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SOIL TESTING IS THE KEY OF MODERN AND INTENSIVE AGRICULTURE

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Human health is dependent on the food what they consume and ultimately the soil health which supplies required nutrients for the plant or crop in turn to the consumer. In India the farmers are practicing the conventional agriculture methods for the crop production. Somehow farmers are harvesting the crop on one side but on the other side the soil fertility or soil health is getting deteriorated. The present agricultural practices have forced farmer to make use of high doses of chemical fertilizers to the crops without proper knowledge of crops, their growing science and also about fertilizers and their usage. The unscientific way of using fertilizers (imbalance applications) have become a serious hazard to sustainable agricultural production system.

A soil test is a chemical method for estimating the nutrient supplying power of a soil. It is much more rapid and has the added advantage over other methods of soil fertility evaluation. One can determine the needs of the soil before the crop is planted. A soil test measures a part of the total nutrient supply in the soil. Soil testing plays a key role in today's modern and intensive agriculture production system as it involves continuous use and misuse of soil without proper care and management. Soil analysis is helpful for better understanding of the soils to increase the crop production and obtaining sustainable yield. Soil testing is an indispensable tool in soil fertility management for sustained soil productivity.

Objectives of soil testing

- To evaluate fertility status of soil by measuring available nutrient status.
- To prescribe or recommend soil amendments like lime and gypsum and fertilizers for each crop.
- To assess nutrient morphology, genesis and classification of soil.
- To find out the effect of irrigation on soil properties.

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- To prepare a soil fertility map of an area (village, block, district and state) nutrient deficiencies, imbalances or toxicities in soil and crop.
- To test the suitability of soil for cultivation or gardening or orchard making.
- To know acidity, alkalinity and salinity problems.

Soil Sampling

In the soil testing programme, "soil sampling" is most important step to be followed for getting accurate results. Soil sampling is a process by which a true representative sample of an area can be obtained. The soil sampling must be done scientifically by adopting appropriate time and depth of sampling given for each crop for accurate analysis of soils.

Method of Soil sampling

Sampling for fertilizer recommendations:

- Take a khurpi or spade and dig soil up to 6inch depth from six different locations in the same field. Mix together all the six samples and take out of it one kg of the sample and the remaining soil. Dry the sample in shade and then store it
- In a clean cloth or plastic bag. Put a proper label showing the name of farmer, name of village, block, tehsil, district and depth of soil taken.
- Write of the name of crop to be sown, manure already applied and source of irrigation.

Sampling for soil reclamation

- Dig a pit 1.5 meter deep in the user patch in field.

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- Make one side of the pit vertical and put mark on it at 1x1x1.5 meter from the surface.
- According to the colour and textures of soil, put the marks and scrape off a uniform thickness of soil from the surface down to this mark and collect the soil sample.
- Collect a kilogram each of the soil sample from the three lower layer: 0-15 cm, 15-35 cm and 35 – 55 cm and put them separately in three cloth bag. If soil is wet, it should be dried in shade.
- Put up a complete label in and outside of the sample showing name of farmer, name of village, exact location of the field, water table source of irrigation and yield and growth if any.

Critical limits of plant nutrients:

Nutrients	Low	Medium	High
P^{H}	< 6.5 Acidic	Normal 6.5 - 7.5	Sodic > 7.5
E C (dsm-1)	< 0.80 normal	0.8o - 1.60 critical	>1.60
Organic carbonite %	<0.50	0.5 - 0.75	>0.75
Nitrogen (kg/ha.)	< 280	28o - 560	> 560
Phosphorus (kg/ha.)	<20.0	20 - 55	> 55
Potassium(kg/ha.)	<125	125 - 250	>250
Calcium (Ca)	< 50 % of CEC		
Magnesium (mg)	<4.0 % of CEC		
Sulphur (S)	< 10.0 ppm		
Zinc (zn)	< 0.60 ppm		
Iron (fe)	1.5 – 4.50 ppm		
Manganese (mn)	< 2.0 ppm		
Copper (cu)	< 4.0 ppm		
Boron (B)	< 0.5 ppm		
Molybdenum (mo)	< 0.2 ppm		
Chlorine (cl)	< 2 .0 ppm		

Picture of the soil Sampling at A.S. (P.G.) Lakhaoti Bulandshahr U.P.

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soil analysis report that you will receive back from the lab should consist of all the attributes of the soil test, you selected when you sent off your samples.

This can include a fertilizer recommendation for achieving the yield goal of the commodity to be grown, which are usually based on local university research for your particular area. But each laboratory can adjust these recommendations based on your specific needs and their expertise. The quantity and quality of information you receive for the cost of the analysis makes soil testing a terrific value. In addition to each element level that will be reported back, you will also receive a few other important soil characteristics as well:

Main Chemical Properties and their Impact on Plant Growth

1.Soil pH

This a measure of acidity or alkalinity of your soil on a scale of 0 to 14, with 7.0 soil pH being neutral. Soils with a pH below 7.0 are acidic, while soils with a pH above 7.0 are alkaline. The pH is important because nutrient uptake can be affected when pH is to high or low. Row crops are typically most efficient with pH between 6.2 and 7.2. Outside of these pH parameters, certain crops can have a difficult time absorbing essential nutrients. With a low pH (less than 6.0), it may be necessary to apply calcium to adjust pH upward. Lowering the soil pH is a more difficult and expensive task—sometimes, an application of elemental sulphur can be used to lower soil pH.

2. Soluble Salts

This measures the electrical conductivity of the soil solution to determine the risk of salt injury to plants. Soluble salts are largely affected by environmental conditions—soils that contain high salt content are called saline soils (NaCl). Soils high in sodium (Na) are referred to as sodic soils. Salts can accumulate from excessive fertilizer applications and poor quality irrigation water, and where rainfall is limited. With proper soil drainage accompanied by rainfall or irrigation, the salt can sometimes be flushed out of the root zone to correct the problem. Don't be too concerned about correcting soluble salts unless they are reported over .75 millimhos/cm (millimhos per cm., which is the basic unit of measure of electrical conductivity in soil) on your analysis.

3. Excess Lime

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This a measurement of the amount of free lime in the soil. The reading can be important in your herbicide selection and fertilizer applications, so that you can avoid product tie-ups with the calcium present—which would render it ineffective and unavailable to your plants.

4. Organic Matter (OM)

Generally speaking, the higher the organic matter, the healthier the soil. This is reported as a percent, and it measures the ability of the soil to supply nutrients, water and other physical wellbeing to growing plants. Organic matter accumulation is a slow process. Reduced tillage has been shown to have a positive impact on organic matter and soil tilth. Row crops should be at around 2.5% OM or higher, though it is not uncommon for sandy soils to be lower.

5. Cation Exchange Capacity (CEC)

This measures the ability of the soil to store and release nutrients. This number also helps to define the soil's texture and composition. Sandy soil to loam soil CEC will vary from 1 to 40, but the most common range is from 13-25 CEC.

6. Percent Base Saturation

Percent base saturation is closely related to CEC and pH. This measurement indicates the nutrient supply and balance of cations for K, Mg, Ca, H and Na. Soils with a high percent base saturation can be more fertile because they often have a higher pH, and can contain greater amounts of these nutrients for use by plants.

B. Essential Plant Nutrients Levels and Their Needed Amount

1.Nitrogen

Nitrogen is tested as nitrate (NO3) form only, unless requested otherwise. By multiplying the analysis ppm number by 0.3 per inch of soil sample depth, you can determine the total pounds of nitrogen in the soil. For example: 8 inch soil sample depth equals 0.3 X 8 = 2.4. If 12 ppm of NO3 is reported, then multiplied by 2.4 equates to 28.8 pounds of nitrate nitrogen in the soil, which means your nitrogen applied should be effectively be reduced by 28.8 pounds from total N needed to grow your next crop.

2.Phosphorus (P)

Soils with 25 to 35 ppm P is typically adequate on most soils. There are three common analysis methods to evaluate the presence of soil phosphorus. Bray test is best with neutral

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and low pH soils, Olsen test is used on high pH soils (this test generally reports phosphorus at lower levels) and Mehlich III test can be used on most pH values of cropping soils.

3.Sulphur (S)

Sulphur is measured as sulphate, which is the available form of sulphur the plant can use. Sulphate is also subject to leaching. For most common soil types, soils with a range of 7-15 ppm S are considered adequate.

4.Zinc (Zn)

Soil tests can also predict if adding zinc will impact your plant health and crop yields. The desired ppm for zinc ranges from 1.0 to 3.0.

5.Iron (Fe)

Iron ppm of 10-20 is typically common on most soils. Iron chlorosis is a problem with iron shortage and high pH issues, so applying additional iron could potentially help to alleviate any iron chlorosis problems you might see.

6.Manganese (Mn)

Manganese at 8-11 ppm is typically sufficient. Mn availability is influenced by soil pH, and low pH can increase Mn availability, while high pH can lessen it.

7.Copper (Cu)

Only small amounts are needed by plants. Copper at 0.8-1.0 is adequate for most crops. The majority of the copper deficiencies occur in highly acidic soils.

8.Potassium (K)

The soil test measures the exchangeable potassium in the soil. Look for a minimum of 165-220 ppm to supply the needed amounts of potassium to maximize production.

9.Calcium (Ca)

Calcium is typically plentiful in soils with pH of 6.0 and higher; however, calcium can be applied as gypsum and not affect soil pH. **Ca** of ≥1400 ppm is generally right for most crops.

10.Magnesium (Mg)

Magnesium is often adequate in soils with a pH 6.5 and higher, though magnesium at 100 ppm or more is acceptable.

11.Sodium (Na)

This part of the analysis is primarily for use in repairing saline or alkali soils. Sodium is not a soil nutrient—adding other elements, such as gypsum or elemental sulphur, will help with

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water infiltration to flush away the sodium you have present. The range for sodium in most common soil types is typically 80-120 ppm.

Importance

- To make the best fertilizer applications on your fields, consult with your independent agronomist or fertility specialist. The main benefits are given below:
- Organic matter content values, help to decide the nutrient availability and microbial population in the soil, and based on the value, one can decide to add or not in to the soil.
- Will help in determining the quantity of nutrients [major, Secondary and Micronutrients] to be added to the soil according to the crop requirements and analysed values.
- Helps to take up any amendments to regulate soil pH and Electrical conductivity [EC] so that crop may avoid crop failures due to abnormal pH and EC values.

Conclusion

Soil test- based fertility management might be one of an approach for sustainable agricultural production system. The first and foremost benefit of a Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendation for maximum crop yields.