

THE ANATOMY OF A SOIL TEST REPORT

Revised 2023 by Christine Charles and Christina Curell, MSU Extension Educators

Adapted from *Understanding the MSU Soil Test Report: Results and Recommendations* by D. D. Warncke, J. G. Dahl, and M. L. Vitosh. (Michigan State University [MSU] Extension, 2016)

BACKGROUND INFORMATION

SOIL TEST REPORT FOR:					CONSULTANT		
DATE	LAB #	COUNTY	Previous Crop	ACRES	FIELD ID	SOIL	TEXTURE
					Deer Food Plot	Mineral	

SOIL TEST RESULTS

SOIL NUTRIENT LEVELS			Below Optimum	Optimum	Above Optimum
¹ Soil pH	6.1	Lime Index	69.0		
² Phosphorus (P)	23	ppm	■■■■■■■■■■		
³ Potassium (K)	22	ppm	■■■		
³ Magnesium (Mg)	40	ppm	■■■■■■■■■■	■■	

ADDITIONAL RESULTS:					Optional Tests:					
Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases			Micronutrients (ppm)					Organic Matter %
		K	Mg	Ca	B	Cu	Mn	Zn	Fe	
400	3.6	2.4	13.9	83.7						1.5

FERTILIZER RECOMMENDATIONS

RECOMMENDATIONS:									
Limestone: 2 ton/A					Tillage Depth:				
Target pH = 6.8					% Stand:				
Plant Nutrients:						Micronutrient: (Optional)			
Year	Crop	Expected Yield	Nitrogen (lb N/A)	Phosphate (lb P ₂ O ₅ /A)	Potassium (lb K ₂ O/A)	Boron (lb B/A)	Manganese (lb Mn/A)	Zinc (lb Zn/A)	Copper (lb Cu/A)

FOOTNOTES

1 Wildlife Forage - Legume	4 ton	0	60	255	2.0
This is a weakly buffered soil, so the lime recommendation is based on soil pH and target pH for the first year crop.					
For questions about interpreting your soil results go to the following website: http://msue.anr.msu.edu/experts and contact the MSUE field crops agent in your area.					
2 Wildlife Forage - Brassica	3 ton	100	20	140	1.0
This is a weakly buffered soil, so the lime recommendation is based on soil pH and target pH for the first year crop.					
For questions about interpreting your soil results go to the following website: http://fieldcrop.msu.edu/uploads/files/FieldCropsPointofContactMap.pdf and contact the MSUE agent in your area.					

BACKGROUND INFORMATION: This section contains information provided primarily by the client, which is important for making the correct fertilizer and lime recommendations. (Page 2)

SOIL TESTS RESULTS: The soil test values are indicators of the relative available nutrient levels in the soil. They are correlated with plant growth and yield responses. (Page 3)

FERTILIZER RECOMMENDATIONS: Fertilizer recommendations are based on the soil test results and crop information provided. (Page 4)

FOOTNOTES: The footnotes are printed out in special situations to help the client better understand the recommendations and maximize crop production. (Page 5)

BACKGROUND INFORMATION

SOIL TEST REPORT FOR:				CONSULTANT			
DATE	LAB #	COUNTY	Previous Crop	ACRES	FIELD ID	SOIL	TEXTURE
					Deer Food Plot	Mineral	

DATE: The date your samples were run in the lab

ACRES: The number of acres represented by the soil sample

FIELD ID: The label provided for the submitted sample (Keep track of the labeling names on the sample after sending them in.)

The client provides the background information when submitting the soil sample. A description of how this information is used to develop a fertilizer recommendation follows. If you provided the following information when you sent your samples, you will receive the most accurate guidance and recommendations:

Plow Depth: the depth of limestone incorporation if lime is needed. Listing the wrong depth could result in too much or too little lime being recommended. If you gave no information on plow depth, a depth of 9 inches is used to determine the lime requirement.

Previous Crop: the last crop grown in the field. When beans, alfalfa, or clover is the previous crop, a nitrogen credit is given. The nitrogen credit equals $[40 + (0.60 \times \text{the percent stand})]$ where over 5 to 6 plants/square foot in an established field is a 100 percent stand. If percent stand is not indicated, 70 percent is assumed and a nitrogen credit of 80 lb/acre [e.g., $40 + (0.60 \times 70)$] is given. The nitrogen credit is reflected in the printed nitrogen recommendation in the footnotes.

Crop: the next crop to be grown in the field. These nutrient recommendations are based on current soil fertility and this crop's needs.

Yield Goal: the yield which the grower seeks to attain on that field. A yield goal is *best based on a five-year yield average, not a one-year yield*. When figuring the yield average over several years, do not include unusually high or low yields. *If a yield is not indicated by the client, the computer will select an average yield for that soil management group.*

SOIL TEST RESULTS

SOIL pH: An indication of the soil's active acidity

LIME INDEX: An indication of the soil's reserve acidity, or the amount of lime it will take to adjust the soil pH

SOIL TEST CALIBRATION: This bar chart is based on research that has determined crop yield responses to different levels of the listed soil nutrients. At below optimum conditions, yield can be improved with nutrient additions but at above optimum conditions, yield plateaus.

SOIL NUTRIENT LEVELS

¹ Soil pH	6.1	Lime Index	69.0
² Phosphorus (P)	23	ppm	
³ Potassium (K)	22	ppm	
³ Magnesium (Mg)	40	ppm	

Below Optimum

Optimum

Above Optimum



ADDITIONAL RESULTS:

ADDITIONAL RESULTS:					Optional Tests:					
Calcium (Ca) (ppm)	CEC (meq/100 g)	% of Exchangeable Bases			Micronutrients (ppm)					Organic Matter %
		K	Mg	Ca	B	Cu	Mn	Zn	Fe	Nitrate-N ppm
400	3.6	2.4	13.9	83.7						1.5

CATION EXCHANGE CAPACITY (CEC):

The amount of cations (positively charged nutrients) per 100g of soil that can be held or exchanged in the soil

% OF EXCHANGEABLE BASES:

Represents the percentage of CEC occupied by the base cations (positively charged nutrients) calcium (Ca²⁺), magnesium (Mg²⁺), and potassium (K⁺)

MICRONUTRIENTS:

Important for a variety of biochemical plant pathways, including stress responses

ORGANIC MATTER:

The percentage of your soil composed of active organic matter

Soil pH: the level of soil acidity or alkalinity. Above 7.0 is alkaline, 7.0 is neutral, and below 7.0 is acidic. This measurement, sometimes referred to as the *soil water pH*, is made with soil in distilled water. A pH between 6.0 and 6.8 is best for production of most field crops.

Lime Index: an indicator of the reserve or potential acidity in soil used to determine the quantity of lime needed to correct the pH of an acidic soil. Lime index measurements are made only on samples testing less than pH 6.8. The lime index usually falls between 70 and 60. With a lime index above 70, no lime is needed. As the lime index decreases below 70, more lime is required to bring the pH back up to 6.5.

Soil test **phosphorus (P), potassium (K), and magnesium (Mg)** values (given under "Soil Nutrient Levels" section) and **calcium (Ca)** values (given under "Additional Results" section) are reported in parts per million (ppm). For mineral soils, 2 lb/acre equals 1 ppm (parts per million). To interpret how specific ranges relate to your management goals and crop, contact your local Extension educator or specialist, or purchase the most relevant nutrient recommendation guide from the MSU Extension Bookstore at <https://shop.msu.edu/collections/msu-extension-bookstore>.

Nitrogen (N) is not directly measured in this type of soil test despite being an essential macronutrient. As a dynamic nutrient with various pathways of movement, N content changes quickly; accurate testing requires immediate freezing and is an expensive process. Therefore, N recommendations are based on multiple calculations that consider soil fertility research, your soil's organic matter content, your cropping history, and the next crop needs.

Micronutrients: Analyses of micronutrients such as **zinc (Zn), manganese (Mn), iron (Fe), boron (B), and copper (Cu)** are made only on special request and are reported in parts per million (ppm). Adequate levels of zinc and manganese vary with the crop and soil pH.

Organic Matter: is reported as percent of active organic matter in the soil. The active rather than the total organic matter content is reported because this part is important in the soil's nutrient-holding capacity and the efficacy of herbicides. Most mineral soils in Michigan have active organic matter contents between 1 and 4 percent and vary based on soil texture.

Cation Exchange Capacity (CEC): an indicator of the nutrient-holding capability of a soil. A relatively permanent characteristic of each soil, it is not easily changed. In general, the greater the clay and organic matter contents, the higher the CEC of a soil. As the soil pH changes, the CEC value will also vary somewhat. The higher the CEC, the greater the capacity of the soil to hold nutrients and bind certain pesticides. The CEC of a soil is also important in determining permissible heavy metal loading rates associated with land application of sewage sludge.

% of Exchangeable Bases: information on the nutrient balance among potassium, calcium, and magnesium. The percentages reported assume K, Ca, and Mg comprise 100 percent of the exchangeable bases. They are used to determine potential magnesium deficient situations.

FERTILIZER RECOMMENDATIONS

LIME: When lime is required to neutralize excess soil acidity, the lime recommendation includes two pieces of information.

The first line indicates the tons of lime required to achieve the necessary pH. The lime recommendation will be printed only if the previous and the next crop have a different lime requirement. When this occurs, the following footnote will print out: "Lime to suggested pH for the most important crop in your rotation. Only one application of lime is intended." Do not apply both rates.

RECOMMENDATIONS:									
Limestone: 2 ton/A				Tillage Depth:					
Target pH = 6.8				% Stand:					
Plant Nutrients:				Micronutrient: (Optional)					
Year	Crop	Expected Yield	Nitrogen (lb N/A)	Phosphate (lb P ₂ O ₅ /A)	Potassium (lb K ₂ O/A)	Boron (lb B/A)	Manganese (lb Mn/A)	Zinc (lb Zn/A)	Copper (lb Cu/A)

The next line gives the pH to which the soil should be increased by liming. This is dependent on the crop(s) being grown. When alfalfa is part of the crop rotation, pH 6.8 is indicated. For most other field and vegetable crops, pH 6.5 is indicated.

MAJOR NUTRIENTS:

Recommendations given for N, P₂O₅, and K₂O are those which will result in the most economical yields. This assumes that the soil sample is representative, that a realistic yield goal has been chosen, that average weather prevails, and that good management practices are used. However, due to variations in these factors, the most economical fertilizer rate may vary from those given.

MICRONUTRIENTS:

The micronutrients for which recommendations are most frequently given are zinc (Zn), manganese (Mn), copper (Cu), and boron (B). Recommendations for Zn, Mn, and Cu are based on crop response, soil pH, and soil test level. Recommendations for B are based on crop response, soil pH, and soil texture. Specific recommendations for these micronutrients can be provided with additional purchase; however, B recommendations may be provided if growing conditions are at risk of B deficiency. Fertilizers are labeled according to the percent of a micronutrient contained. The percentage needed to supply the recommended amount will depend on the fertilizer rate being applied.

When thoroughly incorporated to the depth indicated, the soil pH goal will be achieved in two to three years with agricultural lime. For no-till situations, the lime recommendation is designed to neutralize the acidity in the top 2 inches.

MSU fertilizer recommendations are based on the soil test results and crop information provided. Recommendations are given in pounds of N (nitrogen), P₂O₅ (phosphate), and K₂O (potash) for the major nutrients and in pounds of element per acre for each of the micronutrients. Commercial fertilizer analyses are similarly reported as percent of the element present.

When the cropping information for the subsequent crop rotations are provided, crop-specific fertilizer recommendations are given.

The nutrients recommended can be supplied from a wide variety of fertilizer materials and applied through various combinations of pre-plant broadcast, planting time band, and side dress applications. Since many ways are available for a client to supply the nutrients in the recommendation, the client should work closely with an Extension professional, a consulting agronomist, a horticulturist, or a fertilizer dealer to determine the most suitable fertilization program.

FOOTNOTES

FOOTNOTES: Fertilizer recommendations can be provided for multiple years if listed by the client. Below the fertilizer recommendations for each crop year specified, footnotes are printed out to help the client further understand the recommendations and maximize crop production through proper fertilizer and lime management.

SECONDARY NUTRIENTS: The need for Mg is indicated by one of two footnotes: 1) "Magnesium tests low, use dolomitic limestone," or 2) "Magnesium tests low, broadcast 25-50 ppm Mg or row apply 5-10 ppm Mg." The first footnote is printed when lime is required to neutralize excess soil acidity. The second footnote is printed when the magnesium test is low and the soil pH is adequate so that no lime is needed.

1 Wildlife Forage - Legume	4 ton	0	60	255	2.0
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Fertilizers are labeled as a percentage of the nutrients (N-P-K) they contain by weight, which is listed on the fertilizer bag. For example, 0-44-0 means the fertilizer contains 44% phosphorus by weight. The nutrient recommendations on the soil test provide the recommendation as pounds of nutrient, not fertilizer, needed per acre. To figure out how much fertilizer to spread, divide the pounds of nutrient needed by the percentage of that nutrient in the fertilizer (expressed as a decimal) to get the pounds of fertilizer to apply. For example, to get 60 lbs P/acre using 0-44-0 fertilizer, you would need to apply $60/0.44 = 136$ lbs of fertilizer/acre.

SOURCES

Culman, S., Fulford, A., Camberato, J., & Steinke, K. (2020). *Tri-state fertilizer recommendations for corn, soybean, wheat and alfalfa* (974). Ohio State, MSU Extension, Purdue Extension.

Warncke, D. D., Dahl, J. G., & Vitosh, M. L. (2016). *Understanding the MSU soil test report: Results and recommendations*. Michigan State University Extension.

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