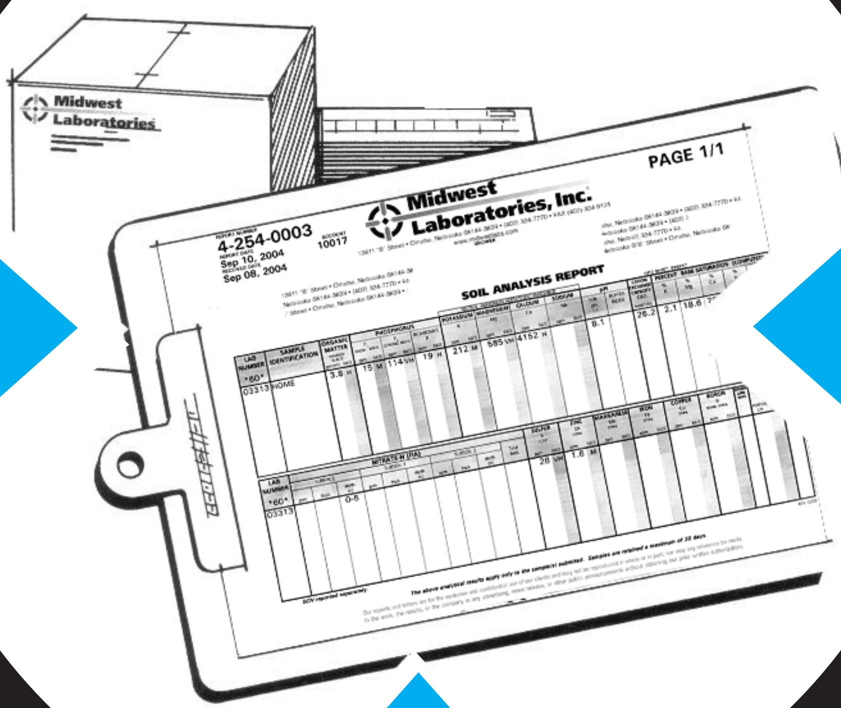
INTERPRETING SOIL ANALYSIS



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SOIL ANALYSIS REPORT

E INFORMATION SHEET: 123456

LAB NUMBER	SAMPLE IDENTIFICATION	ORGANIC MATTER MODIFIED LOI percent RATE	PHOSPHORUS P1 (WEAK BRAY) ppm RATE	PHOSPHORUS P2 (STRONG BRAY) ppm RATE	PHOSPHORUS BICARBONATE P ppm RATE	NEUTRAL AMMONIUM ACETATE (EXCHANGEABLE) POTASSIUM K ppm RATE	MAGNESIUM Mg ppm RATE	CALCIUM Ca ppm RATE	SODIUM Na ppm RATE	pH SOIL pH 1:1	pH BUFFER INDEX	CATION EXCHANGE CAPACITY C.E.C. meq/100g	PERCENT BASE SATURATION (COMPUTED) % K	% Mg	% Ca	% H	% Na
F LAB NUMBER	G SAMPLE IDENTIFICATION	1		2		3	4		5	6	7	8			9		

LAB NUMBER	NITRATE-N SURFACE ppm	SURFACE lbs/A	SURFACE depth (in)	SUBSOIL 1 ppm	SUBSOIL 1 lbs/A	SUBSOIL 1 depth (in)	SUBSOIL 2 ppm	SUBSOIL 2 lbs/A	SUBSOIL 2 depth (in)	Total lbs/A	SULFUR S ICAP ppm RATE	ZINC Zn DTPA ppm RATE	MANGANESE Mn DTPA ppm RATE	IRON Fe DTPA ppm RATE	COPPER Cu DTPA ppm RATE	BORON B SORB. DTPA ppm RATE	EXCESS LIME RATE	SOLUBLE SALTS 1:1 mmhos/cm RATE	
			10								11	12	13	14	15	16	17	18	

19 COMMENTS:

REV. 12/03

REPORT TERMS

Parts per million (ppm)

Results for the major and minor elements are reported in parts per million (ppm) on an elemental basis. An acre of mineral soil 6 to 7 inches deep weighs approximately 2 million pounds. Therefore, to convert parts per million readings to pounds per acre, multiply by 2.

Meq/100q (milliequivalents per 100 grams)

Soil cations, such as calcium, magnesium, potassium, and hydrogen can be expressed in terms of their relative ability to displace other cations. The unit of measure meq/100g serves this purpose. For example, one milliequivalent of potassium is able to displace exactly one milliequivalent of magnesium. The cation exchange capacity of a soil, as well as the total amounts of individual cations may be expressed using these units.

Millimhos/cm (mmhos/cm)

Electrical conductivity measurements are often used to measure the amount of soluble salts in the soil. Conductivity is generally expressed in mmhos/cm. The conductivity increases with increasing soluble salts, and the soil is considered saline when the conductivity reading of the saturation extract reaches 2 mmhos/cm.

Ratings

Most soil test readings on the report are given a rating of very low (VL), low (L), medium (M), high (H) or very high (VH). The purpose of these ratings is to provide a general guideline for determining optimum nutrient levels for crop growth. Upon request, an unrated form can be obtained. Optimum levels may vary slightly from those shown on the Soil Analysis Report, however, the actual value that is best is dependent on many factors such as crop, yield potential and soil type.

SOIL ANALYSIS

Organic Matter

1

Percent organic matter is a measurement of the amount of plant and animal residue in the soil. The color of the soil is usually closely related to its organic matter content, with darker soils being higher in organic matter.

The organic matter serves as a reserve for many essential nutrients, especially nitrogen. During the growing season, a part of this reserve nitrogen is made available to the plant through bacterial activity.

Phosphorus

2

Three types of phosphorus tests are reported. The P_1 (weak Bray) test measures phosphorus which is readily available to plants. The optimum level will vary with crop yield and soil conditions, but for most field crops, 20 to 30 ppm is adequate. Higher levels may be needed for certain vegetable crops or where especially high yields are possible.

The P_2 (strong Bray) test measures readily available phosphorus plus a part of the active reserve phosphorus in the soil. A level of 40 to 60 ppm is desired for good yields of most crops.

The Bicarbonate P (sodium bicarbonate) test measures the amount of readily available phosphorus in slightly basic (pH 7.0-7.2) to highly basic soils (pH 7.3 and greater). In basic soils the phosphorus exists mostly as alkaline earth phosphates, and the extraction of dilute sodium bicarbonate correlates with what crops can extract from these soils. The weak and strong Bray extractions are acidic (low pH) and these extracting solutions are neutralized by the presence of free lime in higher pH soils giving lower phosphorus levels.
The relationship between the P_1 and P_2 test levels (P_1:P_2 ratio) can help evaluate the phosphorus status of the soil as well as identify a

soil condition that contributes to poor crop performance. The following comments will apply to the P_1:P_2 ratio in most areas:

A. 1:1 – VL to L Poor history of fertilizer use – adding P_2O_5 will tend to widen the ratio. Many times the available P_2 increases faster than the standard available P_1 indicating an increase in the reserve.

B. 1:1 – M to VH Low reserve. Fe and Al "P" bond is very tight – a lime application will release P and increases the Ca availability, generally the ratio will widen as a result of the lime application.

C. 1:2 with P_1 M to H. Ideal range with reserve as high as the P_1 availablity.

D. Greater than a 1:2 ratio. Some may be as high as 1:20 or greater. One or more of the following principles may apply:
   1. Response to starter may increase as ratio increases.
   2. Presence of free lime in the soil may be indicated.
   3. Increaing response to the use of sulfur and zinc. (Use 1 part of zinc with 2 to 4 parts of sulfur. A maximum of 8 pounds of SO_4 –S may be used in a starter band.)

E. When the P_2 is over 50 ppm, one can expect greater response to Zn.

F. The amount of P_2O_5 which will be required to increase the P_1 reading is dependent on soil texture (or cation exchange capacity), soil pH, and level of P_1 and P_2. An average value would be 9 lbs. of P_2O_5 required to raise P_1, reading 1 ppm.

Potassium

3 This test measures available potassium. The optimum level will vary with crop, yield, soil type, soil physical condition, and other soil related factors. Generally, higher levels of potassium are needed on soils high in clay and organic matter than in soils which are sandy and low in organic matter. Soils containing high levels of magnesium may also need higher levels of potassium. A corrective factor for additional potassium is introduced when magnesium base saturation exceeds 23%. Optimum levels for light-colored, coarse-textured soils may range from 150 to 175 ppm, dark-colored heavy-textured soils range from 175ppm to 250 ppm.

Magnesium and Calcium

4 The levels of calcium and magnesium found in the soil are affected primarily by soil type, drainage, liming and cropping practices. These basic cations are closely related to soil pH. As the soil pH gets higher, the levels of calcium and magnesium usually increase. Calcium deficiencies are rare when the soil pH is adequate. Magnesium deficiencies are more common in sandy, low organic matter soils. Adequate magnesium levels normally range from 100 to 250 parts per million. The need for magnesium can be further determined by its base saturation, which should be above 10-12 percent. Soils having magnesium base saturation in excess of 23 percent may exhibit drainage and compaction problems characteristic of cold, wet soils. These soil conditions require special attention regarding potassium application and chemical responses.

Sodium

5 Although sodium is an essential nutrient for some crops, it is usually considered in light of its effect on the physical condition of the soil. High exchangeable sodium (greater than 2.5% sodium saturation) may cause adverse physical and chemical conditions to develop in the soil. These conditions may prevent the growth of plants. Reclamation of these soils involves the replacement of the exchangeable sodium by calcium or magnesium and the removal of the sodium by leaching.

Soil pH

6 The soil pH measures active soil acidity or alkalinity. A pH of 6.9 or less is acid, 7.0 is neutral, values higher than 7.0 are alkaline. Usually the most desirable pH range for mineral soil is 6.5 to 6.9 and for organic soil 5.5 to 6.0.

Buffer Index

7 This is an index value used for determining the amount of lime to apply on acid soils with pH less than 7.0. A value is not given for pH's greater than 7.0. The lower the buffer index number, the higher the lime requirement.

Cation Exchange Capacity – (CEC)

8 Cation Exchange Capacity measures the soil's ability to hold nutrients such as potassium, magnesium, and calcium as well as other positively charged ions such as sodium and hydrogen. The CEC of a soil is dependent upon the amounts and types of clay minerals and organic matter present. The common expression for CEC is in terms of milliequivalents per 100 grams (meq/100g) of soil. On most soils, it will vary from 5 to 35 meq/100g depending upon the soil type. Soils with high CEC will generally have higher levels of clay and organic matter. For example, one would expect soil with a silty clay loam texture to have a considerably higher CEC than a sandy loam soil. Although high CEC soils can hold more nutrients, good soil management is required if these soils are to be more productive.

Percent Base Saturation

9 Percent saturation refers to the proportion of the CEC occupied by a given cation (an ion with a positive charge such as potassium, magnesium, or calcium, or combination of cations referred to as bases). The percentage saturation for each of the following cations for optimum crop performance will usually be within the following ranges:

Potassium	2 to 5
Magnesium	12 to 18
Calcium	65 to 75

Nitrate-Nitrogen

10 The soil test measures nitrate-nitrogen (NO_3-N). This form is water soluble and readily available for plant uptake. When considering nitrogen needs for optimum crop performance, this test will indicate where and how much nitrate-nitrogen is present. Depth tests determining NO_3-N will give more detailed information for making nitrogen recommendations. It is important that other soil factors including organic matter content be taken into account when interpreting the nitrate-nitrogen soil test and predicting crop response.

Sulfur

11 The soil test measures everal forms of sulfur that can be readily available. Higher sulfur levels can occur when soils have reduced internal drainage, high soil pH, or are irrigated with water having a higher sulfur content. Optimum levels for sulfur depend largely on organic matter content, soil texture, drainage, and yield goal. Generally, whenever the following conditions exist, the need for sulfur will be increasingly important for optimum crop performance:

A. Well drained, low CEC Soils

B. Soils low in organic matter

C. Low soil pH (below 6.0)

D. Use of high analysis, low sulfur fertilizers

E. High application rates of nitrogen fertilizer

F. High yield goals

Overall effectiveness of a sulfur application depends largely on the ability of the sulfur product used to break down and become water soluble in the soil.

Zinc

12 DTPA extraction is used to extract the zinc. A 1.8-2.5 ppm test level is usually adequate, however, interactions between zinc, soil phosphorus and soil pH can significantly alter rates of application of zinc to achieve desired crop response. When relatively large amounts of zinc are to be applied (5-10 lbs per acre),

broadcast treatments are acceptable, with residual effects of these larger quantities lasting several years. Smaller amounts of zinc are most effective in combination with the application of an N-P-K treatment. Soils that have been leveled and/or terraced should be especially considered for zinc applications.

Manganese

13 Manganese is extracted using the DTPA extraction process. Optimum test levels range from 14-22 ppm. Manganese is its soluble (readily available for plant uptake) form quickly reverts to insoluble (unavailable) forms shortly after application. Row or band treatments along with foliar application are the recommended methods of treatment for optimum crop response and efficiency of applied manganese.

Iron

14 Iron is extracted using the DTPA extraction process. A 12 to 22 ppm test would be optimum in most cases. A soil test indicating iron to be adequate or even optimum may not reflect desired crop response. Soil pH is a very important factor in interpreting the iron soil test. Correcting iron deficiencies is complicated because iron compounds added to the soil quickly react with the soil solution and become unavailable to the growing plant. Chelated forms of iron have been effective as soil treatments, while foliar applications have proven to provide the best results for correcting iron deficiencies.

Copper

15 Copper is extracted using the DTPA extraction process. A 1.2 to 1.8 ppm test level should be sufficient. Several factors enter into conditions contributing to a copper deficiency: soil pH above 7.0, high organic matter soils (peats and mucks,) and soils receiving high rates of nitrogen phosphorus and zinc applications. The crop to be grown and the associated yield goals are also important factors to consider. Soil applications of copper are generally effective for several years, especially on soils with pH's below 7.0.

Boron

16 Boron is extracted from the soil using DTPA/Sorbitol. Adequate levels range from 1 to 1.5 ppm. Boron deficiencies will be most common on sandy, low organic matter soils. Soil pH levels of 7.0 and above contribute to boron deficiencies also. Corrective measures can be effectively done by application of boron fertilizer to the soil. Since the range between boron deficiency and toxicity is narrow for plant growth, broadcast treatments are the desired method of application.

Excess Lime Rate

17 A visual rating of free lime present. Soils having high amounts of free lime available will have problems with availability of major and minor elements to the plant. Application of elemental sulfur or acid forming fertilizer can be beneficial in keeping phosphorus and micronutrients in a more available or soluble form.

Soluble Salts

18 Excessive concentration of various salts may develop in soils. This may be a natural occurrence. It may result from poor irrigation water, excessive fertilization or contamination from various chemicals or industrial wastes. One effect of high soil salt concentration is water stress in a plant such that the plant may wilt or even die. The effect of salinity is negligible if the reading is less than 1.0 mmhos/cm. Readings greater then 1.0 mmhos/cm may affect salt sensitive plants. Readings greater than 2.0 mmhos/cm may require the planting of salt tolerant plants.

Comments

19 This section of the report is used by the agronomists to address certain problems that specific test readings may give in the way of interpretation or crop response. Specific questions or special attention on a certain aspect of the soil test requested by the client may also be answered in the comments section.

Additional Analyses

Additional analysis such as chloride, molybdenum, ammoniacal nitrogen and total nitrogen will be shown on an addendum report, if analyzed. If soil texture is determined, the precent sand, silt and clay will be listed on this addendum report as well.

OFFICE INFORMATION

A. **Report Number**

All samples are filed by report number. When contacting our lab concerning a certain report, be sure to refer to this number.

XX-YYY-ZZZZ
XX=Year
Y = Day of Year (Julian calendar)
Z= Report Number

B. **Account**

An account number has been assigned to each client. The use of this number will speed up the processing and location of samples within the laboratory system.

C. **Report Date**

The date which the sample data was reported is shown here.

D. **Received Date**

The date which the sample was received at the laboratory appears here.

E. **Information Sheet Number**

The number of the information sheet which was submitted with the samples in this report is listed here.

F. **Lab Number**

The identification number which was assigned by the laboratory to each individual soil sample is shown here. There may be more than one laboratory number per report.

G. **Sample Identification**

The identification number assigned by the client to each individual sample is reported here. Because of limited space, samples numbers must be limited to 10 digits.

Midwest Laboratories, Inc. has been serving the agricultural, industrial, enviromental, and sampling needs of the United States and Canada for nearly 30 years. The Midwest Labs Campus offers over 60,000 square feet of laboratory space dedicated to meeting the analytical needs of our clients. Our data management system is one of the best in the industry. By entering an account number and an individually assigned password at www.midwestlabs.com, you can view historical results, alter/add recommendations to existing reports, order supplies, view your personal fee schedules, research scientific literature and auto-submit samples.