

It is important to provide a time gap of one month after lime application and before the fertilizers is applied. This would prevent the calcium in the liming material from reacting with phosphatic fertilizers making them less soluble.

Method of fertilizer application

A simple yet effective method of fertilizer application in coffee plantations is known as the “drip circle application”

The purpose of fertilizer application in this area specifically refers to the circular soil patch which is about 1 ½ - 2 ft around the coffee stem but not the actual “drip circle” which corresponds to the periphery of coffee plant canopy along which the rain drops drip.

This method of fertilizer application helps ensure that the nutrients are distributed efficiently to the coffee plants while minimizing nutrient loss.

- The mulch beneath the coffee plant is swept towards its base.
- Using a stick (or) fork the soil around 1 ½ - 2 feet away from the main stem is gently disturbed.
- This creates a suitable area for fertilizer application within the “drip circle”.
- The fertilizer is uniformly spread in a broad circular band within the designated area.
- The soil is carefully reworked after the fertilizer application making sure it is well mixed with the fertilizer.
- Finally the area is covered with mulch creating a protective layer.

This method of fertilizer application is highly efficient as it minimizes the risk of nutrient runoff & ensures that the nutrients are available to the coffee plants.

Coffee growers can optimize the delivery of nutrients to their plants thus promoting healthy plant growth and maximizing benefits of the fertilizer applied.

In areas with steep slopes a modification of this method is followed - by applying the fertilizers in the form of a semi-arch (or) horse shoe shaped on the elevated side around the stem.

Mixing of fertilizers to achieve required nutrient ratios

- Mixing different nitrogen (N), phosphorus (P) & potassium (K) sources in specific quantities to achieve the desired N:P₂O₅:K₂O ratios is crucial for effective nutrient management in coffee plantations.
- When mixing fertilizers for soil application it is important to consider their compatibility.
- Incompatible nutrient source can cause issues such as clumping (or) difficulties in handling the mixture.
- Additionally, when incompatible fertilizers react chemically it can convert the available nutrients to unavailable forms thus affecting plant growth.
- Using incompatible nutrient sources can compromise the effectiveness of the nutrient management programme even if fertilizers are applied.

Micronutrients

Coffee-growing soils are slightly acidic to highly acidic in nature having medium to high percent organic carbon content.

Generally most of the micronutrient requirement of coffee plants is met by the release of micronutrients on decomposition of organic matter.

However, in some cases, deficiency symptoms of zinc and boron may be observed in the coffee plants which are often due to high levels of phosphorus (or) potassium in the acidic soil.

In such cases, foliar sprays of micronutrients can be provided especially to high-yielding blocks.

Integrated Nutrient Management (INM)

- Plays a crucial role in promoting optimal and efficient plant nutrition, aiming at higher production within limited land resources.
- While organic sources and recycling of farm wastes are important they cannot ensure sustainable coffee cultivation.
- Mineral fertilizers may have environmental concerns and economic constraints. Therefore adoption of INM which combines mineral fertilizers, organic and biological sources of nutrients is being promoted.
- This integrated approach optimizes the efficiency of all nutrient sources, including soil resources, mineral fertilizers, organic manures, recyclable wastes and bio-fertilizers.
- Modern coffee cultivation methods exert considerable stress on soil nutrient availability.
- The fertility of coffee soils is depleting due to exploitation, use of high-yielding varieties, reduced shade and fertilizer use.
- In the face of challenges such as non-availability and increasing prices of chemical fertilizers, coffee planters are adopting INM as a sustainable solution.
- INM involves the judicious and combined use of different nutrient sources such as chemical fertilizers, organic manure and bio-fertilizers
- Studies in nurseries, greenhouses and multi-location field trials have been conducted to assess the impact of INM on coffee yield, quality and soil properties.
- Results indicate that there is a potential to reduce chemical fertilizers without compromising yield and quality by substituting them with organic manures and bio-fertilizers.

Compatibility of fertilizers for preparation of mixtures

UREA	MOP	ROCK PHOS	DAP	SSP	SOP	LIME	AMM. SULPH	GYP SUM	EPSOM	
										UREA
										MOP
										ROCK PHOS
										DAP
										SSP
										SOP
										LIME
										AMM. SULPH
										GYP SUM
										EPSOM
Not Compatible						Compatible				

By following proper fertilizer mixing techniques and considering the compatibility coffee growers can achieve the desired nutrient ratios leading to optimal nutrient uptake and improved plant health.

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NUTRIENT MANAGEMENT IN COFFEE



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Coffee is a perennial crop and performs the dual function of developing fruits of the current year and producing fresh wood framework for the succeeding year.

- Coffee requires about 16 to 17 essential nutrients for growth and development. Among these plants obtain carbon, hydrogen and oxygen from air and water.
- Major nutrients such as Nitrogen, Phosphorus and Potassium are generally supplied through organic matter and fertilizers.
- Calcium, Magnesium and Sulphur are required in smaller quantities and hence classified as secondary nutrients.
- Elements like Iron, Manganese, Zinc, Copper, Boron, Molybdenum, Sodium, and Chlorine are classified as micronutrients as they are required in very small quantities.
- All the above essential nutrient elements must be present in the required form and proportion for optimum growth and development of the plants.

Soil analysis helps in indicating the actual soil nutrient status based on which an effective nutrient management plan is prepared the quantities of nitrogen (N), phosphorus (P₂O₅) and potassium (K₂O) required to be supplied to a particular block depends on various factors such as estimated yield, performance of the plants over the past three to five seasons and the soil nutrient status.

Application of nutrients without considering the soil nutrient status can result in poor plant growth, productivity, economic losses, environmental pollution & nutrient imbalance

Nutrient requirement based on nutrient removal and biomass production

The Coffee Board has standardized the nutrient requirement for Arabica and Robusta coffee based on studies conducted at CCRI and other regional stations.

According to these findings, for producing 1 ton of clean coffee in Arabica (equivalent to 6000 kg Coffee fruits), Robusta (equivalent to 5000 kg Coffee fruits) & biomass production it will remove the nutrients from the soil as follows:

Crop	N (kg's)	P ₂ O ₅ (kg's)	K ₂ O (kg's)
Arabica	40	7	45
Robusta	45	9	58
Biomass	13	2.3	15

The optimum economical dosage of nutrients required for coffee is determined by considering various factors such as:

- a. Crop nutrient removal,
- b. Nutrient recycling through organic matter
- c. Nutrient loss through leaching and fixation
- d. Fertilizer use efficiency (FUE).

Additionally the fertilizer application is fine-tuned based on the soil nutrient status, coffee yields obtained by the growers and the fertilizer applied by them.

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The recommended nutrient application for Arabica and Robusta coffee in terms of nitrogen, phosphorus and potassium (N: P₂O₅: K₂O) in kilo grams per acre per year is indicated in the table below:

**Dosage of major nutrients for young plants
(N: P₂O₅: K₂O - kg per acre to be applied in 3 to 4 splits)**

Year	Arabica	Robusta
1 st	20:20:20	30:30:30
2 nd	20:20:20	30:30:30
3 rd	25:25:25	40:30:40
4 th	25:25:25	40:30:40

Dosage of major nutrients required to realize targeted yield

Clean coffee yield (kg / acre)	Annual dose N:P ₂ O ₅ :K ₂ O (kg / acre)
100	30:27:30
200	40:34:40
300	50:41:50
400	60:48:60
500	70:55:70
600	80:62:80
700	90:69:90
800	100:76:100
900	110:83:110
1000	120:90:120

Time & frequency of fertilizer application

- The time & frequency of fertilizer application play a significant role on the growth and yield of coffee plants.
- Timely application of fertilizers when most needed by the plants ensures efficient and effective nutrient utilization.
- Studies have shown that the peak periods of nutrient demand in coffee coincide with flowering, fruit-set, development and maturation of the crop.
- Therefore, it is recommended to apply fertilizers during pre-monsoon (May - June), break in monsoon (August) & post-monsoon (September-October) in areas under the influence of southwest monsoon.

Split application of fertilizers

- To improve fertilizer use efficiency (FUE) and reduce nutrient loss through leaching, runoff and fixation it is advisable to apply the total annual fertilizer dose in **two (or) more splits**.
- If the annual nutrient dose per acre is small then the fertilizers are applied in two spits per year and in case the nutrient requirement of the crop is high then three or four split applications may be necessary.
- It is important to note that the maximum fertilizer dose per split application should not exceed to an extent of 30 kg, 25 kg and 30 kg N: P₂O₅:K₂O per acre.

Nutrient requirement and application

Nitrogen (N) is essential for coffee plants throughout the year and should be supplied at least three times annually during blossom, break in monsoon & post-monsoon period.

During blossom, coffee plants have a high requirement for phosphorus (P). It is recommended to provide water-soluble phosphorus fertilizers such as DAP (or) SSP along with nitrogen and potassium during the pre-monsoon period.

During the break in monsoon, application of one bag (45 kg) of Urea and 25 kg of MOP (or) two bags (100 kg) of Ammonium sulphate and 25 kg of MOP per acre is highly beneficial as it replenishes the nitrogen supply, reduces leaf & fruit droppings and promotes vigorous vegetative growth.

Application of potassium fertilizers during the post-monsoon period is crucial for berry maturation, bean filling and hardening.

Calcium, Magnesium and Sulphur are secondary nutrients. The calcium and magnesium is usually supplied by the liming material, in addition can be supplied as calcium nitrate and magnesium sulphate.

Coffee is predominantly cultivated under shade, resulting in soil organic matter content ranging from medium to high.

The decomposition of organic matter releases sulphur which fulfils the sulphur requirements of the plants. In cases where deficiency symptoms are observed in the field application of sulphur fertilizers may be necessary.

Selection of fertilisers

Urea is the most commonly used nitrogen fertilizer in coffee plantations due to its popularity, versatility in various soil types and compatibility with phosphorus and potassium fertilizers.

Fertilizer source	Suitable for soils pH
Ammonium sulphate	>6.1
Di-Ammonium Phosphate	5.8 and above
Single Super Phosphate	5.1 to 6.0
Rock Phosphate	<5.0
Complex fertilizers	>5.5

Di-Ammonium phosphate (DAP) supplies both nitrogen and phosphorus in water-soluble form and is suitable for coffee plantations

Super phosphate which also contains water-soluble phosphorus is particularly useful in young clearings. However, its efficacy may decrease in highly acidic soils.

In acidic soils with a pH below 5.0 rock phosphate (RP) is an ideal source as the phosphorus present is slowly released over time thus reducing phosphorus fixation in the soil.

Potassium fertilizers - Muriate of Potash (MOP) is widely used in coffee plantations. Sulphate of Potash (SOP) is also suitable; however its cost is higher than MOP.

Complex fertilizers & granulated fertilizers containing all the three major nutrients have found to be equally effective as straight fertilizers offering the advantage of homogeneity and reducing the risk of adulteration. However, it is important to note that these complex fertilizers have a higher unit cost and a fixed NPK ratio.

Sufficient soil moisture should be ensured before application of fertilizers / manures. Better fertilizer use efficiency can be obtained in coffee plantations on application of farmyard manure (FYM) / compost (or) any other organic manure enriched with phosphorus solubilising and potassium mobilizing micro organisms @ 4 kg each for at least once in 2-3 years and applied at the rate of 2-3 tonnes per acre (Arabica - 2 kg / plant & Robusta - 5 kg / plant).

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