

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 availability.
- 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. Increasing 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

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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

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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

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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

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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

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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)

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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

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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

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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

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The soil test measures several 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

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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

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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

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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

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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

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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

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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

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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 than 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

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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 percent 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.

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