

# Soil Analysis Reference Guide



## Report Terms

### Parts per million (ppm) or lbs/acre:

Results for the major and minor elements are reported in parts per million (ppm) or lbs/acre. The reporting units will be printed right after the lab results. When results are reported in ppm, convert to lbs/acre by multiplying the ppm number by 2 for a 6 inch sample depth.

### Meq/100g (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 is meq/100g. 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.

### Ratings:

Some 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 best value is dependent on many factors such as crop, yield potential and soil type.

### Tracking Information:

- A. Report Number: All samples are filed by report number. When contacting A&L concerning a certain sample, be sure to refer to this number.
- B. Date Report is printed
- C. Account Number: An account number has been assigned to each A&L client. The use of this number will speed up sample processing and location of samples within the laboratory system.
- D. A&L Agronomist: Agronomist reviewing report
- E. Date sample was received in the lab
- F. Laboratory Number: The identification number assigned by the laboratory to each individual soil sample is shown here.
- G. Sample I.D.: The identification number assigned by the client to each individual sample is reported here. Because of limited space, sample ID's must be limited to 6 digits or characters.

## Soil Analysis:

1. **Soil pH:** The soil pH measures active soil acidity or alkalinity. A pH of 6.9 or less is acid. Soils with a pH of 7.0 are neutral; values higher than 7.0 are alkaline. Under normal conditions the most desirable pH range for mineral soil is 6.0 to 7.0 and 5.0 to 5.5 for organic soil.
2. **Buffer pH:** The buffer pH is a value used for determining the amount of lime to apply on acid soils with a pH less than 6.6. The lower the buffer pH, the higher the lime requirement.
3. **Phosphorus:** Four types of phosphorus tests may be reported:
  - I. The P1 (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 (40 to 60 lbs/acre) is adequate. Higher levels may be needed for especially high yields as well as for certain vegetable crops.
  - II. The P2 (strong Bray) test measures readily available phosphorus plus a part of the active reserve phosphorus in soil. A level of 40 to 60 ppm or 80 to 120 lbs/acre is desirable for good yields of most crops.
  - III. The Mehlich I (Double Acid) or Mehlich III extracts readily available phosphorus in slightly acid soils. A level of 30 to 50 ppm (60 to 100 lbs/acre) is adequate for most crops.
  - IV. The Bicarbonate P (sodium bicarbonate) test measures the amount of readily available phosphorus in slightly basic (pH of 7.0 – 7.2) to highly basic soils (pH 7.3 and greater). In basic soils the phosphorus exists mostly as alkaline earth phosphates. The extraction by dilute sodium bicarbonate correlates with what the crops can extract from these soils. The weak and strong Bray extractions are acidic (low pH). These extracting solutions are neutralized by the presence of free lime in higher pH soils, thus giving lower phosphorus test levels.

To determine which phosphorus is listed on your report, see Soil Test Method. If the soil test method is listed as ammonium acetate it will be Bray P1 phosphorus. Double acid will be the Mehlich I and Mehlich III will be listed as such. Bray P2 or sodium bicarbonate P will be listed on the last line of the report.

4. **Potassium:** 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 in soils high in clay and organic matter; lower levels in soils which are sandy and low in organic matter. Optimum levels for light-colored, coarse-textured soils may range from 90 to 150 ppm or 180 to 300 lbs/acre. Dark-colored, heavy-textured soils may require potassium levels from 120 to 240 ppm or 240 to 480 lbs/acre.
5. **Magnesium and Calcium:** 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 increases, the levels of calcium and/or magnesium usually increase. Calcium deficiencies are rare when the soil pH is adequate. Magnesium deficiencies are more common. Adequate magnesium levels normally range from 50 to 70 parts per million. The need for magnesium can be further determined from its base saturation, which should be above 10 percent.
6. **Sulfur (Sulphur):** The soil test measures sulfate sulfur (S04-S) which is readily available and preferred for plant uptake. Optimum levels of sulfur depend on organic matter content, soil

texture, drainage, and desired yield goal. Whenever the following conditions exist, the need for sulfur will normally be increasingly important for optimum crop performance:

- Well drained, low CEC soils
  - Soils low in organic matter
  - Low soil pH (below 6.0)
  - Use of high-analysis, low sulphur fertilizers
7. **Boron:** Readily-soluble boron is extracted from the soil with hot water. Adequate levels range from 1 to 3 ppm. Factors to be taken into consideration when interpreting the boron test should include pH, organic matter and texture, as well as the crop to be grown.
  8. **Copper:** A level of 1 to 1.8 ppm of copper or 2 to 3.6 lbs/acre should be sufficient for the acid extraction methods for DTPA extraction, 0.3 ppm is adequate. The soil pH, organic matter level, high rates of nitrogen, and the crop to be grown are important factors that should be considered when interpreting the copper test results.
  9. **Iron:** A level of 5 to 10 ppm (10 to 20 lbs/acre) of extractable iron is usually adequate for either the 0.1 N HCl or the Mehlich extractions. For DTPA extraction, 5 ppm is adequate. Soil pH is a very important factor in interpreting the iron soil test.
  10. **Manganese:** A test range of to 10 ppm (10 to 20 lbs/acre) of extractable manganese is usually adequate for 0.1 N HCl and Mehlich. For DTPA extraction, 1 ppm is adequate. Soil pH is especially important in interpreting manganese test levels. In addition, soil organic matter, crop, and yield goal must also be considered. Since manganese quickly converts to insoluble (unavailable) forms shortly after application, row or band treatments and foliar applications are the recommended methods for applying manganese.
  11. **Zinc:** A test level of 3 to 5 ppm (6 to 10 lbs/acre) is normally adequate for 0.1 N HCl and Mehlich. For DTPA, 1 ppm is adequate. Factors taken into consideration when interpreting the zinc test include available soil phosphorus, pH, crop and yield goal.
  12. **Sodium:** Sodium is considered as it relates to the physical condition of the soil. Adverse physical and chemical conditions may develop in soil high in exchangeable sodium. These conditions may prevent the growth of plants. Reclamation of these soils involves the replacement of exchangeable sodium by calcium or magnesium and the removal of the sodium by leaching.
  13. **Soluble Salts:** If the level of salinity is less than 1.0 mmhos/cm the effects are negligible. Readings greater than 1.0 mmhos/cm may affect salt-sensitive plants. A level greater than 2.0 mmhos/cm may require planting salt tolerant plants. An excessive concentration of various salts may develop naturally or be the result of poor irrigation water, excessive fertilization, or contamination from various chemicals or industrial wastes. One effect of high soil salt concentration is to produce water stress in a crop which may cause the plant to wilt or even die.
  14. **Organic Matter and ENR:** (Estimated Nitrogen Release) 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. Bacterial activity releases some of this reserve nitrogen, making it available to the plant. The ENR is an estimate of the amount of nitrogen that will be released over the season.

In addition to organic matter level, the ENR may be influenced by seasonal variations in weather conditions as well as physical soil conditions.

15. **Nitrate:** The soil test measures nitrate-nitrogen (NO<sub>3</sub>-N) which is water soluble and readily available for the plant. When considering nitrogen levels needed for optimum crop performance, this test will indicate the level of nitrate present. Depth tests determining NO<sub>3</sub>-N will give more detailed information for making nitrogen recommendations. It is important that other soil factors including organic matter content are taken into consideration when interpreting the nitrate-nitrogen soil test and predicting crop response. This test is not well suited for high CEC soil or high rainfall areas.
16. **Additional Analyses:** Additional requested analyses such as chloride or aluminum will be shown in this area.
17. **Cation Exchange Capacity (CEC):** 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 measurement for CEC is milliequivalents per 100 grams (meq/100g) of soil. On most soils it will vary from 2 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.
18. **Cation Saturation:** Cation saturation refers to the proportion of the CEC occupied by a given cation (an ion with a positive charge such as calcium, magnesium or potassium) or combination of cations referred to as bases. The percentage saturation for each of the cations will usually be within the following ranges for optimum performance:  
**Potassium:** 2 to 5  
**Magnesium:** 10 to 40  
**Calcium:** 40 to 80
19. **Soil Test Method (Extraction):** This lists the extraction method used for the soil analysis.

#### Soil Fertility Guidelines:

1. Crop to be grown
2. Yield Goal for crop to be grown (necessary when recommendations requested)
3. Reporting units: will be listed as lbs/acre or lbs/1000 sq. ft. (necessary when recommendations requested)
4. The guidelines are for yearly application of the lbs of the actual nutrient.
5. Best management practices and suggestions for application times, rates, etc. are listed.

