

- The sampled leaves are placed between two sheets of blotting / filter paper and packed and sent immediately to the laboratory (**Note:** Simultaneously soils are also to be sampled and sent for analysis so as to draw a comparison between the leaf and soil nutrient status)
- Information regarding the history of the block, rate of fertilizer and manure application and crop yield may be made available to draw necessary inferences.

#### Nutrient content of coffee leaves

As mentioned above the leaves are indicative of the soil nutrient status. The threshold level of nutrients in the coffee leaves are presented in the table:

| Nutrient        | Range         |
|-----------------|---------------|
| Nitrogen (N)    | 2.5 - 3.5 %   |
| Phosphorus (P)  | 0.1 - 0.20 %  |
| Potassium (K)   | 1.8 - 3.0 %   |
| Calcium (Ca)    | 0.9 - 2.0 %   |
| Magnesium (Mg)  | 0.2 - 0.4 %   |
| Sulphur (S)     | 0.1 - 0.2 %   |
| Iron (Fe)       | 110 - 240 ppm |
| Manganese (Mn)  | 101 - 260 ppm |
| Zinc (Zn)       | 15 - 25 ppm   |
| Copper (Cu)     | 21 - 32 ppm   |
| Boron (B)       | 40 - 50 ppm   |
| Molybdenum (Mo) | 0.1 - 0.5 ppm |

#### Advisory based on leaf nutrient content

The threshold nutrient content in leaves indicates the nutrient content in the leaves. Leaf nutrient content below (or) above the threshold levels is indicative of the sufficiency (or) deficiency of the nutrient in the leaves.

The identification of the nutrient deficiency symptoms in the early stages is crucial to the productivity of the plantation.

Early identification of the deficiency symptoms helps in recommending the appropriate foliar and soil application of the deficient nutrient thereby rectifying the problem and promoting good plant growth.

| Nutrient   | Content (%) | Classification | Nutrient recommendation    |
|------------|-------------|----------------|----------------------------|
| Nitrogen   | <2.5        | Low            | Need to increase dose of N |
|            | 2.5 to 3.5  | Optimum        | Continue present dose of N |
|            | >3.5        | High           | Reduce dose of N           |
| Phosphorus | <0.1        | Low            | Need to increase dose of P |
|            | 0.1 to 0.2  | Optimum        | Continue present dose of P |
|            | >0.2        | High           | Reduce dose of P           |
| Potassium  | <1.8        | Low            | Need to increase dose of K |
|            | 1.8 to 3.0  | Optimum        | Continue present dose of K |
|            | >3.0        | High           | Reduce dose of K           |



Fig. 1. Fourth pair of leaves sampling in Arabica



Fig. 2. Third pair of leaves sampling in Robusta

#### KAAPI SOIL HEALTH MONITORING AND MANAGEMENT (KSHEMAM) - website for coffee plantations

Soil Health Management is an integral part of sustainable agriculture as soil fertility contributes greatly to the improvement of soil productivity and minimizes the harmful effects on climate, soil, water, air, microbial diversity and human health. Site specific integrated nutrient management drawn based on the sound knowledge of soil fertility status enables to optimize the use of inputs from non-renewable sources besides assuring higher yields and good quality produce.

The Central Coffee Research Institute Coffee Board had taken up a project "Soil fertility appraisal and soil health monitoring in Traditional Coffee-Growing Regions of Karnataka, Kerala and Tamil Nadu" as a pilot programme with two main objectives:

- Monitoring the soil health status through permanent monitoring sites
- Comprehensive mapping of soils for their fertility status

This project aimed at providing efficient service to the coffee growers on soil health management through issue of soil health cards and launching of an exclusive web-portal for information pertaining to Indian Coffee soils.

This pilot project was jointly implemented by the Central Coffee Research Institute, Coffee Board, National Bureau of Soil Survey & Land Use Planning (ICAR), Bengaluru and Indian Institute of Information Technology and Management, Thiruvananthapuram, Kerala.

To be in line with the ambitious initiative of the Government of India, the Coffee Board introduced the **Soil Health Cards** for the benefits of coffee growers and also launched an exclusive web-portal [www.indiacoffeesoils.net](http://www.indiacoffeesoils.net) named KSHEMAM (Kaapi Soil Health Monitoring and Management) on 21<sup>st</sup> April 2017

The soil health cards (SHCs) is designed to present information on soil health indicators like pH, electrical conductivity, organic carbon, major, secondary and micronutrients along with recommendations for nutrient management

The soil health cards will enable judicious use of fertilizers, correct nutrient deficiencies and maintain the soil health for achieving sustainable yields

The web-portal had ICT enabled and provide location specific fertilizer recommendation and decision support system for helping the farming community



## SOIL AND LEAF SAMPLING IN COFFEE PLANTATION



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Coffee is a major crop cultivated in the hilly tracts of Eastern & Western Ghats of India, where soils are slightly acidic to strongly acidic due to various factors such as:

- a. Loss of calcium and magnesium by leaching, erosion or by crop removal result into acidic soil.
- b. Continuous use of acid forming nitrogenous fertilizers and degradation of plant residues also cause reduction in soil pH.
- c. Due to presence of aluminium, iron and manganese which produces hydrogen on reaction with soil moisture causing acidity.

Thus it becomes very important to maintain pH and nutrient status of the soil at an optimum level.

Soil sampling:

It is important that the soil which is tested is a ‘true representative’ of the block from which it was sampled. Soil is sampled from different blocks as each block presents different features and problems.

Method for soil sampling

- ❖ Soil sampling is carried out immediately after crop harvest and before blossom showers.
- ❖ The plantation is divided into blocks of two hectares (five acres) each and soil is sampled from each block separately.  
  
If the areas within the block differ distinctly in plant growth or appearance of the soil or have been manured differently then the block is divided into smaller units and soil sample from each unit is drawn separately.
- ❖ As many as 20 spots are selected at random at the middle of four plants. Remove surface litter and dig a hole of approximately 6 inches diameter using a suitable tool (crowbar /sabbal) up to a depth of 9 inches (22.5 cm). Soil is scraped uniformly all along the pit from top to bottom and is removed from the pit and placed in a clean bucket.
- ❖ Similarly soil is sampled from the remaining spots. The soil from 20 spots are mixed thoroughly and unwanted material such as stones, plant residues *etc* are removed. Using the quartering technique 0.5 to 1 kg of soil sample is obtained, which would be a “true representative” soil sample of the block (Fig). The soil sample is placed in a polythene cover or cotton bag and sent to the laboratory for analysis.
- ❖ In young plantation (1 to 4 years old coffee plantation) collect soil sample from the drip circle i.e., 30 to 45 cm (periphery of coffee plant canopy along which the rain drops drip).
- ❖ Soils are not to be sampled from blocks that have been recently limed or fertilized, from roadside, old bunds, marshy places or under shade trees.
- ❖ Soil samples are placed in clean polyethylene or cotton bags. Each sample is labelled containing details of the name of the estate, block or number, address and date of soil sampling. In case the soil is moist the labels placed inside could be disfigured hence care should be taken to fix a label on the outer surface of the bag and sent to the laboratory for analysis.
- ❖ Fertilizer or pesticide contaminated bags should not be used for packing soil samples.
- ❖ Soil samples drawn from problematic blocks should be labelled separately.

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- ❖ Details of the estate, crop harvested for the last five years, elevation, rainfall, irrigation schedules if any should be provided in the information sheet. The duly filled information sheet should accompany the soil sample as it is required to provide fertilizer recommendation.
- ❖ Soils sampled long back or stored for long time should not be sent for analysis.

Soil test rating for coffee

Soil testing is one of the most important tools used to generate precise information regarding the nutrient status of the soil based on which the optimal lime & fertilizer recommendations are made.

It is essential to test the soils for its nutrient status at least once in 2-3 years in order to plan for appropriate nutrient management.

It is advised to test soil samples once in 2 years in the areas receiving heavy rainfall (>120 inches annually) and once in 3 years for the areas receiving medium to low rainfall (<120 inches annually).

The Coffee Board has established soil testing units at different locations of India i.e., Karnataka (3 STL), Kerala (1 STL), Tamil Nadu (1 STL), Andhra Pradesh (1 STL) and Assam (1 STL).

In Karnataka, STLs are situated at Central Coffee Research Institute, Balehonnuru, Chikkamagaluru District, Coffee Research Sub-Station, Chettalli, North Kodagu & Technology Evaluation Centre, Gonikoppal, South Kodagu. In Kerala, it is located at Regional Coffee Research Station (RCRS) Chundale, Wayanad District. In Tamil Nadu it is at Regional Coffee Research Station (RCRS) Thandigudi, Dindigul District, in Andhra Pradesh, it is at RCRS RV Nagar, Alluri Sitharama Raju District and in Assam it is at RCRS Diphu.

These STLs will undertake testing of soil samples of coffee grower’s fields and provide suitable advisory on nutrient management.

The table indicates the nutrient status of major, nutrients in soil ranging from low to high. This information is vital for the planter to compute the quantity of fertilizer required based on the nutrient status of his/her plantation indicated by the soil test report. This will enable balanced nutrient application and maintain good soil fertility.

Soil test ratings for organic carbon and major nutrients

| Rating | O.C (%) | Avail. N               | Avail. P <sub>2</sub> O <sub>5</sub> | Avail. K <sub>2</sub> O |
|--------|---------|------------------------|--------------------------------------|-------------------------|
|        |         | (kg ha <sup>-1</sup> ) |                                      |                         |
| Low    | < 1.0   | < 280                  | < 23                                 | < 141                   |
| Medium | 1.0-2.5 | 280-560                | 23-56                                | 141-336                 |
| High   | > 2.5   | > 560                  | >56                                  | >336                    |

The table below indicates the nutrient status of secondary and micronutrients in soil that need to be present in a specific range which is referred to as the ‘critical limit’. If soil records nutrient status below the lower limit it indicates that the soil is below critical limit in that particular nutrient and arrangements must be made to supply the required nutrient in the required quantity at the right time and proportion to improve soil nutrient status so as to ensure good crop growth.

Critical limits of secondary and micronutrients in coffee soils

| Nutrient                    | Range (ppm) |
|-----------------------------|-------------|
| Exchangeable Calcium (Ca)   | 700 - 1400  |
| Exchangeable Magnesium (Mg) | 180 - 375   |
| Available Sulphur (S)       | 16 - 32     |
| DTPA- Iron (Fe)             | 16 - 72     |
| DTPA - Manganese (Mn)       | 15 - 80     |
| DTPA- Zinc (Zn)             | 1.5 - 4.0   |
| DTPA - Copper (Cu)          | 4.0 - 40    |
| Hot water soluble Boron (B) | 0.5 - 2.0   |



Leaf analysis

- The leaf is an active functional part of the plant which produces photosynthates for plant growth, berry formation and development.
- Leaf analysis is another approach to determine the nutrient availability from the soil and the actual nutrient status of the plant at the time of sampling.
- The use of leaf analysis technique is based on the concept that the greater the content of a particular nutrient in the leaf the higher is its availability in the soil.
- Leaf analysis is generally suggested in coffee plantations to confirm the presence of nutritional disorders (or) for identifying the sufficiency / deficiency / toxicity of nutrients.
- Therefore results of leaf analysis may be used to suggest corrective measures. It is important to note that routine fertilizer recommendation in coffee plantations is made based on the soil nutrient status and not on the basis of the leaf nutrient content.

Method of leaf sampling

The younger leaves are more active than the older leaves indicative of the nutrient status of the soil thus qualifying for an ideal sample. Leaves are sampled as follows:

- The fourth pair of leaves from growing tip in case of Arabica (Fig.1) and third pair in case of Robusta (Fig.2) (at about 2/3 the height of the bush) is sampled at random.
- A minimum of 50 pairs of leaves over two (2 ha) hectares is sampled.
- The leaves are to be sampled in the forenoon preferably before 10 am.

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