

Precise sampling of soil

Pre-requisite for evaluation of soil health

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Soil health is essential for sustaining crop productivity and ecological balance in agricultural ecosystems. But decline in soil health, caused by both natural and anthropogenic factors, poses global challenges, especially in developing nations. Maintaining soil health therefore becomes necessary and reliable soil test results can accurately depict soil health status while reducing the cultivation costs. However, achieving accuracy requires collection of representative soil sample and following precise soil sampling techniques, including field surveys, collection methods based on crop type along with appropriate mixing, quartering, and labelling of soil samples. Adherence to the sampling protocols can sustain soil health, increase crop yield and facilitate precise fertilization recommendations.

Keywords: Fertilizer recommendations, Soil health, Soil sampling, Soil testing

SOIL is an intricately woven ecosystem where microorganisms coexists with plant roots and interact with minerals and organic matter in dynamic system and control the multifarious functions regulating soil health. Soil health means the ability of soil to maintain crop productivity while safeguarding the ecological balance. A healthy human body regulates life by optimizing the functioning of different organs, similarly a healthy soil is necessary to sustain life on earth by its ability to support growth and development of plants and microbes, biogeochemical cycles, bio control of pests and regulation of moisture and aeration. Evidence, however, points to both natural and anthropogenic factors degrading soil health due to soil contamination and pollution, loss of organic matter, erosion of top layer and rise in problematic soils.

Decline in soil health has become a global phenomenon but developing nations have been particularly hard hit with its impact. Rising birth rates led to an increase in the demand for food grain to feed the expanding human population and as the

population pressure grew, the area of land used for farming shrunk. Consequently, intensive agriculture became a norm to meet the overwhelming food grain demand with the application of injudicious and disproportionate quantity of fertilizers and pesticides, without ascertaining the fertility status of soil. To combat the issue, soil health card scheme was launched in India for assessing the nutrient status at farmer's field. Soil health cards have been distributed as a record keeping tool, providing status of soil health in terms of 12 soil health indicators viz., available nitrogen, phosphorus, potassium, sulphur, zinc, iron, copper, manganese, boron along with pH, E.C. and organic carbon. The results of soil testing for farmer's land holdings are provided in the soil health card in the form of a report. Based on the soil test report, fertilizer recommendations and amendments are suggested so that farmers can decide the type of crop better suited for their land holdings. Such advisories are intended to dispense accurate fertilizer recommendations for promoting balanced fertilization

practices among farmers to increase farmer's profit whilst maintaining crop yield as well as soil health.

Soil testing is crucial to reduce cultivation cost incurred by small and marginal farmers by providing fertilizer recommendations based on soil sample evaluation. A fully representative soil sample must be obtained as it is the most challenging phase in soil testing. Samples brought to soil testing laboratories (STLs) undergo processing and chemical analysis to estimate various physico-chemical and biological properties of soil necessary for a precise fertilizer recommendation and to evaluate soil health. It is essential to note that without a representative soil sample, soil testing is futile and wasteful exercise. Such samples do not describe the property of soil as whole because of variability in composition and properties of soil from one region to another accounting towards erroneous soil sampling.

How to collect soil samples?

The most basic type of sampling applied for smaller, homogeneous fields, disregards field variance

and considers every sampling unit to have equal, independent chance of getting selected for soil, testing. Spatial variability in soil properties is disadvantageous in random sampling towards evaluating soil health. Therefore, if field is of heterogeneous soil, then larger number of samples should be taken. Grid sampling method involves laying of a grid of pre-determined size over the field and taking a series of 5-10 cores around each grid point where the grid lines intersect each other. Rainfed areas should have samples drawn in a grid of 10 ha, whereas irrigated areas should have samples drawn in a grid of 2.5 ha.

Practicing sampling protocols will help farmers to collect a representative soil sample from field using the key steps (Fig. 1) described below.

Field survey: Conduct a visual survey of the field and observe the variation in appearance of soil texture, colour, degree of erosion, slope and elevation, etc. Note down history of the area i.e., previous crop grown and management practices employed, etc. Unit of sampling is decided based on such visual surveys. An area uniform with respect to soil characteristics and land morphology will be considered as single sampling unit. If variations exist then field is divided into smaller homogeneous sampling units (Fig. 2). Thereafter, samples will be collected from the homogenous sampling units in a ziz-zag pattern (Fig. 3).

Collection of representative soil sample: Sampling procedure varies according to type of crop to be grown (i.e. the depth to which roots penetrate) and the soil to be

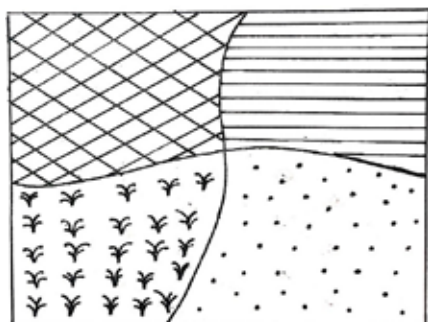


Fig. 2. Division of the sampling area

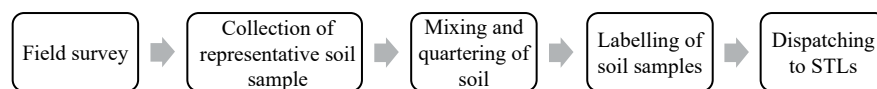


Fig. 1. Soil sampling protocol

sampled. For cereals, vegetables and seasonal crops, sampling can be performed using a spade or shovel after scraping the litter from the soil surface. A 'V-shaped notch' (Fig. 4) is dug from the plough layer 0-15 cm in depth and bread like slice of approximately 2.5 cm thickness is cut from one of its plane. For deep rooted or longer duration crops such as sugarcane or under dry farming conditions, samples can be collected from different depths depending on the requirement of individual situations. Use khurpi/spade/ tube auger for sampling moist soils, screw auger for hard and dry soils and post hole bucket type auger (Fig. 5) for wet soils.

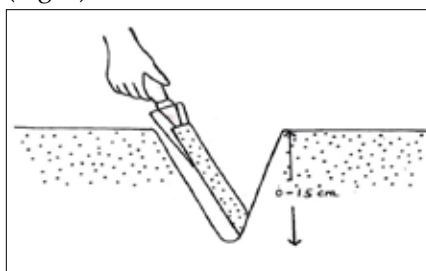


Fig. 4. V-shaped notch to collect soil samples using khurpi

In orchards one must keep in mind, the rooting behaviour and root zone of a shrub or a tree. Roots of horticultural crops extend deeper into the soil profile and sampling to a surface level may not provide accurate soil test results. Approximately 4 to 5 pits are dug in about half hectare area lengthening up to hardpan/bedrock (approximately 150 cm deep). The pits are marked vertically at 15,

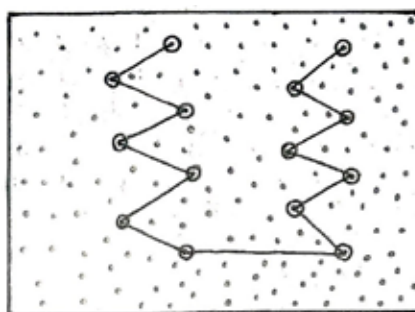


Fig. 3. Zig-zag pattern of sampling

30, 60, 90 and 120 from the surface where samples are collected separately from preceding layers i.e., 90-120, 60-90, 30-60, 15-30 and 0-15 cm depths. It is followed by marking the soil sample collected from different depths in clean bags.

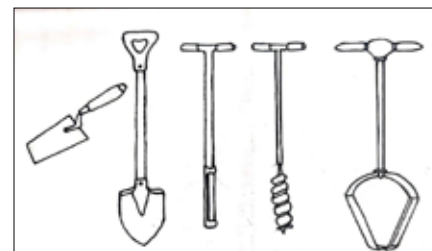


Fig. 5. Soil sampling tools

Sample may be drawn up to 15 cm depth for testing salinity, alkalinity and acidity in problematic soils. If salt crust is visible on the surface of salt affected soils, then it should be sampled separately. Sampling from deeper layers (up to 1 m depth) is performed to know the magnitude of salinity caused by usage of poor quality irrigation water in the soil profile for the purpose of reclaiming the soil.

Mixing of sample: Primary soil samples collected from area having similar soil type, management practices, depth and elevation, etc. are mixed properly and then all the lumps or clods are broken down to prepare representative composite soil sample.

Quartering of sample: It involves splitting of composite samples in order to reduce its size. It can be performed both mechanically as well as manually. Manual quartering is more prevalent, where the sample is spread uniformly over a clean plastic or cloth bag and divided into four equal parts (Fig. 6). The parts at the opposing ends are discarded. This process can be repeated several times until the soil sample has attained appropriate weight (approximately half a kilogram).

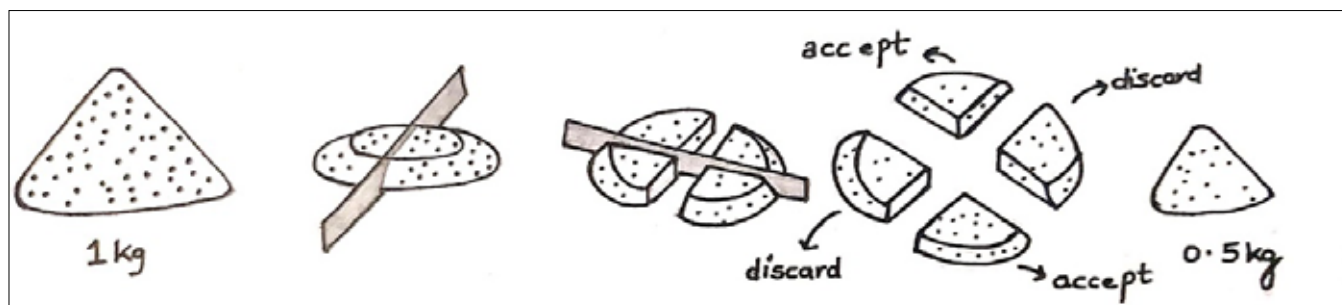


Fig. 6. Quartering of composite soil sample

Labelling of sample: Samples should be labelled properly for the purpose of identification. One label should be placed inside the sample bag while the other be knotted outside the bag. The information sheet should contain sampling location, field number or any other identification mark, name of the farmer, sampling date and depth, upland/lowland, irrigated/unirrigated, drainage conditions, previous cropping history and management, etc.

Soil health report

After analysis, soil test findings are interpreted using a rating chart (Table 1), which aids in determining soil health condition in terms of organic carbon, plant available N, P and K. It also aids in determining the quantity of soluble salt and pH range of the soil.

Frequency of sampling

Sampling may be carried out any time of the year, however it is best

to perform sampling during autumn after *kharif* crops harvest or 2-4 weeks prior to sowing. If intensive farming is practiced then it is advisable to undergo sampling every year. However, sampling every 3 years is generally passable for field crops and cropping systems.

Sampling precautions

- Sampling should be carried out at the same time duration every year.
- Samples should be collected in a zigzag pattern.
- Abstain sampling around old bunds, marshy spots, composts, heaps, trees, hedges, irrigation channels, areas recently fertilized and approximately 2-3 m area along the field edges.
- Prefer core sampler over shovels for sampling to maintain uniformity in the quantity of soil collected across the sampling depth.

- Sampling tool should be cleaned by using clean water (preferably distilled water) to remove any residue or particulate matter.
- Use stainless steel over rust containing shovel/spade to draw samples for micronutrient analysis.
- Avoid sampling when the field is wet to prevent non-uniformity in the depth of samples.
- To prepare composites, at least 12 soil cores should be collected across the field to account for field variability.
- Clean bags should be used to keep the sample safe and to avoid contamination.
- Sample should be air dried in shade before placing in clean bags.
- Information labelled on sample bag should be written by pencil to avoid smearing of information.

SUMMARY

Maintaining a healthier soil is pivotal factor not only to attain higher yield and crop productivity but also to sustain ecological balance. Not being in harmony with the practice of balanced fertilization is the root cause for declining soil health and loss of potential crop yield. Precise evaluation of soil health can only be achieved if soil testing is performed following correct protocols. However, the effectiveness of soil testing depends on the manner of collecting representative samples of soil. Hence, meticulous sampling of soil is the most crucial step towards precise evaluation of soil health and fertilizer recommendation.

Table 1. Rating chart for soil test data

Parameter		Soil test rating				
		Low		Medium	High	
Organic carbon		< 0.5%		0.5 to 0.75%	> 0.75%	
Available N		< 280 kg/ha		280-560 kg/ha	> 560 kg/ha	
Available P		< 10 kg/ha		10-25 kg/ha	> 25 kg/ha	
Available K		< 110 kg/ha		110-280 kg/ha	> 280 kg/ha	
Soil pH						
Extremely acid	Strongly acid	Moderately acid	Slightly acid	Neutral	Moderately alkaline	Strongly alkaline
<4.6	4.6-5.5	5.6-6.5	6.6-6.9	7.0	7.1-8.5	> 8.5
Soil EC						
Salt free (Salinity effect negligible, except for more sensitive crops)		Slightly saline (Yield of many crops restricted)		Moderately saline (Only tolerant crops yield satisfactorily)	Highly saline (Only very tolerant crops yield satisfactorily)	
<0-2 mS/cm		4-8 mS/cm		8-15 mS/cm	>15 mS/cm	

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