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### RESEARCH ARTICLE

#### SOIL HEALTH CHECKUP FOR BETTER CROP PRODUCTIVITY

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#### Abstract

Healthy soils produce healthy crops that in turn nourish people and animals. It is the foundation of the food system. Soil testing is a well recognized scientific method for quick characterization of the soil fertility status and prediction of crop nutrient requirement which are lost through improper use of fertilizers, continuous cropping, erosion, leaching, volatilization, denitrification and fixation. Soil Health Card (SHC) is a Government of India's scheme which apart from giving the health index of soil & also indicates fertilizer recommendations and soil amendment required for the farm. Knowing the fertility status of soil before sowing of crop will lead to proper usage & dosage of appropriate fertilizer, thus maintaining the essential nutrients profile & OC status for optimal crop productivity.

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#### Introduction:-

Soils are the critical ecosystem service providers for the sustenance of humanity<sup>(1)</sup>. They have different physical and chemical properties. Processes such as leaching, weathering and microbial activity combine to make a whole range of different soil types like sandy, slit, clay, loamy etc. Each type has particular strengths and weaknesses for agricultural production<sup>(2)</sup>.

Healthy soils produce healthy crops that in turn nourish people and animals. It is the foundation of the food system. Quality of soil is directly linked to quality and quantity of food. Soils supply the essential nutrients, water, oxygen and root support that our food-producing plants need to grow and flourish. They also serve as a buffer to protect delicate plant roots from drastic fluctuations in temperature<sup>(3)</sup>.

Soil health and fertility ensures sustainable income through higher productivity by the farmers<sup>(4)</sup>. A well recognized scientific method for quick characterization of the soil fertility status and prediction of crop nutrient requirement is soil testing. One of the main objectives of soil tests is to segregate the nutrient deficient areas from non-deficient ones. This information is important for determining the adequate supply of nutrients for optimum crop production. Indiscriminate use of fertilizer not only increases the cost of crop production but also leaves deleterious effects on soil fertility.

The balanced nutrition of crops concept also guides the use of plant nutrients in a definite proportion as required by the crops which is possible only if one knows the available nutrient status of his soils. Soil testing helps to understand the fertility status of the soils. The soil test aimed at soil fertility evaluation with fertilizer recommendation is a key link between the agronomic research and its practical application to the farmers' field<sup>(3)</sup>.

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Soil Health Card (SHC), a Government of India scheme is aimed towards giving the health index of soil & fertilizer recommendations and soil amendment required for the farm <sup>(5)</sup>.

### **Soil Nutrients**

Plants absorb a large number of macro & micro nutrients <sup>(3)</sup>. SHC generates the status of soil with respect to 12 parameters, namely N, P, K (Macronutrients); S (Secondary- nutrient); Zn, Fe, Cu, Mn, Bo (Micro-nutrients); and pH, EC, OC (Physical parameters) <sup>(4)</sup>.

### **Soil organic carbon (SOC)**

Is the most important component for maintaining soil quality, supporting multiple soil functions such as physical, chemical and biological for optimal productive capacity of soil for food, fodder, and energy production. It is an indicator for soil health, and important for its contribution to food production and the achievement of the sustainable development goals. A high Soil organic matter (SOM) content helps in releasing nutrients to plants and improves water availability and ultimately improves crop productivity.

**Nitrogen** is essential for the growth of plant <sup>(6)</sup>.

**Phosphorus** is a cell nucleus constituent, essential for cell division and developing meristematic tissues at the growing points <sup>(3)</sup>.

**Potassium** plays a crucial role in the formation or synthesis of amino acids and proteins from ammonium ions which are absorbed from the soil. It is also essential in the photosynthetic activity of the leaves <sup>(3)</sup>.

**Sulphur** is required for chlorophyll production & helps in the formation of several amino acids, proteins and vitamins <sup>(6)</sup>.

**Manganese, Iron and Zinc** plays vital role in plant growth process <sup>(6)</sup>.

**Copper** is needed for the synthesis of enzymes for chlorophyll production <sup>(6)</sup>.

**Boron** is necessary for the metabolism of nitrogen & movement of sugars throughout the plant <sup>(6)</sup>.

**pH** determines the availability of all the essential plant nutrients & is important for plant growth <sup>(7)</sup>.

**Soil EC** does not directly affect plant growth but is used as an indirect indicator of the amount of nutrients available for plant uptake and salinity levels <sup>(8)</sup>.

### **Loss Of Nutrients In Soil**

Nutrients are lost through improper use of fertilizers, continuous cropping, Erosion, Leaching, Volatilization, Denitrification and Fixation <sup>(3)</sup>.

### **Improper use of fertilizers:**

Continual, improper use of fertilizers without knowing the requirement & testing of the soil is harmful not only to the environment but it may lead to over dosage, imbalancing of nutrient profile.

### **Continuous cropping:**

Monocropping pattern, no crop rotation leads to over exploitation of particular macro & micronutrients.

### **Erosion:**

The upper most layer soil is lost due to soil erosion by water or wind; this results in soil phosphorus loss <sup>(3)</sup>.

### **Leaching:**

Water percolating through a soil profile carries dissolved nutrient elements. In humid and sandy soils regions, nutrients are easily lost. As compared to cultivated soils, bare soil loses more nutrients <sup>(3)</sup>.

**Volatilization:**

Nitrogen is easily lost as ammonia through volatilization, particularly in the paddy soils and upland soils in poorly drained areas. This is referred to as ammonia volatilization. This loss is enhanced by wind and high temperature <sup>(3)</sup>.

**Denitrification:**

In this process, Nitrate form of N is lost where nitrogen gas or nitrous oxide is released. This loss occurs mainly in paddy soils and in upland soils which are part of the time or saturated with water periodically <sup>(3)</sup>.

**Fixation:**

Conversion of a nutrient to an unavailable form is Fixation. Phosphorus is converted to unavailable forms both in acidic and alkaline soils, as Al/Fe phosphate or Calcium phosphate  $\text{Ca}_3(\text{PO}_4)_2$  respectively. Potassium and ammonium can be fixed by certain clay minerals <sup>(3)</sup>.

**Nutrient Deficiency Symptoms**

Prominent nutrient deficiency symptoms in plants are summarized below:

<b>Nutrient</b>	<b>Colour change in lower leaves</b>
N	Older leaves yellow, plant light green
P	Plant small & dark green with purple cast
K	Scorching & yellowing along the margin of older leaves
Zn	Interveinal chlorosis and bronzing of leaves
<b>Nutrient</b>	<b>Colour change in upper leaves (Terminal bud dies)</b>
Ca	Delay in emergence of primary leaves, terminal buds deteriorate
B	Growth buds appear as white or light brown, with dead tissue. Leaves near growing point turn yellow
<b>Nutrient</b>	<b>Colour change in upper leaves (Terminal bud remains alive)</b>
S	first appearance in young leaves, leaves including veins turn pale green to yellow
Fe	Interveinal chlorosis at leaf tip, leaves yellow to almost white
Mn	Leaves reddish or yellowish-gray, gray with green veins
Cu	Young leaves uniformly pale yellow. May wilt or wither without Chlorosis

**Objectives Of Soil Analysis & Impact On Crop Productivity**

Crops are usually grown on a very wide range of soil types and require different fertilizer application. Improper dosage of fertilizer can result to imbalancing of nutrients in soil, eventually affecting the environment and contaminating water. Knowing the fertility status of soil before sowing of crop will lead to proper usage & dosage of appropriate fertilizer, thus maintaining the essential nutrients profile & OC status for optimal crop productivity.

Soil is one of the supreme management practices for crop production <sup>(9)</sup>. The Objectives of Soil Testing are:

1. To assess the nutrient status & fertility of soil for providing an index of nutrient availability or supply in given soil <sup>(10)</sup>.
2. To determine the problems like acidity, salinity and alkalinity in soil <sup>(10)</sup>.
3. To recommend the amount of manure and fertilizer for the crop based on soil test value <sup>(10)</sup>.
4. To avoid excessive use of fertilizer and to ensure safety of environment <sup>(10)</sup>.
5. A considerable amount of nutrients are removed from the soil, when crops are harvested which causes loss of fertility in soil over a long period of time. So, the soil test should be done <sup>(10)</sup>.
6. Evaluation of the soil suitability for the crop <sup>(10)</sup>.
7. Restoration of soil fertility is a key factor for profitability, sustainability and crop productivity <sup>(10)</sup>.
8. Fertilization programmes must consider soil supply, crop needs, fertilizer use efficiency, the contribution from manures etc <sup>(10)</sup>.
9. To sustain productivity for crop and site-specific balanced fertilization program, time to time evaluation of the inherent soil fertility status is essential <sup>(10)</sup>.

**Benefits Of Soil Analysis**

1. To grow a crop efficiently and to maximize return, it's important to apply the right combination fertilizers <sup>(9)</sup>. Soil test information paired with a realistic yield goal is essential to know the nutrient profile & application of required dosage of fertilizer.

2. Identification of nutrients that could be yield-limiting <sup>(10)</sup>.
3. Monitoring of soil health properties like pH, EC and OC, that affects the availability of nutrient to crops and thereby improve yields and profit <sup>(10)</sup>.
4. Provides a basis for variable rate application (VRT) depending upon soil and crop.
5. To maximize management options, improved knowledge of the soil types within the farm <sup>(10)</sup>.
6. Maximizes in-season responsiveness <sup>(10)</sup>.
7. By efficient use of plant nutrients, fewer losses from leaching or runoff into waterways are achieved <sup>(10)</sup>.
8. It aware the farmer about the current health of the farm's soil and how to upgrade it. Armed with the information, farmers can define the exact type & quantity of fertilizer that is needed for application which improves the soil <sup>(11)</sup>.
9. Knowledge of the exact deficiency helps farmers to prevent excessive use of money on unnecessary fertilizer application. Hence, soil tests lead to minimization of fertilizer expenditure <sup>(11)</sup>.
10. Farmers can easily avoid soil degradation. Soil restoration is a difficult, costly and time-consuming process. For that reason, through soil testing better soil management is an easier route to take, and use of the right amount of fertilizers is adequate and financially justified <sup>(11)</sup>.
11. In soil management, soil testing is the initial step. This will provide valuable information to farmers that helps in improvement of the soil's health; healthy soils eventually imply healthy crops & optimal yields <sup>(11)</sup>.

**"Healthy soil is the foundation of a healthy crop and healthy farm."**

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