corn, grain	191-210 bu	***	0	105	0	0	0	0	***	0	105
Soybean, grain	56-65 bu	0	0	130	0	0	0	0	0	0	130
(no crop)	n/a	0	0	0	0	0	0	0	0	0	0
(no crop)	n/a	0	0	0	0	0	0	0	0	0	0

The lime required for this rotation to reach pH 6.3 is 2 T/a of 60-69 lime or 1.5 T/a of 80-89 lime.

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S	6.4	2.4	99	64									2	0.96	7.1						

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To determine your soil test **phosphorus (P)** category:

1) Choose the highest demanding crop in your rotation.
2) Choose the soil group for the predominant soil in the field.
3) Find your soil test category by using the analysis number for phosphorus from your soil test results.

	Soil test category				
	Very low (VL)	Low (L)	Optimum (O)	High (H)	Excessively high (EH)
Soil group	soil test P (ppm)				
demand level 1: ***Corn grain, Soybean, Clover, Small grains (but not wheat), Grasses, Oilseed crops, Pasture***					
Loamy	< 10	10–15	16–20	21–30	> 30
Sandy, Organic	< 12	12–22	23–32	33–42	> 42
demand level 2: ***Alfalfa, Corn silage, Wheat, Beans, Sweet Corn, Peas, Fruits***					
Loamy	< 12	12–17	18–25	26–35	> 35
Sandy, Organic	< 18	18–25	26–37	38–55	> 55
demand level 3: ***Tomato, Pepper, Brassicas, Leafy greens, Root, Vine, and Truck crops***					
Loamy	< 15	15–30	31–45	46–75	> 75
Sandy, Organic	< 18	18–35	36–50	51–80	> 80
demand level 4: ***Potato***					
Loamy	< 100	100–160	161–200	> 200	
Sandy, Organic	< 30	30–60	61–90	91–120	> 120

If the desired crop is not listed on the table or you are unsure of your soil group, consult UWEX publication A2809 *Nutrient Application Guidelines for Field, Vegetable, and Fruit Crops in Wisconsin*'s tables 4.1 and 4.2.

Understanding Soil Tests

County:	Account No:
Dane	BN02887
Field: 1	
Acres: 10.0	
Soil Name/Subsoil group:	
McHenry	
Plow Depth:	Previous Crop:
6.00	
Slope:	Irrigated: / Tiled:
8.0	No / No

NUTRIENT RECOMMENDATIONS

Cropping Sequence	Yield Goal	Crop Nutrient Need N	P_2O_5	K_2O	Fertilizer Credits Legume N	Manure N	P_2O_5	K_2O	Nutrients to Apply N	P_2O_5	K_2O
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(no crop)	n/a	0	0	0	0	0	0	0	0	0	0
(no crop)	n/a	0	0	0	0	0	0	0	0	0	0

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S	6.4	2.4	99	64									2	0.96	7.1						

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To determine your soil test **potassium (K)** category:

1) Choose the highest demanding crop in your rotation.
2) Choose the soil group for the predominant soil in the field.
3) Find your soil test category by using the analysis number for potassium from your soil test results.

	Soil test category					
	Very low (VL)	Low (L)	Optimum (O)	High (H)	Very high (VH)	Excessively high (EH)
Soil group	soil test K (ppm)					
demand level 1: ***Corn grain, Soybean, Clover, Small grains (but not wheat), Grasses, Oilseed crops, Pasture***						
Loamy	< 70	70–100	101–130	131–160	161–190	> 190
Sandy, Organic	< 45	45–65	66–90	91–130	—	> 130
demand level 2: ***Alfalfa, Corn silage, Wheat, Beans, Sweet Corn, Peas, Fruits***						
Loamy	< 90	90–110	111–140	141–170	171–240	> 240
Sandy, Organic	< 50	50–80	81–120	121–160	161–200	> 200
demand level 3: ***Tomato, Pepper, Brassicas, Leafy greens, Root, Vine, and Truck crops***						
Loamy	< 80	80–140	141–200	201–220	221–240	> 240
Sandy, Organic	< 50	50–100	101–150	151–165	166–180	> 180
demand level 4: ***Potato***						
Loamy	< 80	80–120	121–170	171–190	191–220	> 220
Sandy, Organic	< 70	70–100	101–130	131–160	161–190	> 190

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Understanding Soil Tests

Corn Nitrogen Guidelines

Soil[1]	Previous Crop	N:Corn Price Ratio 0.05	0.10	0.15	0.20
		total lb N/acre to apply[2]			
LOAMY: HIGH YIELD POTENTIAL SOILS	**Corn**, forage legumes, legume vegetables, green manures[5]	**190**[3] 170 ---- 210[4]	**165** 155 ---- 180	**150** 140 ---- 160	**135** 125 ---- 150
	Soybean, small grains[6]	**140** 125 ---- 160	**120** 105 ---- 130	**105** 95 ---- 115	**90** 80 ----- 105
LOAMY: MEDIUM YIELD POTENTIAL SOILS	**Corn**, forage legumes,legume vegetables, green manures[5]	**145** 130 ---- 160	**125** 115 ---- 140	**115** 105 ---- 125	**105** 95 ---- 110
	Soybean, small grains[6]	**130** 110 ---- 150	**100** 85 ---- 120	**85** 70 ---- 95	**70** 60 ---- 80
SANDS/LOAMY SANDS	Irrigated—**all crops**[5]	**215** 200 ---- 230	**200** 185 ---- 210	**185** 175 ---- 195	**175** 165 ---- 185
	Non-irrigated—**all crops**[5]	**140** 130 ---- 150	**130** 120 ---- 140	**120** 110 ---- 130	**110** 100 ---- 120

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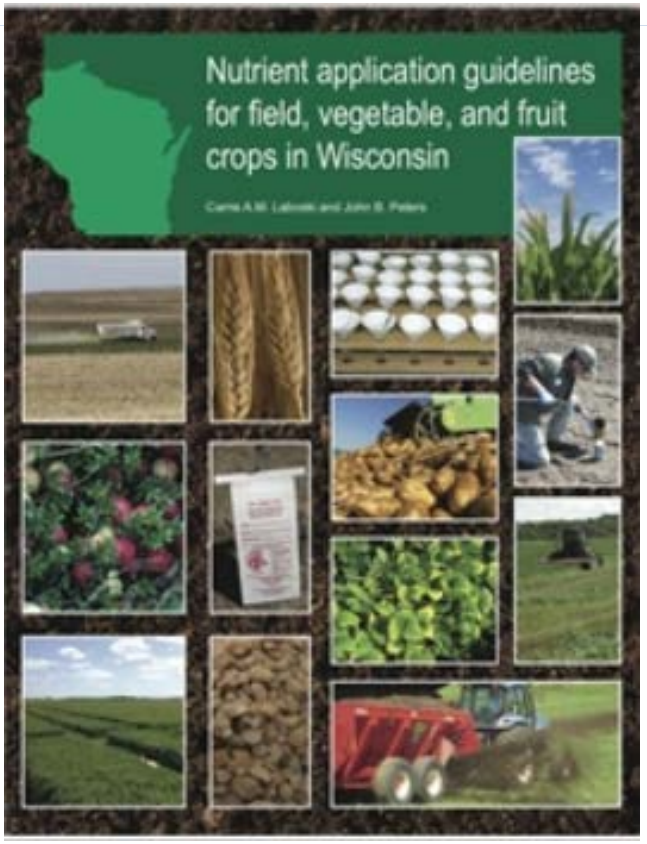
- A2809: Nutrient application guidelines for field, vegetable, and fruit crops in Wisconsin



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Understanding Soil Tests

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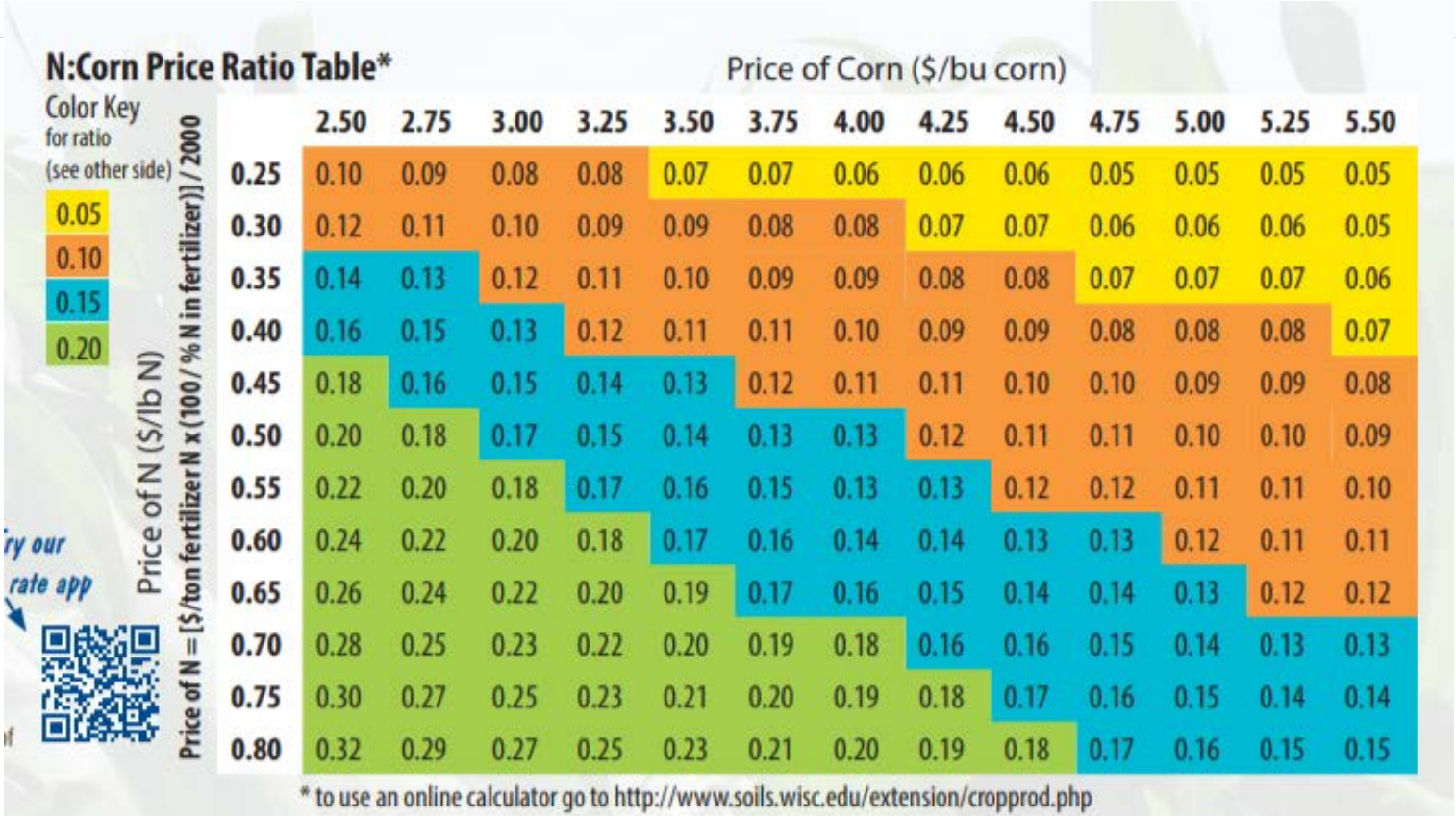

N:Corn Price Ratio Table*

Color Key for ratio (see other side)

0.05
0.10
0.15
0.20

Price of N ($/lb N)

Price of N = [$/ton fertilizer N x (100 / % N in fertilizer)] / 2000

Price of Corn ($/bu corn)

	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50
0.25	0.10	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05	0.05	0.05	0.05
0.30	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.06	0.06	0.06	0.05
0.35	0.14	0.13	0.12	0.11	0.10	0.09	0.09	0.08	0.08	0.07	0.07	0.07	0.06
0.40	0.16	0.15	0.13	0.12	0.11	0.11	0.10	0.09	0.09	0.08	0.08	0.08	0.07
0.45	0.18	0.16	0.15	0.14	0.13	0.12	0.11	0.11	0.10	0.10	0.09	0.09	0.08
0.50	0.20	0.18	0.17	0.15	0.14	0.13	0.13	0.12	0.11	0.11	0.10	0.10	0.09
0.55	0.22	0.20	0.18	0.17	0.16	0.15	0.13	0.13	0.12	0.12	0.11	0.11	0.10
0.60	0.24	0.22	0.20	0.18	0.17	0.16	0.14	0.14	0.13	0.13	0.12	0.11	0.11
0.65	0.26	0.24	0.22	0.20	0.19	0.17	0.16	0.15	0.14	0.14	0.13	0.12	0.12
0.70	0.28	0.25	0.23	0.22	0.20	0.19	0.18	0.16	0.16	0.15	0.14	0.13	0.13
0.75	0.30	0.27	0.25	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.14	0.14
0.80	0.32	0.29	0.27	0.25	0.23	0.21	0.20	0.19	0.18	0.17	0.16	0.15	0.15

ry our
rate app

* to use an online calculator go to http://www.soils.wisc.edu/extension/cropprod.php

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Understanding Soil Tests

Guidelines for choosing an appropriate N application rate for corn (grain)

Corn Nitrogen Guidelines

Soil[1]	Previous Crop	0.05
LOAMY: HIGH YIELD POTENTIAL SOILS	**Corn**, forage legumes, legume vegetables, green manures[5]	**190**[3] 170 ---- 210[4]
	Soybean, small grains[6]	**140** 125 ---- 160
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	Soybean, small grains[6]	**130** 110 ---- 150

- if 100% of the N will come from organic sources, use the top end of the range
  - In addition, up to 20 lb N/ac in starter may be applied

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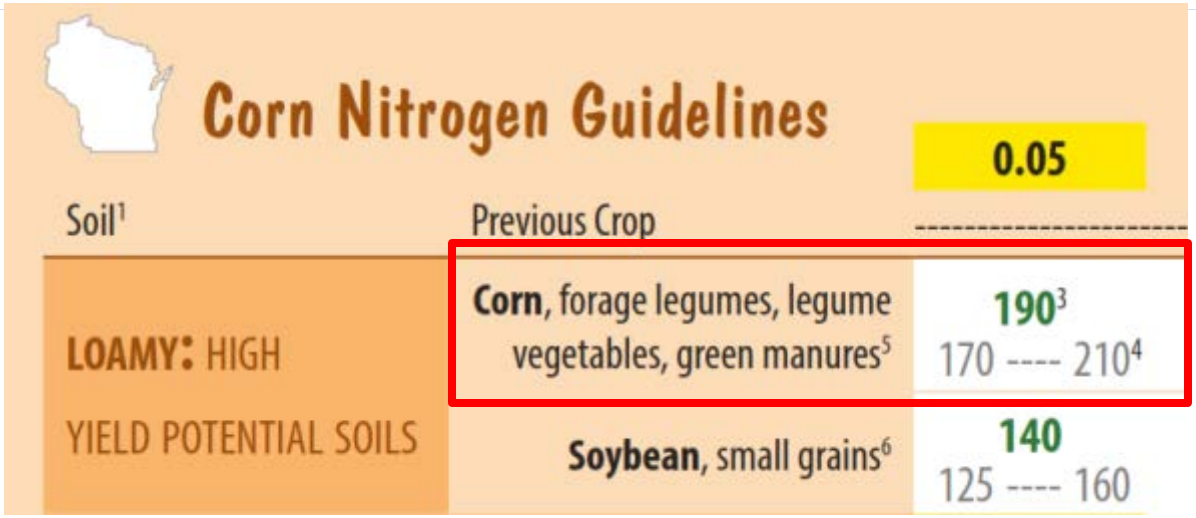
Understanding Soil Tests



Corn Nitrogen Guidelines

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	Soybean, small grains[6]	140 125 ---- 160

Ringwood soil = High Yield Potential

Corn on corn N rec = 190 (range 170-210)

Subtract N credit previous years application

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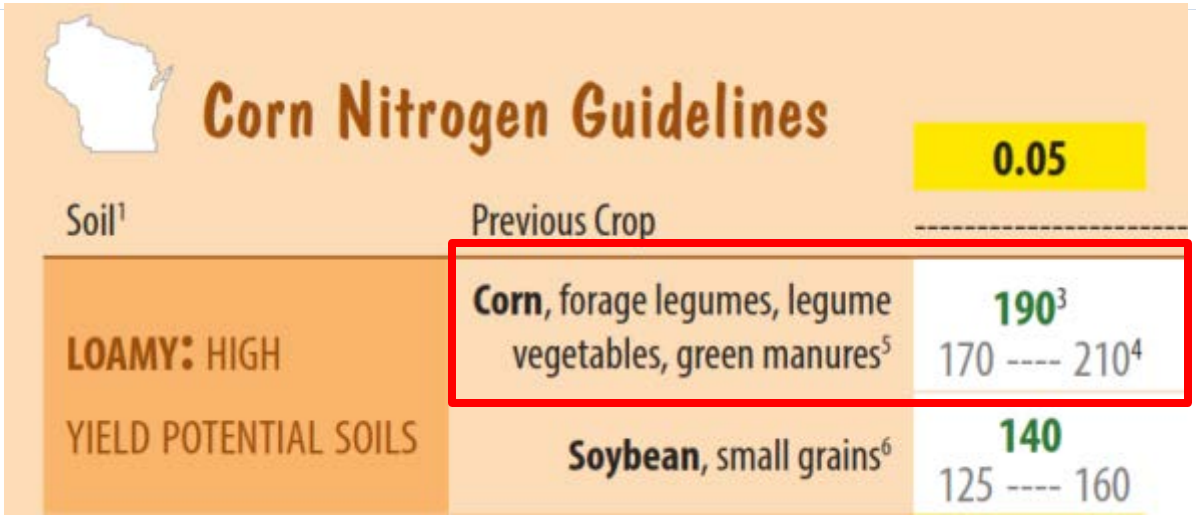
Understanding Soil Tests



Corn Nitrogen Guidelines

0.05

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Biosolids Example:

Recommendation = 210 lbs (for 100% organic source N)

less any carry over credits (for example = 8 lbs)

= 210 lbs – 8 lbs = 202 lbs

Madison Metropolitan Sewerage District

Questions?

Kim Meyer, CCA
Resource Recovery Manager
kimm@madsewer.org
608-222-1201 ext. 256

Madison Metropolitan Sewerage District