



Diagnostic Techniques for Soil and Plant Health Management

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Over the last decade, various technical methods have been developed utilizing modern electronics to respond to field and crop variability. This includes soil testing for various properties like physical, chemical and biological properties, Diagnosis and Recommendation Integrated System (DRIS), Soil Test Crop Response Technique (STCR), GIS-GPS techniques, Site Specific Nutrient Management (SSNM). Effective nutrient management is considered as a key factor to sustain the productivity of cropping systems, prevents nutrient mining and environmental degradation and thereby improves the soil health. An economically and ecologically sound nutrient management strategy viz., Soil Test Crop Response based Integrated Plant Nutrition System (STCR-IPNS) provides effective fertilization as per the crop nutrient requirement.

The use of Diagnosis and Recommendation Integrated System (DRIS) method puts the limitation of nutrients in order of plant demand, enabling the nutritional balance between the nutrients in leaf sample. GIS-GPS technique helps to monitor the changes in nutrient status over a period of time as geo-referenced sampling site can be re-visited with the help of GPS which is otherwise difficult in random sampling. Intensive cropping systems, improper use of fertilizers or no fertilizer application, and unreliable and poor quality of irrigation water have led to declining soil fertility. A healthy soil produces a healthy plant by supplying all the essential nutrients in right amount and proportion. So soil degradation directly effect the plant growth and imbalance in nutrient content.

Soil Health

It is the capacity of soil to function as a living system, with ecosystem and land use boundaries, to sustain plant and animal productivity, maintain or enhance water and air quality, and promote plant and animal health. Healthy soils maintain a diverse community of soil organisms that help to control plant disease, insect and weed pests, form beneficial symbiotic associations with plant roots, recycle essential plant nutrients, improve soil structure with increasing water and nutrient holding capacity, and ultimately improve crop production.

Diagnostic tools for soil and plant health management

- Soil health card
- Diagnosis And Recommendation Integrated System (DRIS)
- Soil Test Crop Response (STCR) Technique
- GIS-GPS technique
- Site Specific Nutrient Management (SSNM)

Soil Health Card: Soil Health Card (SHC) provides information to the farmers on soil acidity, salinity, alkalinity and nutrient content. Soil testing will be done following uniform

sampling and soil analysis procedures. At present Soil health card contains information on EC, pH, Organic carbon, nitrogen, phosphorus, potassium with micro nutrients which is very vital for judicious fertilizer application. Soil health card also contains the fertilizers recommendation for major kharif, rabi and summer crop. Soil health card is field specific detailed report of soil fertility status and other important soil parameters that affect crop productivity. It also provides an advisory on soil test based use of fertilizers and amendments.

Diagnosis and Recommendation Integrated System (DRIS): DRIS is new approach to interpreting leaf or plant analysis which was developed by Beaufils to the maize crop at the University of Natal, South Africa. DRIS approach takes into account the concentration of nutrients at appropriate plant growth stages and their interrelationship with yield. The nutrient diagnostic norms for a crop, at a given stage, developed in this approach serve as a standard nutrient guide for diagnosis of nutrient deficiencies as well as excess and accordingly mid-season correlation of nutrient disorders can be employed. A survey type of approach is first employed in accumulating the basic data required to establish a data bank from which norms are determined.

Establishment of DRIS norms: A survey type of approach is first employed in accumulating the basic data required to establish a data bank from which norms are determined. First a large number of sites where a crop is growing are selected at random in order to represent the whole production area of a country, state or district. At each site, plant and soil samples are taken for all essential element analyses. Second, the entire population of observation is divided into two sub populations (high and low yielder) on the basis of vigour, quality and yield. Each element in the plant is expressed in as many ways as possible. For example, the percentage of N in the dry matter or ratios N/P, N/K, or products N-P, N-K, and so on, may be used. The mean of each type of expression for each sub-population is calculated. Each form of expression which significantly discriminates between the high and low yielding sub-populations is retained as a useful diagnostic parameter. The mean values for each of these forms of expression then constitute the diagnostic norms.

Advantages of DRIS norms: The importance of nutritional balance is taken into account in deriving the norms and making diagnoses. This is particularly valuable at high yield levels where balance is often critical in determining yield. The norms for the elemental content in leaf tissues can be universally applied to the particular crop, regardless of where it is grown. Diagnoses can be made over a wide range in stages of crop development, irrespective of cultivar. The nutrients limiting yield either through excess or insufficiency can be readily identified and arranged in order of their limiting importance on yield.

Soil test crop response (STCR): Soil test crop response is a fundamental base for prescription of right amount of fertilizers. Fertilizer is one of the costliest inputs in agriculture and the use of right amount of fertilizer is fundamental for farm profitability and environmental protection. To enhance farm profitability under different soil-climatic conditions, it is necessary to generate information on optimum doses for crops. Traditionally, to determine the optimum fertilizer doses, most appropriate method are to apply fertilizer on the basis of soil test and crop response studies.

Global Positioning System (GPS): A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

- Geographic Information System (GIS)
- A geographic information system (GIS) is a computer system for capturing, storing, checking, and displaying data related to positions on Earth's surface.

Site Specific Nutrient Management

- This approach provides scientific principles of optimally supplying crops with nutrients as and when needed for specific fields in a particular cropping season.

- It conceptualized aimed at dynamic field specific management of N, P and K fertilizer to optimize the supply and plant demand of nutrients.
- 'Nutrient expert' is tool developed by IPNI which can provide nutrient recommendations for an individual farmers field which works on the principle of Site Specific Nutrient Management.

Conclusion

The skill development, capacity building and trainings on soil health management are essential with evolution of new tools and techniques. Use of information and communication technologies may add value to the relevance of these programmes and make them more meaningful. Apart from different technologies for obtaining aimed yield targets and profits with sustenance of soil fertility, soil test based fertilizer recommendation under IPNS and Site Specific Nutrient Management (SSNM) would be a promising solution.