COLLECTION AND PREPARATION OF SOIL AND PLANT SAMPLES

Soil and plant analysis is a diagnostic instrument for soil fertility and basis for fertilizer recommendation; to known where and where not fertilizer is to be applied. Obtaining accurate and precise values has always being the basis of soil analysis.

From agronomic view, the aims of soil and plant analysis are:

1) To satisfy the demand for soil classification data.
2) To generate information for management and improvement of the soil.
3) To determine the ecological effect of some agricultural production and environmental pollution.
4) To evaluate soil fertility in order to recommend fertilizer.

It is important to have a clear idea about the purpose of any soil analysis as this will help determine sampling technique, sample preparation methods, elements or fractions to be determined and the analytical techniques to be employed.

General Principles of Soil and Plant Sampling

It is necessary to procure a test sample that will be representative of the soil or plant under investigation and to prepare the test sample for analysis. This is because sampling errors are commonly greater than analytical errors. Analytical value can serve as an accurate description of the soil or plant if the followings are true:

1) The gross sample accurately represents the whole soil/plant from which it was taken.
2) No changes occur in the gross and subsamples prior to analysis.
3) The subsamples analysed represents the gross sample accurately.
4) The analysis determines a true value of the soil/plant characteristics under investigation.

A soil or field may be assessed for its capability of providing a crop with essentials nutrients in several ways:

1) Field plot fertilizer trials
2) Greenhouse pot experiments
3) Crop deficiency symptoms
4) Plant analysis
5) Rapid tissue or sap analysis
6) Biological tests such as growing microorganisms
7) Soil testing prior to cropping

All the approaches can be used in research, the latter one is most amenable and popular and one upon which recommendations for farmers can be based. On the other hand, plant analysis is a postmortem approach and one that should be interpreted in the light of soil test results.

Most soil tests primarily focuses on elements in most demand by crops which are supplied by fertilizers: N, P and K, others are Ca, Mg and S. In drier areas micronutrients such as Fe, Zn, Mn, Cu and B are often measured. As nutrient behavior in soils is governed by soil properties and environmental conditions, measurement of such properties is often required. These include pH, salinity, organic matter, $CaCO_3$ and texture in drier areas the presence of Na and gypsum ($CaSO_4.2H_2O$) is also of concern.

Types of Sampling

1) Simple random sampling

2) Systematic sampling

3) Stratified sampling

Phases of Soil Testing

1) Sample collection

2) Extraction or digestion and nutrient determination

3) Interpreting the analytical results

4) Fertilizer recommendation

PROCEDURES

1) Soil Sampling

Soil sample should be composed of several subsamples representing a seemingly unform area or field with similar cropping and management history. There is no universally accepted numbers of subsamples for different field situations. However, the following points can serve as guidelines:

(A) Composite sampling

(B) Time of Sampling

(C) Depth of Sampling

(D) Sampling Tools

2) Field Processing

3) Laboratory Processing

LABORATORY FACTORS OF IMPORTANCE TO SOIL EXTRACTION

These are factors that have significant impact on the test results. They include means of shaking, rate of reciprocation, type of extraction vessel, extraction time and laboratory temperature.

1) Extraction vessel shape
2) Shaking vs stirring
3) Shaking rates
4) Extraction time
5) Laboratory temperature

PLANT SAMPLING FOR ANALYSIS

From the nutritional standpoint, plant analysis is based on the principle that the concentration of a nutrient within the plant is an integral value of all the factors that have interacted to affect it. Plant analysis involves the determination of nutrient concentration in diagnostic plant part(s) sampled at recommended growth stage(s) of the crop. In a way plant analysis complements soil analysis. There are reliable sampling criteria and procedures for most of the world's commercial crops.

Laboratory Processing

Some steps are followed for processing the sampled plant tissues:

1) *Cleaning plant tissue to remove dust, pesticide and fertilizer residues*
2) Immediate drying in an oven to stop enzymatic activity, usually at 65^{o}C for 24/72 hours.
3) Mechanical grinding to produce a material suitable for analysis,
4) Grinding of a dry sample.
5) Final during at 65^{o}C of ground tissue to obtain a constant weight upon which to base the analysis.

6) Storing in appropriate container.

DISSOLUTION FOR TOTAL ELEMENTAL ANALYSIS

It is important to have a clear idea about the purpose of any soil analysis as this will help determine sampling technique, sample preparation methods, elements or fractions to be determined and the analytical techniques to be employed. There are several types of soil analysis viz:

1) Elemental analysis
2) Fractional analysis
3) Total elemental analysis (TEA)

TEA determine the quantity of an element present in the soil without reference to the quality (available form or polluted form). TEA is achieved by either wet or dry ashing.

Wet ashing**:** can be accompanied by use of nitric, sulphuric or perchloric acid in different combinations

Dry ashing**:** this is done in a murfle furnace at temp of 600°C but with high temperature

Testing for Soil pH and Soil Acidity and Lime Requirement

pH measures relative acidity and alkalinity whereas soil acidity means the total amount of acid present in the soil. Quantitatively we use the pH scale in order to remove unwieldy figures e.g. 0.056M H^+. P means – log.

The pH scale could be derived from the ionization of water.

$H_2O \quad H^+ + OH^-$ Kw =

activity of pure solid, liquid or gas in solution is 1.

At 25°C Kw = 10^{-14} (moles $litre^{-1}$)

$\therefore (H^+)(OH^-) = -14$

In pure water the concentration of (H^+) and (OH^-) are equal

$(H^+)(OH^-) = 10^{-14}$

$x \quad x = x^2 = 10^{-14}$ $\therefore x = 10^{-14/2} = 10^{-7}$

$\therefore (H+) = -7,$ $(OH^-) = -7$

$\therefore$ pH = 7 of pure water

POH = 7 of pure water

pH scale runs between 0 and 14 and that pH 7 is neutral.

Application of pH to Soil

Most mineral soil in the humid region has pH range between 3.5 to 7, while those of arid region have a range between 6.8 – 8.8. pH above 9 are found in alkali Na saturated soil and pH below 3.5 are found in acid organic soil (peat).

pH is one of the most enlightening attributes of the soil, whether the soil pH is high or low will depend on the solubility of certain compounds in the soil. pH of around 4 signifies the presence of free acids in the soil (usually from oxidation of sulphides), pH of 5.5 and below indicates the likely presence of $CaCO_3$.

Measurement of pH means the H concentration in solution and its called the active acidity, the potential/reserve acidity is that left within the microcell. Cations in exchange site is in constant equilibrium with that in solution.

pH measures the active acidity while potential acidity is determined by titration using a base.

Causes of soil acidity: (1) Leaching loss of bases (2) Application of fertilizer especially N fertilizer; NH_4^+ producing and NH_4^+ containing fertilizer like urea and $(NH_4)_2SO_4$ (3) Acid rain (4) Decomposition of organic matter, here CO_2 evolved react with soil water to form H_2CO_3 (5) Hydrolysis of aluminum.

$\therefore\ Al^{3+} + 3H_2O \qquad Al(OH)_3 + 3H^+$