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SOIL TESTING

SOIL TESTING OFFERS MULTIPLE ADVANTAGES

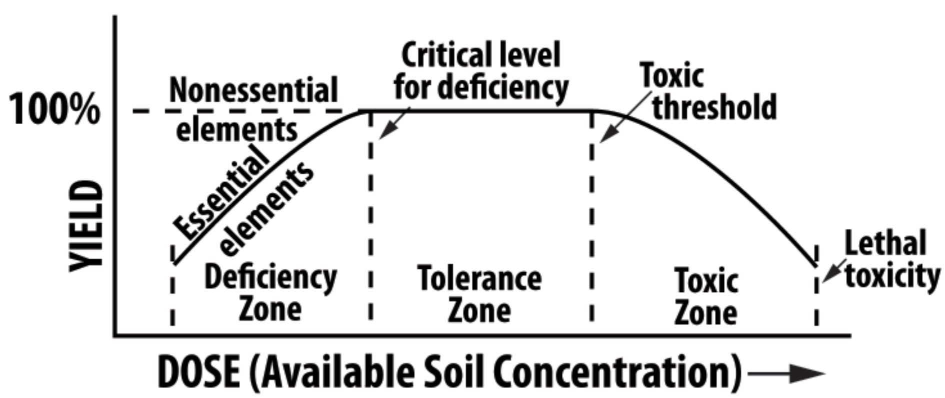
Soil is analyzed to help guarantee successful planting, to extend and prolong established plants, to help determine whether excessive or insufficient irrigation water is being applied and to help keep plants growing vigorously.

Plants in good healthy condition have the ability to tolerate some pests. However, when there are multiple problems, the ability of the plants to outgrow diseases, to remain green, and to survive periods of weather extremes declines rapidly. Soil testing is plant insurance.

OPTIMUM NUTRIENT CONCENTRATION

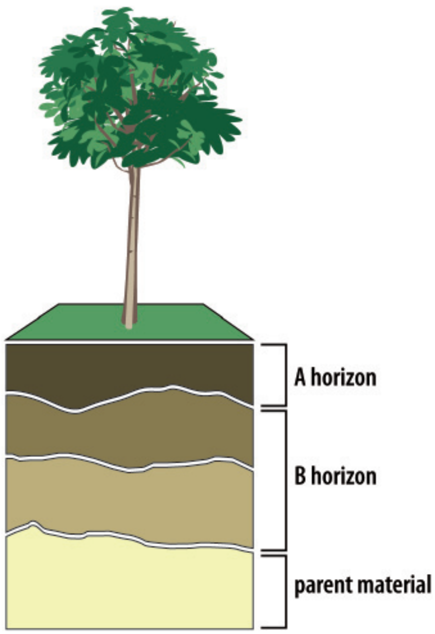
All nutrients are needed at moderate amounts. Excessive concentrations will cause toxicity while insufficient concentrations will stunt growth. One of the more frequent causes of mediocre growth is too much fertility or the addition of the incorrect product.

Waiting to analyze the soil until discoloration, burned leaves, wilting and diseases occur decreases the probability of successful corrections. Green plants does not necessarily mean that growth conditions are ideal. Green plants may have hidden hunger. Optimum balance of the thirteen essential mineral nutrients, irrigation and environmental factors allow for the proper growth and vigor of the plants. Moderate mineral deficiencies will not cause major changes in the appearance of the tissues, but they can substantially lower the vitality. The worst cases are multiple simultaneously. With critical deficiencies or nutrient toxicities, discoloration follows with a rapid decline of the plant.



Soil testing as a management tool is greatly under utilized. The most recent data for lawns and gardens are from 1987. The frequency of soil testing is the highest in the Southern States where it is one test per about 200 people per year. The per capita rate of soil testing is very low in the Southwestern States. California has a rate of one test per 2,091 people per year while Arizona has a rate of one test per 958 people per year. Ideally, every site should be tested every few years. The frequency of needed soil testing depends upon the amount of irrigation, the quality of irrigation water, the use of nutrients and amendments and the initial soil properties. Testing could help to prevent and solve many problems.

WHAT IS SOIL?



Soil is formed from the parent minerals contained in rocks. Through the influence of climate (rain, wind, heating, freezing etc.) and organisms the rocks weather. Simple plants like lichens and microorganisms use the minerals released in the weathering process and continue with the formation of soil. As organisms grow and die, organic matter accumulates which interacts with the mineral particles. Eventually, a horizon or profile of developed soil is generated which is called a topsoil.

Rain leaches the soluble minerals into the deeper soil profiles. The topsoil profile is called an "A horizon" while the soil profile which receives the minerals that are moved into the soil by water is called a "B horizon" or subsoil. Below the B horizon is the "C horizon" or the unweathered rock.

The properties of the topsoil depend mainly upon native vegetation and upon the amount of rain. These are a function of climate. Weathering of rocks releases salts which had previously been encapsulated, usually as part of the structure of the rock. In the desert and semiarid zones of the Southwest, the salt content of the soil is very high due to little leaching of the soils. The salts also impart an alkaline condition to the soil. Native plant species are desert shrubs which are tolerant of the local conditions. Due to poor plant growth, the accumulation of organic matter is generally low and the soil has poor physical properties. The soils are light colored.

The Great Plains has more rainfall than do the Western deserts; the salinity or salt level is decreased, but there is not an excessive amount of mineral leaching. The topsoil supports the growth of grasses. Organic matter accumulates and the soils have good tilth, are fertile and have a dark brown or black appearance due to the accumulation of organic matter.

As the amount of rain increases such as in the eastern regions of the country, the nutrient content of the topsoil is lower. The minerals have been leached into the deeper soil profiles. The soil is a gray-brown. The native species are broadleaf deciduous trees in high rainfall locations and the trees are needle-leaf trees in higher rainfall areas. Organic matter decomposes forming organic acids making acidic conditions. The acidity dissolves the nutrients which are leached into the groundwater by the rains.

Tropical soils near the surface are red because of the extremely low level of organic matter which unmask the presence of iron oxides which are very prevalent in soils. The fertility is extremely low and mostly what is available comes from the recycling of the nutrients from decaying vegetation and parasitic growth from plants growing on host plants. Weathering is rapid in the hot, humid conditions which releases some nutrients from the rocks.

Variations of the above conditions exist. Former marine sediments can be exposed in the normally alkaline west containing deposits of sulfur or iron sulfide which were formed from sulfate ions in the ocean. When exposed to the air, sulfuric acid is produced by oxidation leading to acidic soils. Also earth slides, erosion or grading can expose alkaline deposits from the "B" horizon in areas which are normally acidic.

Soils with the best physical properties exist with the highest level of soil organic matter. This occurs in the areas with moderate rain. The extremes of too little water and of too much rain decrease soil organic matter with a reduction in the tilth of the soil.

MODIFICATION OF SOIL PROPERTIES

The application of soil amendments and fertilizers can increase directly or indirectly the level of soil organic matter, increase the fertility of the soil and change the salt level and pH of the soil. Acidifying fertilizers such as ammonium sulfate and soil sulfur at high rates can make soil too acidic in normally alkaline conditions. Alkaline forming fertilizers such as calcium nitrate and potassium nitrate or the addition of excessive amounts of limestone can also cause growth inhibition.

It is surprising for most people to learn that plants have growth optimum conditions for nutrients; too much can be as bad as too little. When too much fertilizer is applied which is common for many sites, the rate of plant growth is decreased. Part of the inhibition is an induced deficiency of another nutrient caused by competition. Additionally, excessive nutrients increases the salt level of the soil which interferes with the moisture absorption by most plants.

In some cases, the soils are very resistant to change. This can be the situation for the arid and semiarid climates of the Southwest where limestone is present -- it is extremely difficult to acidify the soil. Plant growth problems exist in plants species (acid-loving plants) adapted to acidic soils when they are grown under alkaline conditions. Iron deficiency recognized by yellow leaves with narrow green veins is caused by the limestone and bicarbonates. In extreme cases the yellow leaves are very small; totally white leaves are easily burned from saline conditions. Special iron products are available to correct these problems. The iron deficiency condition is so common in some locals that many people believe that some species are normally yellow when they are not.

GUIDANCE FROM SOIL TESTING

Soil Acidity -
If the soil is too acidic, aluminum is dissolved causing a specific ion toxicity. The plant growth is stunted and the leaf coloration is sometimes deep green.

If the soil is too alkaline, some plant nutrients are unavailable causing a mineral deficiency. The source of these two problems can be the use of too much plant fertilizers of the incorrect type. A soil acidity (pH test) is required to know the soil acidity status.

Managing alteration in soil acidity with choice of nitrogen fertilizers – Fertilizer products are not interchangeable. Each product has a particular advantage and benefit over other materials. Use of the incorrect product will exacerbate problems while the correct on will enhance growth. For instance with nitrogen products, ammonium sulfate (21-0-0) will acidify the soil; ammonium nitrate (34-0-0) will be pH neutral if not over applied; calcium nitrate (15.5-0-0) will slightly increase the soil pH; urea (46-0-0) needs to be hydrolyzed before it is available. Nitrate nitrogen will supply soil oxygen. Ammonium nitrogen consumes oxygen when it is nitrified to nitrate.

Slow-release nitrogen materials also have certain benefits. Ureaformaldehyde (38-0-0) release nitrogen according to temperature and biological activities. IBDU releases in the presence of moisture and acidity, not according to plant growth. If coated products are broken, they become rapid-release.

Presence of limestone -
If limestone (calcium carbonate or chalk) is present, acid-loving plants become iron deficient unless corrective measures are taken.

Lime Requirement -
In areas of high rainfall, there are inadequate levels of potassium, calcium and/or magnesium due to the acidic soil. Tests for the required level of limestone or dolomite needed to raise the soil pH to a safe level are essential.

Excess Salts in the Soil -
The term used by laboratories is salinity. If salts have excessively accumulated in the soil, many plants are unable to use the moisture in the soil and may have toxicity from sodium and/or chloride. A salinity test is required to determine if this is a problem. The salinity can be controlled by leaching unless soils have drainage problems. A soil high in salinity is called “saline.”

Excessive Sodium -
Excessive sodium or a “sodic” soil most often has an elevated pH level. Soils high in pH values are suspect. Sodium can cause toxicity, but the more likely problem is soil compaction and poor drainage caused by the reaction of sodium on the clay.

Gypsum Requirement -
Excessive sodium can be corrected with the addition of gypsum. Another cause of high pH values is the presence of bicarbonates. Gypsum is also used to precipitate the excessive bicarbonates and lower the very high soil pH values. A laboratory test shows how much gypsum is needed.

Fertility - Most plants require at least 16 nutrients. Three nutrients are supplied by the water and by the air (oxygen, hydrogen and carbon). Thirteen are mineral nutrients. If any one is too low, the plants will not grow. In some cases, too much fertilizers have been applied causing an adverse reaction. Too much phosphorus, for instance, inhibits the plant uptake of iron, manganese, zinc and copper causing induced deficiencies. The best method to determine if a problem is caused by a true deficiency or is an induced deficiency is soil testing. Soil analysis is used to assess the nutrient levels of the soil. Plant tissue testing is also used to ascertain which nutrients have reduced availability in the soil.

Toxicity - Soils may contain toxic metals. They either exist in the soil naturally or have been introduced as contaminants in amendments. Mined minerals and waste products are the frequent contaminant sources. These elements prevent plant growth. If a vegetable garden is to be grown and if the presence of heavy metals is suspected, the soil should be tested as a precaution for human poisoning. Lead can be present in urban soil at levels which do not injure plants but can accumulate in produce at levels which may harm humans. Excess levels of selenium and molybdenum are problems with wild life or cattle. Other common toxic elements are aluminum, cadmium, chromium, nickel, arsenic, silver, and vanadium.

Soil Compaction - Excessive compaction impedes root growth, impairs water penetration and reduces soil aeration. Reduced aeration hinders the absorption of nutrients. In addition, slow water penetration exasperates the problem. Soil compaction can be measured and corrected with soil conditioners. Their need can be detected with soil testing.

Conclusions
Soil testing is best done before planting. Since many of the nutrients do not move through the soil, they remain on the soil surface if they have been broadcasted over the soil. Unless the nonmobile nutrients are tilled into the soil, they are not readily available for the plants. The best time for incorporation into the soil is during soil preparation. Except for nitrogen, sufficient nutrient can be added to provide adequate minerals to last a decade or more.

If the conditions of the soil restrict plant root growth, it is by far easier to remedy the problems before planting. Of course, plants can be used as indicators of soil conditions. If plants wilt easily, grow poorly, give discoloration etc., observation of plant symptoms is one of the methods of performing fertility testing. The cost of using or losing plants is more expensive than using a laboratory for soil analysis. Even without discoloration, plant growth can be severely limited. For full utilization of soil testing data, plant tissue analyses is needed. The two types of data indicate how well and which nutrients are readily available as well as any possible impeded nutrient availability due to interactions.

Soil is a precious resource. Properly managed, it benefits all of us. With poor cultural practices, it becomes a liability. As with any asset, soil needs monitoring and evaluation for its best and most productive use as well as to make it most valuable to the owner. It is even wise to analyze soils from properties being considered for acquisition.

