Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 02, Issue: 04 (JULY-AUGUST, 2022)
Available online at http://www.agriarticles.com

Soil Fertility Evaluation and Evaluation Techniques

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Abstract

Soil properties such as C, N, and P content have traditionally been used to determine soil fertility. Soil fertility testing is now a standard practice in agricultural production and soil management. Fertilizers are applied to the soil by uneducated farmers who have little respect for the needs of the plant or the soil. As a result, planned efficiency/replenishment is not maximized, and fertilizer usage is not optimized. Visual symptoms of nutrient deficiency, plant tissue analysis, and soil testing are the three most prevalent approaches for detecting soil fertility in this study. The research also looks into the various ways for determining soil fertility.

Key words: Fertility evaluation, DRIS, Analysis, Symptom

Introduction

Fertile and productive soils are essential components of stable communities because they allow plants to grow that are needed for food, fiber, animal feed and forage, medicines, industrial products, energy and a beautiful environment. Modern soil fertility approaches take into account both environmental protection and agricultural productivity, as pollution of soil, air, and water must be avoided while optimizing the nutrient status of soils for crop production. By providing adequate soil volume for plant root development, water and air for root development and growth, chemical elements to meet the nutritional requirements of the plants, and anchorage for the resulting plant structure, a productive fertile soil can support optimal plant growth from seed germination to plant maturity. These soil characteristics can be classified as either intrinsic or dynamic soil quality indicators. Inherent soil quality indicators, such as soil texture, depth, and mineralogy, cannot be changed in crop cultivation. Soil organic matter concentration, nutrient- and water-holding capacity, and soil structure are all dynamic soil quality indicators. Soil fertility is one of the most important dynamic soil factors that may be maintained or improved through proper management to increase agricultural soil productivity. In order to meet production goals, more nutrients are frequently required than the soil can provide.

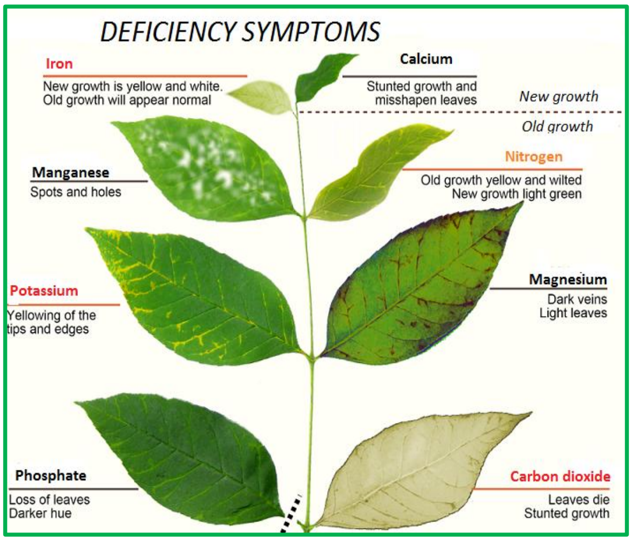
Soil fertility evaluation

Soil fertility assessment is an important part of modern soil fertility management. The primary goal of soil fertility testing is to quantify a soil's ability to give nutrients for plant growth. Soil fertility can be assessed using a variety of field and laboratory diagnostic procedures, as well as a growing number of empirical and/or theoretical models that quantitatively link soil fertility indicators to plant response. Chemical and biological soil tests, visual observations of plant growth for nutrient shortage or toxicity symptoms, and chemical analysis of plant tissues are among the diagnostic tools. New approaches include passive and active optical sensing technologies, as well as geographic information systems, that enable landscape scale site-specific assessments of soil fertility and can better explain and address soil fertility's temporal and spatial variability.

Methods of Evaluating Soil Fertility

There are three basic tools for evaluating soil fertility. They are listed below:

1. Visual signs of nutrient inadequacy are used to assess fertilizer requirements: Visual signs of nutrient shortage can be a powerful tool for detecting a plant's nutritional condition. It's also remembering that a single visual indicator is rarely adequate to make a definitive nutritional status diagnosis. Many traditional deficiency indicators, such as tip burn, chlorosis, and necrosis, are sometimes accompanied with more than one mineral deficit, as well as other stresses that are not diagnostic for any specific nutrient stress, according to Wade (2010). This is known as "hidden hunger," in which a deficiency has a detrimental impact without being recognized, despite the fact that appropriate action may usually be taken if an early diagnosis is acquired. Visual diagnostic symptoms offer the following benefits: they are simple to get; they can provide an early indicator of nutrient status and they do not require any type of instrument if the symptoms do not require confirmation (Wallace, 1943).



Nutrient Deficiency symptoms in crops (Source: Marschner (1995)

2. Plant tissue analysis: Plant tissue analysis is a laboratory technique for identifying the overall element composition of plants or individual plant parts (Reuter and Robinson, 1997). It's used for a variety of purposes, including agricultural nutrition monitoring and troubleshooting. It's also where perennial fruit crop fertilizer recommendation are made. It's the only way to know if a crop is getting enough nutrients during its growing season (Flynn *et al*., 2004). Tissue testing is a form of field test that involves taking sap samples from live plant tissue and evaluating them on the spot. Plant tissue analysis is done on dried plant tissue that has been processed in the lab. The analysis may be of limited benefit if the plants come from a field infested with weeds, insects, or disease organisms; if the plants are stressed for moisture; or if the plants have significant mechanical damage. According to Steinhilber and Salak (2010) and other earlier studies, there are principles that must be followed for an analysis to be successful, and even a minor error can be harmful to the crops.

3. Soil testing/soil analysis: Soil testing is done to assess how much of each nutrient is immediately available as well as how much will be available later in the crop's life. Various ways have been developed, and the methods' calibration is important to their effectiveness. The process of establishing a relationship between soil test values and crop response is known as "soil test calibration" (Agboola and Ayodele, 1987). Appropriate soil sample is the first step in an effective long-term soil and crop nutrient management plan. It's preferable to use it before you start planting so you know how much lime or fertilizer you'll need.

4. DRIS (diagnosis and recommendation integrated system): DRIS classifies nutrient shortages or excesses in order of importance by simultaneously measuring the effects of several nutrients on crop output (Walworth and Sumner, 1987). DRIS is a method for comparing the "ideal" values of tissue nutrient concentration ratios in a high-yielding or otherwise desired population to the "optimal" values of the same ratios in a sample (Escano *et al*., 1981). This technique of calculation assigns an index to each nutrient. The average of the deviations of the ratios of a single nutrient from their corresponding optimal or DRIS normative values makes up this nutrition index (Bailey *et al*., 1997). A DRIS norm is a collection of correlations between nutrients in a desired or high-yielding group, each with its own mean and coefficient of variation. The DRIS is sometimes less susceptible to changes caused by leaf position, tissues age, climate, soil conditions, and cultivar effect than the sufficiency range approach since it uses nutrient ratios.

5. Biological Tests: The use of a growing plant in the research of fertilizer requirement is clearly appealing, and this method for determining the fertility condition of soils has received a lot of attention.

i. Field Tests

One of the earliest and most well-known biological tests is the field-plot method. The treatments used are determined by the specific question the experimenter intends to be answered. After that, the treatments are assigned at random to a plot of land known as a replication. To acquire more trustworthy results and account for changes in soil and management, several replications are used. These tests aid in the development of broad suggestions. When a significant number of experiments are performed on well-characterized soils, conclusions drawn from these studies can be generalized to other soils with similar properties.

ii. **Mitscherlich Pot Culture**.

Oats are grown to maturity in pots containing 6 lb of soil in this approach. There are a total of ten pots in use. The N-P and N-K treatments' yields are expressed as a percentage of the total N-P-K treatment's yield. The yield would be 75 percent if the N-P-K treatment yielded 80 g and the N-K treatment yielded 60 g. From Mitscherlich's yield tables, the plant nutrient reserve in the unfertilized soil may be read in pounds per acre, and projections of the percentage increase in yield predicted from the addition of various amounts of nutrients can be determined from the same tables.

Conclusion

To maintain production, nutrients must be continuously replaced since they are continuously removed from the soil by various methods. The easiest approach to anticipate the need for fertilizer for farmers appears to be the soil fertility evaluation techniques. Complex tissue analysis may be utilized as a tool to some extent, but it must be paired with the results of the soil test. It could be concluded that soil fertility evaluation techniques could be very helpful in providing more accurate and time-wise information about the status of soil fertility within certain area. Soils varied from excellent to good according to their physical index and they were excellent depending on their chemical index. The soil index was ranged between low, medium, high nutrient content. However, these soils varied from poor to very poor according to their fertility index.

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