TN Tribal Welfare Kallakurichi Project
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Agro-Advisory Manual on Soil Health Management for Cassava and Sweet Potato in Kalvarayan Hills, Tamil Nadu

ICAR Central Tuber Crops Research Institute
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Kalvarayan Hills, Tamil Nadu

ICAR Central Tuber Crops Research Institute
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From the Director

Healthy soils are the cornerstone of sustainable agriculture, food and nutritional security, environmental resilience, and prosperous farming communities. For tribal farmers of the Kalvarayan Hills, cassava and sweet potato are not merely crops; they are vital sources of food, nutrition, income, and livelihood. Sustaining the productivity of these crops requires scientific soil health management that conserves natural resources while ensuring profitable and resilient farming systems.

Over the years, continuous cultivation coupled with inadequate replenishment of nutrients has resulted in declining soil fertility, reduced soil organic carbon, nutrient imbalances, and lower productivity in many hill ecosystems. While balanced fertilizer application remains important, long-term sustainability can only be achieved through integrated soil health management that combines organic manures, biofertilizers, green manures, crop residue recycling, microbial technologies, and judicious nutrient use based on soil testing. Such an integrated approach improves nutrient-use efficiency, restores soil biological activity, enhances soil carbon, and builds resilience against climate variability.

The Government of India has accorded high priority to restoring soil health through initiatives such as the Soil Health Card Scheme, Natural Farming Mission, and programmes promoting balanced nutrient management and resource conservation. This manual complements these national efforts by providing location-specific, science-based recommendations for sustainable cassava and sweet potato production in the Kalvarayan Hills.

Prepared under the Tamil Nadu Tribal Welfare Department-supported project on Development of Cassava Value Chain-Based Entrepreneurship through Satellite Incubation Centre to Enhance Tribal Livelihoods in Kalvarayan Hills, this publication presents practical guidance on soil testing, interpretation of Soil Health Cards, diagnosis of nutrient deficiencies, integrated nutrient management, green manuring, and restoration of soil health. The recommendations are presented in a simple, farmer-friendly manner to facilitate their adoption by extension personnel, researchers, development agencies, Farmer Producer Organizations, and farming communities.

I congratulate the authors for their dedicated efforts in bringing out this timely and highly useful manual. I am confident that this publication will serve as a valuable resource for improving soil health, enhancing fertilizer-use efficiency, increasing cassava and sweet potato productivity, and strengthening the livelihoods of tribal farmers while promoting environmentally sustainable agriculture.

I hope this manual will inspire all stakeholders to recognise that healthy soils are the foundation of healthy crops, healthy people, and a sustainable future.

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July 2026
Thiruvananthapuram

CHAPTER 1: Understanding Your Soil

1.1 Soils of the Kalvarayan Hills

A. Types of soils

The soils in the Kalvarayan Hills are mostly clay, loamy, or lateritic (Fig 1). They are naturally low in organic matter and highly prone to erosion and nutrient loss. Because rainfed conditions dominate, these soils require organic enrichment and careful management every season.

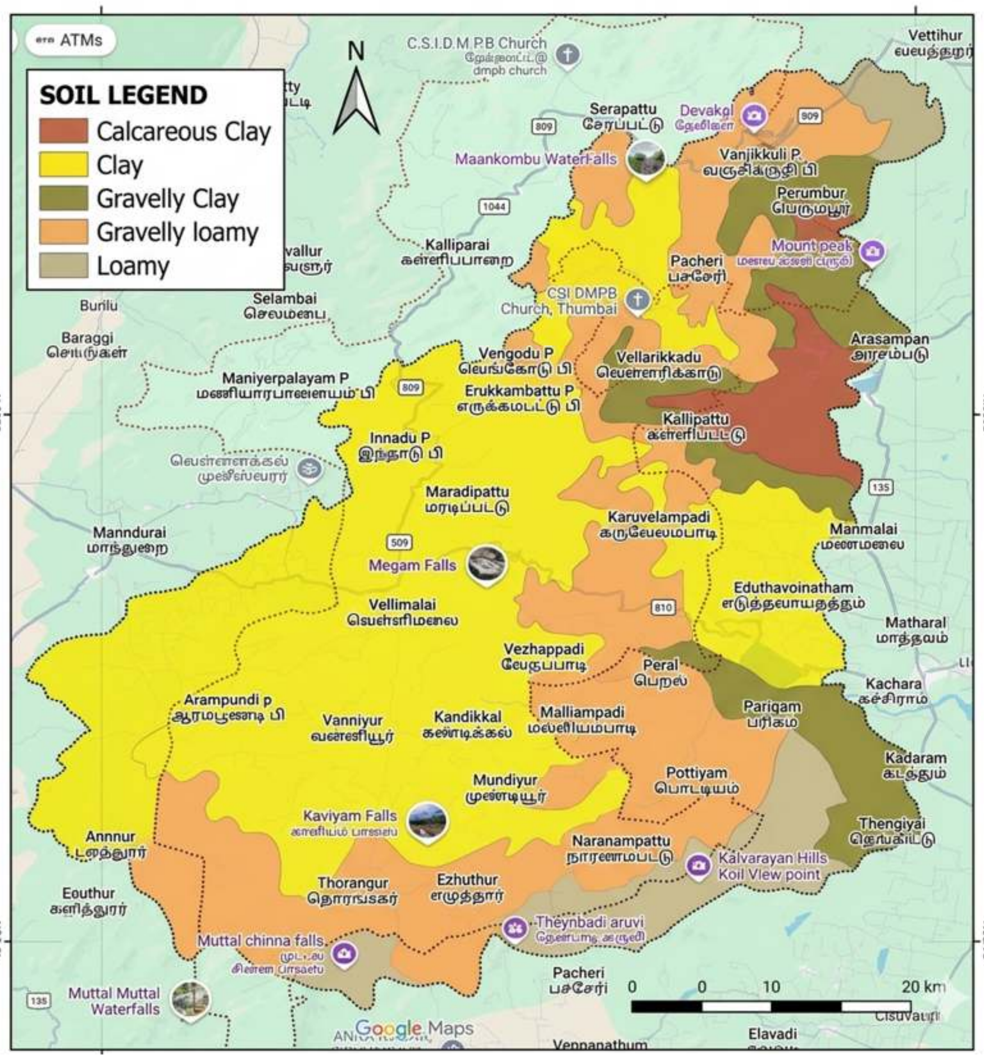


Fig. 1. Soil map of Kalvarayan Hills (Adapted from Sakthivel *et al.,* 2011)

B. Nutrient content of the soils

The soils of the Kalrayan Hills are generally good for cultivating cassava, sweet potato, and other tuber crops. The soil contains moderate to high levels of organic matter, essential nutrients, and beneficial microorganisms that support healthy crop growth. However, the soil conditions vary from village to village and even between fields. Therefore, proper soil management is important for maintaining productivity and improving tuber yield and quality (Ramachandran et al., 2016)

(Table 1)

Table 1. Properties of soils in Kalvarayan Hills

Sl. No.	Parameter	Observed Range / Status
A. Soil organic matter and nutrients		
1	Carbon (C) (%)	0.60 – 3.74
2	Nitrogen (N) (%)	0.11 – 1.43
B. Soil nutrient availability		
3	Available Nitrogen (kg/ha)	214 – 378
4	Available Phosphorus (kg/ha)	34.5 – 98
5	Available Potassium (kg/ha)	123 – 467
C. Soil Chemical Properties		
6	Soil pH	6.1 – 6.7
7	Electrical Conductivity (EC) (dS/m)	0.12 – 0.14
D. Soil Biological Properties		
8	Microbial Biomass Carbon (MBC)(mg kg^{-1})	111 – 515
9	Microbial Biomass Nitrogen (MBN)(mg kg^{-1})	23 – 501
10	Total Bacteria Population	Comparatively high
11	Total Fungi Population	Comparatively high

(Adapted from: Ramachandran *et al.,* (2016)

1. Soil Organic Carbon – Good for Soil Health

The soil organic carbon levels range from 0.60% to 3.74%, indicating that many fields have good organic matter content. Organic matter improves soil softness, water-holding capacity, root growth, and nutrient availability. Fields with higher organic carbon are usually more fertile and produce healthier tubers. Farmers should continue adding farmyard manure, compost, leaf litter, green manure, and crop residues to maintain soil fertility (Ramachandran et al., 2016).

2. Nitrogen Status – Important for Plant Growth

The nitrogen level in the soil is moderate to high in many areas. Nitrogen helps in leaf growth, stem development, and overall plant vigour. However, fields may become deficient due to repeated cropping and soil erosion on hill slopes. The application of organic manures, biofertilizers, and balanced fertilizers can help maintain healthy crop growth.

3. Phosphorus Availability – Helps Root and Tuber Formation

The phosphorus content is generally adequate in most soils of the Kalvarayan Hills. Phosphorus is important for root development and tuber formation. Good phosphorus availability helps cassava and sweet potato establish strong root systems and improve tuber yield.

4. Potassium Availability – Essential for Tuber Quality

Potassium levels are favorable in many locations. Potassium is very important for tuber crops because it improves starch content, tuber size, keeping quality, and disease resistance. Fields with low potassium may produce small or poor-quality tubers. Farmers should use potash fertilisers or organic sources, such as ash and compost, as needed.

5. Soil pH – Suitable for Cassava and Sweet Potato

The soil pH ranges from 6.1 to 6.7, which is slightly acidic and highly suitable for cassava and sweet potato cultivation. This pH range supports better nutrient uptake and healthy root growth. No major soil acidity or alkalinity problem was observed (Ramachandran et al., 2016).

6. Low Salinity – Good for Crop Growth

The electrical conductivity (EC) values are very low (0.12–0.14 dS/m), showing that the soils are non-saline. This means salt accumulation is not a problem in the Kalvarayan Hills, and crops can grow normally without salinity stress.

7. Soil Microorganisms – Living Soil Supports Better Farming

The soils contain high levels of beneficial bacteria and fungi. These microorganisms help decompose organic matter, release nutrients naturally, improve soil fertility, and support healthy crop growth. The high microbial activity indicates that the soils are biologically active and healthy (Ramachandran et al., 2016).

Farmers Tip

Continuous cassava cultivation without restoring soil health leads to declining fertility, smaller tubers, and lower income year after year.

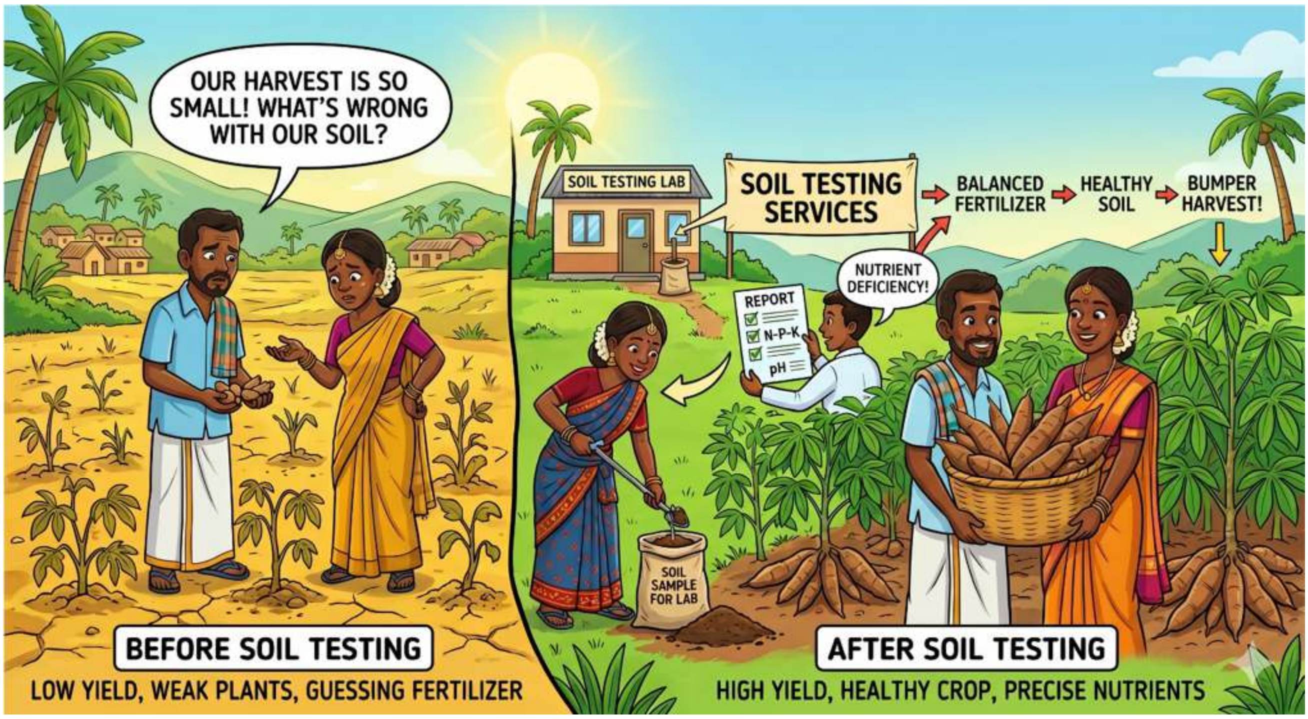
1.2 Why Soil Health Matters for Cassava and Sweet Potato

Both cassava and sweet potato are nutrient-exhaustive (heavy feeder) crops. They remove large amounts of Nitrogen (N) and Potassium (K) from the soil with every harvest. If these nutrients are not replenished, the soil becomes progressively carbon-deprived (Fig 2).

Fig. 2. Effects of poor soil health on cassava and sweet potato

CHAPTER 2: Soil Testing – Know Before You Grow

2.1 Why Soil Testing is Essential



Many farmers in Kalvarayan Hills plant cassava and sweet potato without testing their soil. This often leads to poor crop growth, low tuber yield, and unnecessary fertiliser expenses. In some fields, farmers apply more fertiliser than required, while in other fields, important nutrients are not applied at all. Soil testing helps farmers understand the nutrient status and condition of their soil before planting.

A soil test shows whether the soil is acidic or neutral, whether nutrients are sufficient or deficient, and whether organic matter levels are adequate for healthy crop growth. Based on the test results, farmers can apply the appropriate types and quantities of fertilisers and organic manures. This reduces input cost, improves fertiliser efficiency, increases tuber yield and quality, and helps maintain long-term soil health.

In hill regions like Kalvarayan Hills, soil fertility may vary greatly between villages and even between nearby fields due to slope, erosion, rainfall, and previous crop management practices. Therefore, soil testing is essential for scientific and profitable cassava and sweet potato cultivation.

What every farmer should do:

- Test your soil before each planting season
- Repeat soil testing every 2–3 years minimum
- Follow fertiliser recommendations based on your test results

2.2 Key Parameters to Check

Different soil parameters provide important information about soil fertility and crop suitability. Understanding these parameters helps farmers make better decisions regarding nutrient management and crop production in cassava and sweet potato cultivation (Table 2).

Table 2. Soil parameters and their meaning

Parameter	What It Tells You
pH	Soil acidity or alkalinity
Organic Carbon	Soil fertility, moisture holding capacity, and physical properties of the soil
Nitrogen (N)	Plant growth and leaf development
Phosphorus (P)	Root and tuber development
Potassium (K)	Tuber size, starch content, disease resistance
Secondary and micronutrients	Overall plant health (Ca,Mg,S, Zn,B)

2.3 Where to Get Your Soil Tested

Farmers can approach nearby agricultural institutions and laboratories for soil testing services. Proper soil testing and expert guidance help improve the efficiency of fertiliser use and crop productivity in cassava and sweet potato cultivation.

Service	Contact Details
KVK Kallakurichi (Programme Coordinator)	ICAR–Krishi Vigyan Kendra (Villupuram-II), Kalasamuthiram Village, Chinnasalem Taluk, Kallakurichi District, Tamil Nadu – 606301 Phone: 8300978770 Email: kvk-villupuram-2@tanuvas.org.in
Assistant Director of Horticulture, Vellimalai	Office of the Assistant Director of Horticulture, Vellimalai, Kalvarayan Hills Region, Kallakurichi District, Tamil Nadu Mobile: 9787237797
Soil Testing Laboratory (STL), Chinnasalem	Department of Agriculture, Chinnasalem, Kallakurichi District, Tamil Nadu – 606201

CHAPTER 3: The Soil Health Card – Your Soil's Report Card

3.1 What is a Soil Health Card?

A Soil Health Card (SHC) is a printed report issued by the Government of India through the State Agriculture Department. It is based on a scientific analysis of a soil sample taken from your field. The card tells you exactly what is in your soil, what is missing, and what you should apply to grow a good crop.

The Soil Health Card is:

- Free of cost for all farmers
- Specific to YOUR field – not a general recommendation
- Updated every 2–3 years under the national SHC scheme
- Available in Tamil and English

Farmers Tip
Your Soil Health Card is the most important farming document you can have. It is your soil's report card

3.2 What Does the Soil Health Card Measure?

The card tests for 12 parameters, divided into macronutrients, secondary nutrients, and micronutrients (Table 3).

Table 3: Soil nutrients included in Soil Health Card

Macro-Nutrients (Primary – Needed in Largest Amounts)			
Parameter	**Symbol**	**What It Does for Your Crop**	**Typical Status in Kalvarayan Hills**
Soil Reaction	PH	Controls nutrient availability; affects root health	Acidic to neutral (5.5–7.0)
Electrical Conductivity	EC	Measures salt content in soil	Generally low – not a major concern
Organic Carbon	OC	Important for soil health, it holds moisture and nutrients and controls soil physical properties	Low (< 0.5%) – critical to improve
Nitrogen	N	Drives leaf and plant growth	Low
Phosphorus	P	Develops roots and tubers	Low to medium
Potassium	K	Improves tuber size, starch, disease resistance, and reduces bitterness	Medium to high

Secondary Nutrients

Parameter	Symbol	Role	Notes for Hill Soils
Sulphur	S	Protein formation improves flavour in tubers	Often deficient in red soils
Calcium	Ca	Cell wall strength; root tip development	Low due to heavy leaching
Magnesium	Mg	Chlorophyll production; photosynthesis	Can be deficient in acidic soils

Micronutrients (Needed in Small but Critical Amounts)

Parameter	Symbol	Role
Zinc	Zn	Enzyme activity: pollen formation, reduction of bitterness, disease resistance
Boron	B	Cell division; tuber development
Iron	Fe	Chlorophyll formation
Manganese	Mn	Photosynthesis; enzyme activation
Copper	Cu	Enzyme systems; pollen viability
Molybdenum	Mo	Nitrogen use by plants

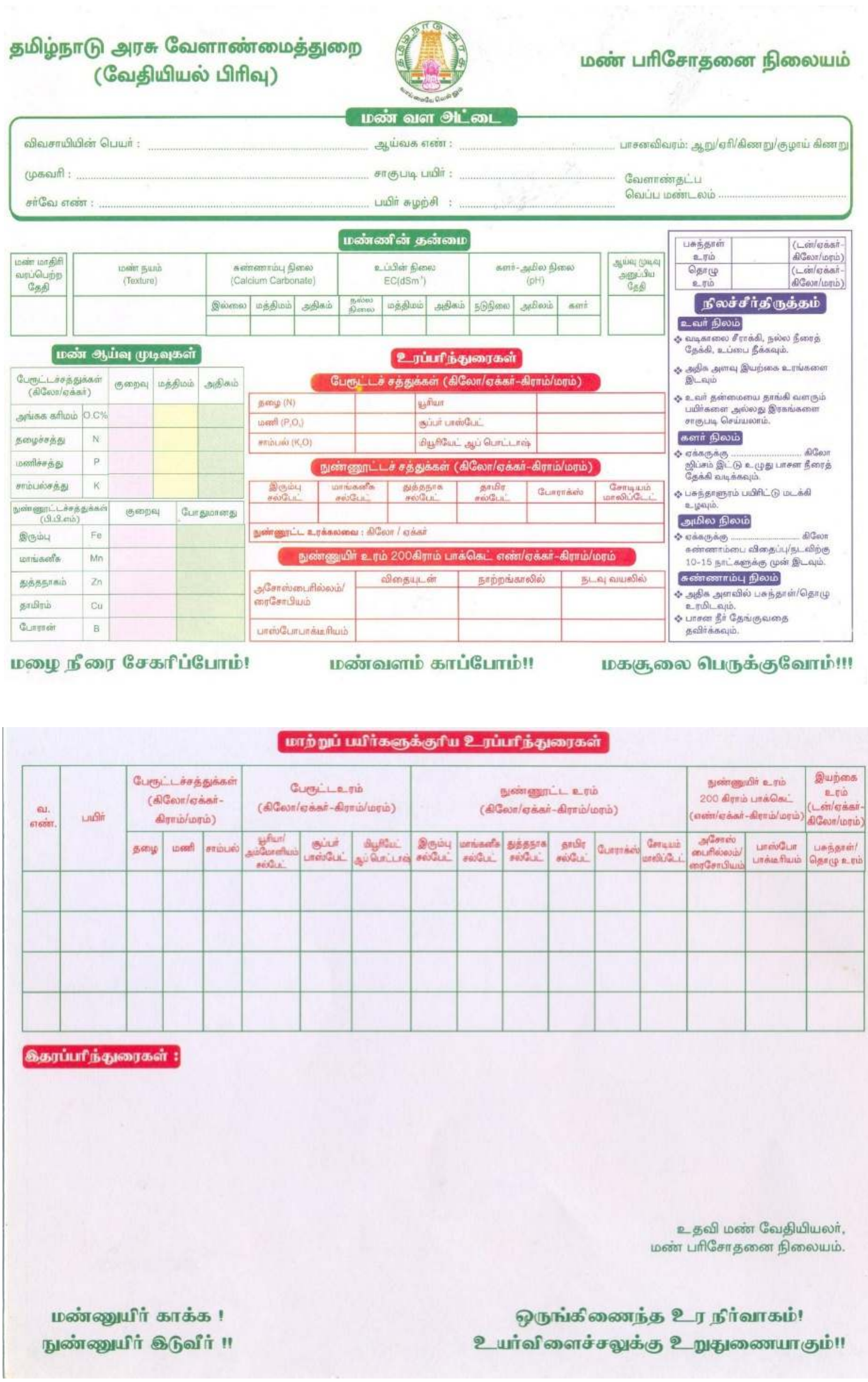
3.3 How to Read Your Soil Health Card – Understanding the Ratings

A Soil Health Card is an important guide for farmers to understand the fertility status of their field. It provides information on nutrient levels, soil pH, and the overall health of the soil. By reading the Soil Health Card correctly, farmers can decide which fertilizers, organic manures, or soil amendments to apply to achieve better crop growth and higher tuber yield.

Many farmers apply fertilisers based on traditional practices or on recommendations from neighbours. However, every field is different, and nutrient levels may vary even within the same village. The Soil Health Card helps farmers apply the right nutrients, in the right quantity, at the right time. This reduces unnecessary fertiliser expenses and improves soil productivity over the long term.

For cassava and sweet potato cultivation, understanding soil nutrient status is especially important because these crops remove large quantities of nutrients from the soil. Balanced nutrient management helps improve tuber size, starch content, sweetness, shelf life, and market value.

The Soil Health Card usually classifies nutrient levels into categories such as Low, Medium, and High. These ratings help farmers determine whether additional nutrient application is required. A sample of Soil Health Cards issued by the Govt. of Tamil Nadu is shown in Fig. 3.



தமிழ்நாடு அரசு வேளாண்மைத்துறை
(வேதியியல் பிரிவு)

மண் பரிசோதனை நிலையம்

மண் வள அட்டை

விவசாயியின் பெயர் : .... ஆய்வக எண் : .... பாசனவிவரம்: ஆறு/ஏரி/கிணறு/குழாய் கிணறு

முகவரி : .... சாகுபடி பயிர் : .... வேளாண்தட்ப வெப்ப மண்டலம் ....

சர்வே எண் : .... பயிர் சுழற்சி : ....

மண்ணின் தன்மை

மண் மாதிரி வரப்பெற்ற தேதி	மண் நயம் (Texture)	சுண்ணாம்பு நிலை (Calcium Carbonate)			உப்பின் நிலை EC(dSm⁻¹)			களர்-அமில நிலை (pH)			ஆய்வு முடிவு அனுப்பிய தேதி
		இல்லை	மத்திமம்	அதிகம்	நல்ல நிலை	மத்திமம்	அதிகம்	நடுநிலை	அமிலம்	களர்	

பசுந்தாள் உரம்		(டன்/ஏக்கர்-கிலோ/மரம்)
தொழு உரம்		(டன்/ஏக்கர்-கிலோ/மரம்)

நிலச்சீர்திருத்தம்

உவர் நிலம்
- வடிகாலை சீராக்கி, நல்ல நீரைத் தேக்கி, உப்பை நீக்கவும்.
- அதிக அளவு இயற்கை உரங்களை இடவும்
- உவர் தன்மையை தாங்கி வளரும் பயிர்களை அல்லது இரகங்களை சாகுபடி செய்யலாம்.

களர் நிலம்
- ஏக்கருக்கு .... கிலோ ஜிப்சம் இட்டு உழுது பாசன நீரைத் தேக்கி வடிக்கவும்.
- பசுந்தாளுரம் பயிரிட்டு மடக்கி உழவும்.

அமில நிலம்
- ஏக்கருக்கு .... கிலோ சுண்ணாம்பை விதைப்பு/நடவிற்கு 10-15 நாட்களுக்கு முன் இடவும்.

சுண்ணாம்பு நிலம்
- அதிக அளவில் பசுந்தாள்/தொழு உரமிடவும்.
- பாசன நீர் தேங்குவதை தவிர்க்கவும்.

மண் ஆய்வு முடிவுகள்

பேரூட்டச்சத்துக்கள் (கிலோ/ஏக்கர்)		குறைவு	மத்திமம்	அதிகம்
அங்கக கரிமம்	O.C%			
தழைச்சத்து	N			
மணிச்சத்து	P			
சாம்பல்சத்து	K			

நுண்ணூட்டச்சத்துக்கள் (பி.பி.எம்)		குறைவு	போதுமானது
இரும்பு	Fe		
மாங்கனீசு	Mn		
துத்தநாகம்	Zn		
தாமிரம்	Cu		
போரான்	B		

உரப்பரிந்துரைகள்

பேரூட்டச் சத்துக்கள் (கிலோ/ஏக்கர்-கிராம்/மரம்)

தழை (N)		யூரியா	
மணி (P_2O_5)		சூப்பர் பாஸ்பேட்	
சாம்பல் (K_2O)		மியூரியேட் ஆப் பொட்டாஷ்	

நுண்ணூட்டச் சத்துக்கள் (கிலோ/ஏக்கர்-கிராம்/மரம்)

இரும்பு சல்பேட்	மாங்கனீசு சல்பேட்	துத்தநாக சல்பேட்	தாமிர சல்பேட்	போராக்ஸ்	சோடியம் மாலிப்டேட்

நுண்ணூட்ட உரக்கலவை : கிலோ / ஏக்கர்

நுண்ணுயிர் உரம் 200கிராம் பாக்கெட் எண்/ஏக்கர்-கிராம்/மரம்

	விதையுடன்	நாற்றங்காலில்	நடவு வயலில்
அசோஸ்பைரில்லம்/ ரைசோபியம்			
பாஸ்போபாக்டீரியம்			

மழை நீரை சேகரிப்போம்! மண்வளம் காப்போம்!! மகசூலை பெருக்குவோம்!!!

மாற்றுப் பயிர்களுக்குரிய உரப்பரிந்துரைகள்

வ. எண்.	பயிர்	பேரூட்டச்சத்துக்கள் (கிலோ/ஏக்கர்-கிராம்/மரம்)			பேரூட்ட உரம் (கிலோ/ஏக்கர்-கிராம்/மரம்)			நுண்ணூட்ட உரம் (கிலோ/ஏக்கர்-கிராம்/மரம்)						நுண்ணுயிர் உரம் 200 கிராம் பாக்கெட் (எண்/ஏக்கர்-கிராம்/மரம்)		இயற்கை உரம் (டன்/ஏக்கர்-கிலோ/மரம்)
		தழை	மணி	சாம்பல்	யூரியா/ அம்மோனியம் சல்பேட்	சூப்பர் பாஸ்பேட்	மியூரியேட் ஆப் பொட்டாஷ்	இரும்பு சல்பேட்	மாங்கனீசு சல்பேட்	துத்தநாக சல்பேட்	தாமிர சல்பேட்	போராக்ஸ்	சோடியம் மாலிப்டேட்	அசோஸ் பைரில்லம்/ ரைசோபியம்	பாஸ்போ பாக்டீரியம்	பசுந்தாள்/ தொழு உரம்

இதரப்பரிந்துரைகள் :

உதவி மண் வேதியியலர்,
மண் பரிசோதனை நிலையம்.

மண்ணுயிர் காக்க !
நுண்ணுயிர் இடுவீர் !!

ஒருங்கிணைந்த உர நிர்வாகம்!
உயர்விளைச்சலுக்கு உறுதுணையாகும்!!

Fig 3. Sample copy of the Soil Health Card issued by Tamil Nadu Government

Each nutrient on the Soil Health Card is usually given a colour-coded rating to help farmers quickly understand the nutrient status of their soil (Table 4). These colour indicators show whether a nutrient is deficient, sufficient, or excessive in the field. By understanding these ratings, farmers can make better fertiliser decisions, avoid unnecessary expenditure, and improve the productivity of cassava and sweet potatoes.

Table 4: Interpretation of Soil Health Card

Rating on Card	Colour Code	What It Means	What You Should Do
Low / Deficient	Red	Your soil does not have enough of this nutrient	Apply as recommended immediately
Medium / Sufficient	Yellow / Orange	Borderline – monitor and maintain	Apply at standard dose; add organic matter
High / Excess	Green	Adequate – no need to apply more	Reduce or skip that input; saves money

Low / Deficient (Red)

A red rating means the nutrient level in the soil is too low for healthy crop growth. Cassava and sweet potato grown in deficient soils may show poor growth, low tuber yield, smaller tubers, or nutrient deficiency symptoms. Immediate nutrient correction through fertilisers, organic manures, or micronutrient application is necessary.

Medium / Sufficient (Yellow / Orange)

A yellow or orange rating means the nutrient level is moderate and should be maintained carefully. The crop may grow normally, but continuous cultivation without replenishment can reduce soil fertility over time. Farmers should apply the recommended fertiliser dose and regularly add compost or farmyard manure to sustain soil health.

High / Excess (Green)

A green rating indicates that the nutrient is already available in sufficient quantity in the soil. Applying more of that nutrient may not increase yield and can unnecessarily increase production cost. Excess fertiliser application may also damage soil health and reduce nutrient balance. Farmers can reduce or skip that fertiliser and save money.

Farmers Tip
A 'High' or 'Green' rating for Potassium (K) is common in Kalvarayan Hills. This means many farmers can safely skip or reduce MOP (muriate of potash) application and save money/apply maintenance dose of K for tuber crops as 25% of recommended K.

3.4 Step-by-Step: How to Collect a Good Soil Sample

The accuracy of your Soil Health Card depends entirely on how well you collect your soil sample. A bad sample gives wrong results and wrong recommendations.

Tools You Need

- A clean spade, khurpi (trowel), or soil auger
- A clean plastic bucket or tray (do NOT use metal containers)
- A clean polythene bag (at least 500 g capacity)
- A marker pen and a small paper label

Collection Steps

Table 5. Steps in collecting soil samples

Step	What to Do	Why It Matters
1. Choose collection points	Walk in a W or Z pattern across your field and collect from 8–10 spots	Ensures your sample represents the whole field
2. Clear the surface	Remove surface litter, grass, or mulch from each spot before digging	Prevents contamination from decomposing material
3. Dig to correct depth	Dig a V-shaped hole 0–15 cm deep (for upland crops like cassava)	This is the root zone where nutrients are absorbed
4. Take a thin slice	Scrape a thin vertical slice from one side of the hole	Gives a uniform sample from top to bottom of root zone
5. Collect in bucket	Place the slice in the bucket; repeat from all 8–10 spots	All spots mixed together give a composite sample
6. Mix and reduce	Mix the soil well in the bucket; take 500 g sample through quatering into the polythene bag	Composite sample is more accurate than single spot
7. Label the bag	Write: Farmer name, village, field number, crop to be grown, date	Essential for the lab to link results to your field

Farmers Tip
Do NOT collect soil from bunds, paths, waterlogged corners, or places where you recently applied fertiliser, manure, or lime. These give wrong results.

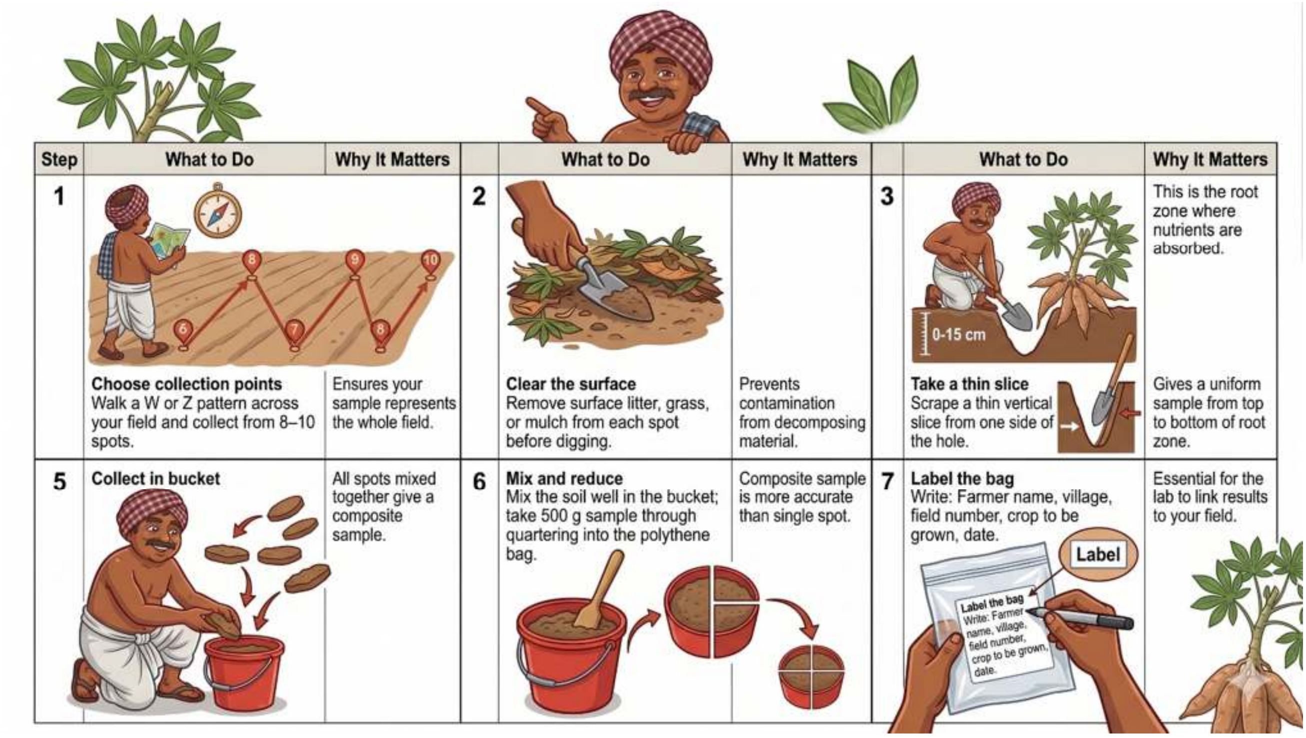


Fig 4. Steps in the collection of soil samples for testing

3.5 When to Collect Soil Samples

Proper timing of soil sample collection is very important for getting accurate soil test results. Soil nutrient levels can vary with crop stage, fertilizer application, rainfall, and irrigation. Therefore, farmers should collect soil samples at the correct time to understand the true fertility status of their field (Table 6 and Fig 5)

Table 6. Timing of data collection

Timing	Recommendation	Reason
After harvest, before next planting	Best time	Field is idle; no crop interference; easy access
During dry season (November–February)	Very good	Soil moisture is uniform; results are more consistent
Before applying lime or gypsum	Essential	pH must be known before deciding lime dose
During or just after heavy rains	Avoid	Soil moisture affects results; nutrients may be leached
Immediately after fertiliser application	Never	Will show artificially high nutrient levels

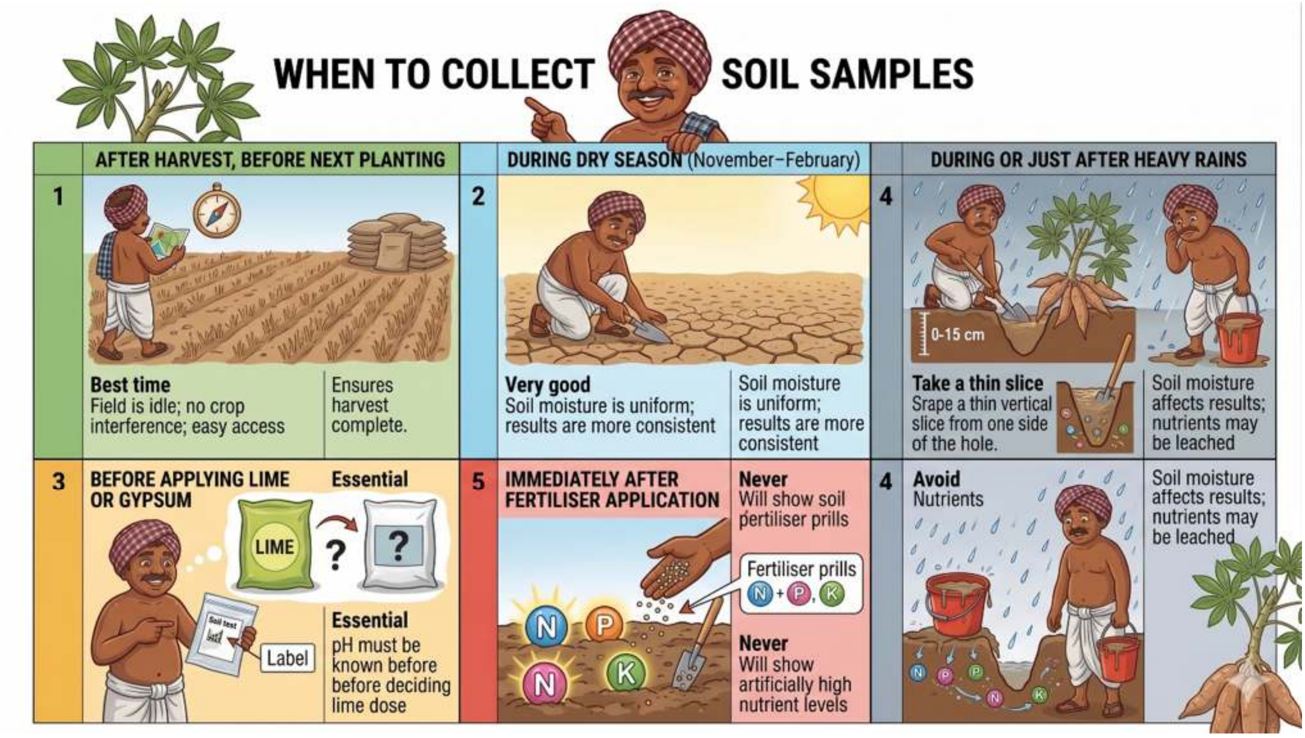


Fig 5. Timing of the collection of soil samples

3.6 Submitting Your Sample – Where to Go

After collecting and properly drying the soil sample, farmers should pack the sample in a clean cloth bag or plastic cover and label it correctly before submission. The label should include the farmer's name, village, survey number or field identification, crop to be planted (cassava or sweet potato), and date of collection. Proper labelling helps laboratories provide accurate soil test reports and fertiliser recommendations.

Farmers are advised to submit about 500 g of well-mixed soil collected from different parts of the field. Avoid sending wet soil, soil mixed with stones, leaves, roots, fertiliser particles, or animal waste. A properly collected sample gives more reliable test results.

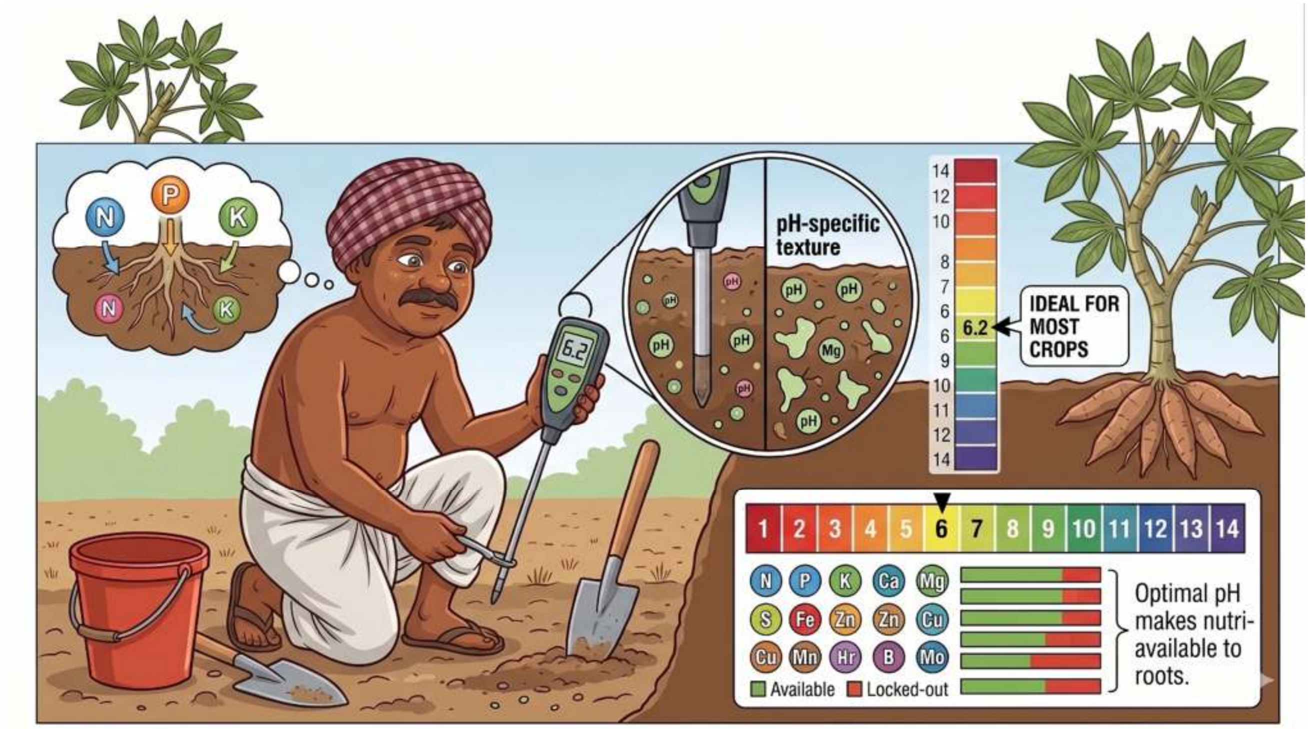
Farmers in Kalvarayan Hills can submit soil samples to the following offices and laboratories for soil analysis and nutrient recommendations.

Service Point	Location	Contact / Details
KVK Kallakurichi	ICAR–Krishi Vigyan Kendra (Villupuram-II), Kalasamuthiram Village, Chinnasalem Taluk, Kallakurichi District, Tamil Nadu – 606301 Phone: 8300978770 Email: kvk-villupuram-2@tanuvas.org.in	Programme Coordinator; helps with collection & submission
Soil Testing Laboratory (STL)	Department of Agriculture, Chinnasalem, Kallakurichi District, Tamil Nadu – 606201	Test samples; generate nutrient reports; upload to SHC portal

Service Point	Location	Contact / Details
Assistant Director of Horticulture, Vellimalai	Office of the Assistant Director of Horticulture, Vellimalai, Kalvarayan Hills Region, Kallakurichi District, Tamil Nadu Mobile: 9787237797	Assists with sample collection and card distribution

Farmers Tip
You can check your Soil Health Card online at: soilhealth.dac.gov.in – enter your mobile number or SHC ID to download your card.

3.7 Understanding pH – The Master Control of Your Soil



a. What is soil pH

- Soil pH is the single most important number on your Soil Health Card.
- Soil pH refers to the acidity or alkalinity of soil.
- Soils with a pH lower than 7 are acidic, and soils with a pH above 7 are alkaline.
- Values between 6.5 and 7.5 are ideal (most nutrients have maximum availability in this range).

b. Why is soil pH important?

- Soil pH affects the soil's physical, chemical, and biological properties that are vital for plant growth

- It controls how well your crop can absorb all other nutrients. Even if nutrients are present in the soil, an incorrect pH can lock them out.
- At very low or very high pH, the availability of many essential macro- and micronutrients is affected.
- Soil microbial activity is also optimum at a pH of 6.5−7.5.
- At very low or high pH, the breakdown of organic matter and release of nitrogen is reduced because of poor microbial activity.
- Soil structure is also degraded at high soil pH, leading to detrimental effects on plant growth.

c. Management of soils at different pH ranges

Soil pH is an important factor that affects nutrient availability, root growth, microbial activity, and overall crop performance. Cassava and sweet potato generally grow well in slightly acidic soils. However, when soil becomes too acidic or too alkaline, certain nutrients become unavailable to plants, while some toxic elements may increase. Therefore, farmers should understand their soil pH and manage the field accordingly (Table 7).

Regular soil testing helps identify soil pH problems early. Appropriate soil amendments, such as lime, organic manure, gypsum, or balanced fertiliser application, can help improve soil conditions and crop productivity.

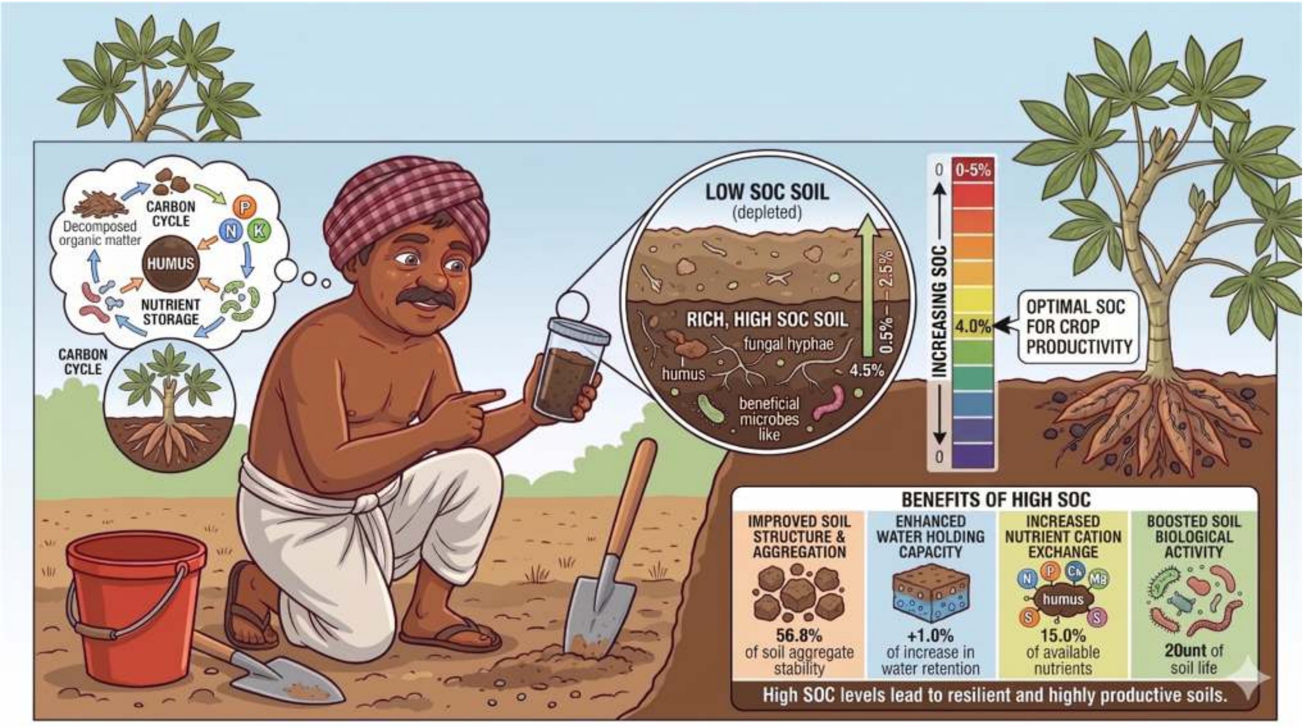
Table 7. Management of soils based on their pH range

pH Range	Soil Type	Effect on Nutrients	Action for Cassava / Sweet Potato
< 5.0	Strongly acidic	Aluminum and Manganese become toxic; Phosphorus, Calcium and Magnesium become unavailable	Apply dolomite or lime urgently (4–8 t/ha); add organic manure; avoid excess nitrogen fertiliser
5.0–6.0	Moderately acidic	P and Molybdenum availability reduced	Apply lime (2–4 t/ha); use organic manure
6.0–7.0	Ideal range	All nutrients freely available; best for root crops	Maintain with FYM and green manure; no lime needed
7.0–8.0	Neutral to mildly alkaline	Micronutrients (Zn, Fe, Mn) may be less available	Add sulphur or gypsum if needed; apply $ZnSO_4$
> 8.0	Strongly alkaline	Multiple nutrient lockouts; poor root growth	Apply gypsum + sulphur; seek expert advice

Farmers Tip

Most soils in the Kalvarayan Hills fall in the 5.5–6.5 range. A lime application of 1–2 t/ha once every 3 years is generally sufficient to maintain the ideal pH.

3.8 Understanding Organic Carbon – The Life of Your Soil



a. What is soil organic carbon

- Organic Carbon (OC) is the most important long-term indicator of soil health.
- Soil organic carbon is a component of soil organic matter, which derives from the deposition and incorporation of leaf litter, crop residues, plant material, dead roots and animal wastes in the soil.
- In hill regions like Kalvarayan Hills, maintaining good organic carbon is essential for preventing soil erosion, conserving moisture, and sustaining cassava and sweet potato production.

b. Why is soil organic carbon important

1. Improves Soil Fertility and Sustainability
   - Influences chemical, physical, and biological properties of soil.
   - Forms the foundation of sustainable agriculture.
2. Enhances Nutrient Supply and Crop Growth
   - Acts as a slow-release source of nutrients.
   - Ensures continuous nutrient availability to crops and supports better crop growth and productivity.
3. Supports Soil Microbial Activity
   - Provides food (energy source) for soil microorganisms.
   - Enhances microbial activity and nutrient cycling.
4. Improves Soil Structure and Stability
   - Microbial activity helps bind soil particles into aggregates ('peds') through bacterial excretions, root exudates, fungal hyphae and plant roots
   - High microbial activity results in better soil structure and reduced soil erosion

5. Improves Water and Air Management in Soil
    - Enhances water infiltration into the soil, water-holding capacity of the soil and soil aeration
    - Helps crops withstand drought and water stress.
6. Helps in Climate Change Mitigation
    - Acts as a carbon sink (if properly managed), storing atmospheric carbon in soil.
    - Reduces greenhouse gas emissions, thereby contributing to climate resilience.
7. Reduces Soil Toxicity and Pollution
    - Binds harmful substances such as heavy metals and pesticides
    - Helps reduce toxicity and improve plant growth conditions.

c. Guidelines to manage soil organic carbon levels

The following guidelines (Table 8) will help farmers understand the status of soil organic carbon in their fields and take appropriate management measures to improve soil fertility and productivity. Soil organic carbon plays an important role in maintaining soil moisture, nutrient availability, soil structure, and beneficial microbial activity. Good organic carbon levels are especially important for cassava and sweet potato cultivation in the sloping soils of Kalvarayan Hills.

Table 8. Guidelines for managing soil organic carbon levels

Soil Organic Carbon Level (%)	Rating	What It Means	Priority Action
< 0.5%	Very Low (Critical)	Soil biology is collapsing; poor water holding; crop stress	Apply 12–15 t/ha FYM + green manure every season
0.5–0.75%	Low	Soil health is declining; crop shows stress in dry spells	Apply 10 t/ha FYM + 2 t/ha vermicompost
0.75–1.0%	Medium	Acceptable; maintain with regular organic additions	Apply 8–10 t/ha FYM; practice green manuring
> 1.0%	High (Good)	Healthy soil; good structure and water retention	Continue organic additions; avoid burning crop residues

Farmers Tip
Most hill soils in Kalvarayan Hills show OC below 0.5% – the critical zone. Raising OC from 0.3% to 0.7% over 3–4 seasons through consistent FYM and green manuring typically increases yield by 20–30%

3.9. Full Action Plan Based on Your Soil Health Card Results

The Soil Health Card helps farmers identify nutrient deficiencies and soil-related problems in their fields. Based on the test results, farmers can take corrective measures to improve crop growth, tuber yield, and soil fertility. The following table (Table 9) provides simple field-level recommendations for cassava and sweet potato. A few important aspects to consider for better soil health management are shown in Figure 6.

Table 9. Action plan based on soil health card results

Parameter	Card Shows	Action for Cassava	Action for Sweet Potato
pH	< 5.5 (acidic)	Apply dolomite 2–4 t/ha before planting	Apply dolomite 2–4 t/ha; ideal pH is 6.0–7.0
pH	5.5–7.0 (ideal)	No lime needed; maintain with FYM	No lime needed; maintain with organic matter
Organic Carbon	Low (< 0.5%)	Apply 12.5 t/ha FYM + Daincha green manure	Apply 5–7 t/ha FYM + green manure before planting
Nitrogen (N)	Deficient	Apply 100 kg N/ha in 2 split doses	Apply 50 kg N/ha; half at planting, half at 30 DAP
Phosphorus (P)	Low	Apply SSP (375 kg/ha) or DAP; use PSB biofertiliser	Apply SSP (190 kg/ha); use PSB biofertiliser
Potassium (K)	Adequate/High	Reduce MOP; apply wood ash as a potassium source	Reduce MOP; apply wood ash
Sulphur (S)	Deficient	Apply SSP (contains S) or gypsum (200 kg/ha)	Apply gypsum 100–150 kg/ha at planting
Zinc (Zn)	Deficient	Apply $ZnSO_4$ 12.5 kg/ha; spray 0.1% $ZnSO_4$*	Apply $ZnSO_4$ 20 kg/ha; spray 0.1% $ZnSO_4$
Boron (B)	Deficient	Apply Borax 10 kg/ha; spray 0.1–0.5% Borax*	Apply Borax 10 kg/ha
Magnesium (Mg)	Deficient	Apply $MgSO_4$ 20–30 kg/ha; spray 0.5% $MgSO_4$*	Apply $MgSO_4$ 80 kg/ha at planting

*0.1% - Mixing one gram in one litre; 0.5% - Mixing 5 g in one liter

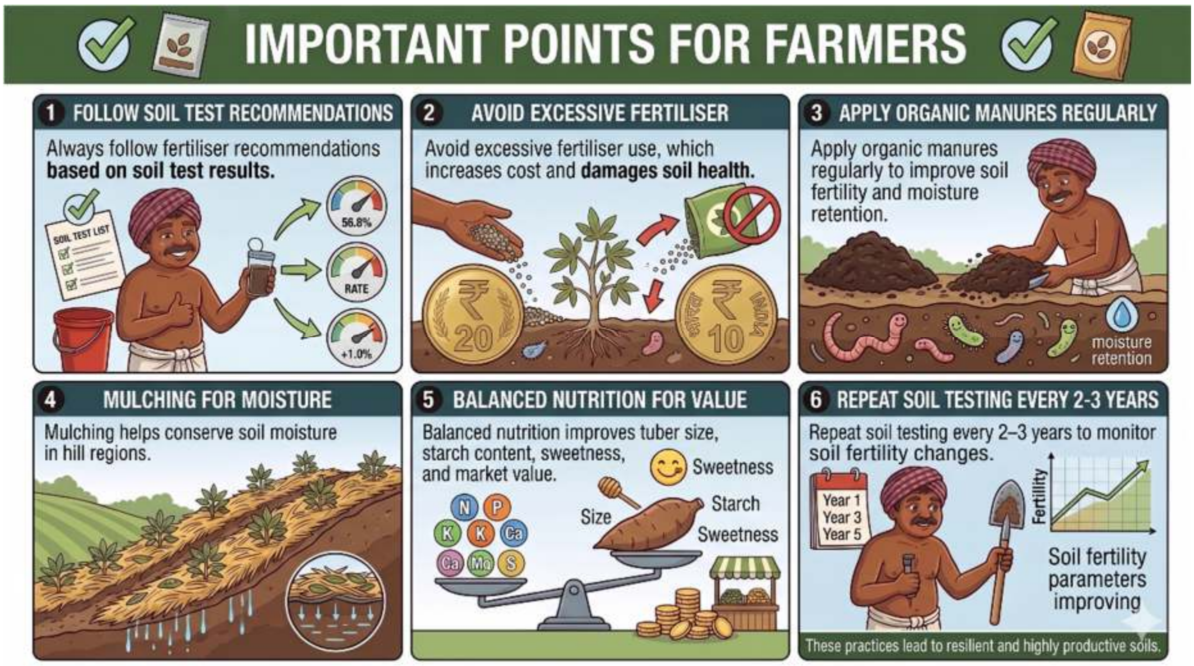


Fig 6. A few important aspects to be considered for better soil health management

3.10 Common Mistakes Farmers Make with Soil Health Cards

Mistake	Why It Is a Problem	What to Do Instead
Collecting soil from only one spot	Does not represent the whole field	Collect from 8–10 spots in a W or Z pattern
Not labelling the sample bag	Lab cannot link results to your field	Always write name, village, field number, and crop
Ignoring the SHC after receiving it	Misses cost-saving and yield-improving guidance	Read the card with your AEO; follow the recommendations
Using a neighbour's SHC for your field	Soils vary from field to field	Always get your own card for each field
Applying more than the recommended dose or application of complex fertilizers during top dressing, where straight fertilizers are recommended	Wastes money; may damage soil and crops	Follow the SHC dosage exactly; more is not better
Getting SHC tested only once every many years	Soil changes every season with cropping	Retest every 2–3 years or after any major change

Farmers Tip
Every Rs 100 spent on soil testing through the Soil Health Card can save Rs 500–1,000 in unnecessary fertiliser costs and increase income by Rs 2,000–5,000 per acre.

3.11 Soil Health Card and Organic / Low-Input Farming

For farmers practising organic or low-input farming in Kalvarayan Hills, the Soil Health Card is especially useful, as it helps identify nutrient deficiencies and guides them in using locally available organic resources efficiently. Instead of applying costly chemical fertilisers, farmers can use farmyard manure, compost, crop residues, green manures, ash, biofertilisers, and other locally available materials to improve soil fertility.

Organic and low-input farming practices not only reduce cultivation cost but also improve soil organic matter, microbial activity, moisture retention, and long-term soil health. In hill agriculture systems, regular addition of organic matter is essential for sustaining cassava and sweet potato productivity under rainfed conditions. The organic alternatives are displayed in Table 10.

Table 10. Cheap organic alternatives to reduce nutrient deficiencies

SHC Shows Deficiency In...	Best Organic / Low-Cost Source	Application Rate (per ha)
Nitrogen (N)	Daincha green manure (45 days) + FYM	Daincha seed: 25–30 kg + FYM: 12 t
Phosphorus (P)	Rock phosphate + PSB biofertiliser	Rock phosphate: 250 kg + PSB: 5 kg
Potassium (K)	Wood ash + Neem cake	Wood ash: 1 tonne + Neem

SHC Shows Deficiency In...	Best Organic / Low-Cost Source	Application Rate (per ha)
		cake: 500 kg
Organic Carbon	FYM + vermicompost + crop residue incorporation	FYM 12.5 t + Vermicompost 2 t
Sulphur (S)	Neem cake (naturally contains sulphur)	Neem cake: 500 kg/ha
Zinc (Zn)	$ZnSO_4$ (permitted in organic certification)	12.5 kg/ha soil application
Boron (B)	Borax (permitted in organic)	10 kg/ha soil application
Magnesium (Mg)	Dolomitic limestone or $MgSO_4$	Dolomite: 1–2 t/ha; or $MgSO_4$: 20 kg/ha

CHAPTER 4: Nutrient Management for Cassava

4.1 How Much Cassava Removes from Soil

Cassava is frequently described as a "scavenger crop" because of its ability to survive and produce economically under relatively poor soil conditions. However, this characterisation presents a paradox. Although cassava exhibits remarkable adaptability to marginal environments, the crop is highly extractive and removes substantial quantities of nutrients from the soil during tuber harvest. Consequently, continuous cassava cultivation without adequate nutrient replenishment can accelerate soil nutrient depletion and contribute to long-term land degradation.

The magnitude of nutrient removal associated with cassava production is considerable. On average, the harvest of 1 tonne (1,000 kg) of fresh cassava tubers removes approximately the following quantities of nutrients from the soil system (Table 11).

Table 11. Nutrient removal by cassava for producing one tonne of fresh tubers

Nutrient	Nutrients removed per tonne of tubers	Annual Removal for a hectare (For tuber yield of 30 t ha^{-1})
Nitrogen (N)	6.0 – 6.5 kg	180–200 kg/ha
Phosphorus (P)	0.5–0.7 kg	15–22 kg/ha
Potassium (K)	4.5 – 5.5 kg	140–160 kg/ha

*The figures above are only for the tubers. If you also remove the stems and leaves from the field (rather than mulching them back into the soil), the nutrient depletion can double or even triple.

Farmers Tip
Cassava is a highly potassium-demanding crop. Maintaining adequate potassium levels in the soil is critical for achieving higher tuber yield, better starch content, improved tuber quality, and enhanced resistance to drought stress and diseases. Applying Potassium as straight fertilizer (instead of complex) at later stages of the crop will increase the yield.

4.2 Basic Fertiliser Recommendation

Based on the fertiliser recommendation of Tamil Nadu Agricultural University (TNAU) for rainfed tapioca cultivation in red lateritic upland soils, the following nutrient dose is recommended for cassava cultivation under Kalvarayan Hills conditions (Table 12).

Table 11. Fertiliser recommendation for rainfed cassava in Kalvarayan Hills

Input	Recommended Dose
Farmyard Manure (FYM)	12.5 tonnes per hectare (5 t/acre)
Nitrogen (N)	50 kg/ha
Phosphorus (P)	65 kg/ha
Potassium (K)	125 kg/ha

This recommendation is suitable for:

- Rainfed upland conditions
- Red lateritic and hill soils
- Acidic to neutral soils (pH 5.5–7.0)
- Sloping tribal farming areas
- Cassava cultivated under low- to medium-input production systems

4.3 Fertilizer Application Schedule

The recommended fertilizer dose should be applied in split doses to improve nutrient use efficiency, reduce nutrient loss under sloping hill conditions, and support proper tuber development (Table 12)

Table 12. Schedule of fertilizer application

Stage	Timing	What to Apply
Basal Dose (At Planting)	Day 0	Apply entire Farmyard Manure (12.5 t/ha), full Phosphorus (65 kg P_2O_5/ha), half Nitrogen (25 kg N/ha), and half Potassium (62.5 kg K_2O/ha) in the planting pits/ridges before planting
Top Dressing	45–60 days after planting	Apply remaining Nitrogen (25 kg N/ha) and remaining Potassium (62.5 kg K_2O/ha) along with weeding and earthing up

Farmers Tip
Split application of fertiliser improves yield and reduces nutrient loss through leaching. Never apply all fertiliser in one dose.

4.4 Organic Nutrient Management Package for Cassava

Organic nutrient management plays an important role in improving soil health, maintaining long-term productivity, reducing soil erosion losses in hill ecosystems, and enhancing the sustainability of cassava cultivation in the Kalvarayan Hills. Integrated use of organic manures, biofertilisers, green manures, and locally available nutrient sources helps improve soil organic carbon, microbial activity, moisture retention, nutrient recycling, and tuber quality while reducing dependence on external chemical fertilisers.

The following organic nutrient management package is designed to approximately meet the recommended cassava nutrient dose of N:P_2O5: K2O = 50:65:125 kg/ha through locally available organic and biological nutrient sources suitable for Kalvarayan Hills conditions Table 13 & 14)

Table 13. Organic nutrient requirement for cassava

Organic Input	Per Hectare	Per Acre	Major Contribution
FYM / Compost	12–15 tonnes	5.0 tonnes	Improves soil structure, microbial activity, and moisture retention
Vermicompost	1.5 – 2.0 tonnes	600-800 kg	Supplies readily available nutrients and beneficial microbes
Neem Cake	400 - 500 kg	160 - 200 kg	Provides slow-release nitrogen and suppresses soil pests

Organic Input	Per Hectare	Per Acre	Major Contribution
Wood Ash	1.5 – 2.0 tonne	600 - 800 kg	Major local source of potassium for tuber bulking
Rock Phosphate	300 - 350 kg	120 - 140 kg	Supplies phosphorus slowly in acidic hill soils
Biofertilisers – Azospirillum	3 kg	1.2. kg	Biological nitrogen fixation
Biofertiilisers - PSB (Phosphate Solubilising Bacteria)	2%* or 3 kg	1.2. kg	Enhances phosphorus availability
Cowpea Green Manure Intercrop (between cassava rows/mounds)	20 kg	8 kg	Adds biomass and improves soil fertility

*Add 2g in one litre of water

Cowpea should be sown between cassava rows immediately after planting and incorporated into the soil at 45–60 days after sowing during earthing up operations. This practice improves soil organic matter, nutrient recycling, and biological nitrogen fixation under rainfed hill conditions.

Under Kalvarayan Hills conditions, maintaining adequate potassium supply through wood ash, biomass recycling, and organic manures is particularly important because cassava is a heavy potassium-removing crop.

Table 14. Organic nutrients application schedule – Cassava

Stage	Time	Input & Quantity (per ha)	Method
Basal (Land Preparation)	Before planting	FYM/Compost (12.5 t) + Rock Phosphate (300–350 kg) + Neem Cake (250 kg)	Mix thoroughly into ridges/mounds during final land preparation
Planting Time	Day 0	Azospirillum (3 kg) + PSB (3 kg)	Sett dipping or soil application mixed with compost
Green Manure Intercrop	Immediately after planting	Cowpea seed (20 kg)	Sow between cassava rows/mounds
1st Top Dressing	30–45 DAP	Vermicompost (750 kg–1 t) + Wood Ash (750 kg–1 t) + Neem Cake (100–125 kg)	Apply near root zone followed by weeding and earthing up

Stage	Time	Input & Quantity (per ha)	Method
Green Manure Incorporation	45–60 DAP	Incorporate cowpea biomass into the soil	Incorporate during earthing up to improve soil fertility
2nd Top Dressing	60–75 DAP	Vermicompost (750 kg–1 t) + Wood Ash (750 kg–1 t) + Neem Cake (100–125 kg)	Apply around plants, followed by light earthing up
Foliar Spray	45 & 75 DAP	Panchagavya (3%) or Jeevamrutham	Uniform foliar spray during morning/ evening hours

4.6 Nutrient-Efficient Variety Recommendation

Cultivation of nutrient-efficient cassava varieties is an important strategy for reducing fertiliser requirements, improving nutrient use efficiency, and enhancing the sustainability of cassava cultivation in low-input hill farming systems such as the Kalvarayan Hills. Some improved varieties developed by the ICAR–Central Tuber Crops Research Institute (ICAR–CTCRI) can produce satisfactory yields even under reduced fertiliser application. The salient features of these varieties are given in Table 15 as well as in

Table 15. Salient features of nutrient-efficient cassava varieties released by ICAR-CTCRI

Variety	Nutrient Efficiency Characteristic	Special Features
Sree Pavithra	Requires only about 50% of the recommended potassium dose	Suitable for low-input farming systems; good tuber yield with moderate starch content
Sree Annam	Performs well with about 25% reduction in the recommended NPK dose	Excellent cooking quality; suitable for household consumption; moderate starch
Sree Manna	Performs well with reduced fertilizer input (about 25% lower NPK requirement)	Good culinary quality; adaptable to low-input conditions
Sree Reksha	Suitable for organic and low-external-input farming systems	Tolerant to cassava mosaic disease; stable performance under hill conditions
Sree Vijaya	Performs relatively well under organic nutrient management systems	Good processing and cooking quality; suitable for chips and value-added products

Fig 6. Nutrient-efficient cassava varieties

4.7. Use of Biofertilisers for Cassava

Biofertilisers are beneficial microorganisms that improve nutrient availability, nutrient uptake efficiency, root growth, and soil biological activity in the cassava production system. Under rainfed hill conditions, such as in the Kalvarayan Hills, the integrated use of biofertilisers with organic manures can substantially reduce dependence on chemical fertilisers, lower cultivation costs, and improve long-term soil health and sustainability.

Cassava responds particularly well to microbial inoculants because of its extensive root system and high nutrient demand, especially for nitrogen, phosphorus, and potassium. Research studies have shown that the appropriate use of biofertilisers can help save approximately 25–50% of the chemical fertiliser requirement in low- to medium-input farming systems. The recommended biofertilisers for cassava are given in Table 16.

Table 16. Recommended Biofertilisers for Cassava

Biofertiliser	Microorganism	Primary Benefit
Nitrogen Fixer	*Azospirillum lipoferum*	Atmospheric nitrogen (N_2) fixation and improved root growth
Phosphorus Solubiliser (PSB)	*Bacillus megaterium* var. *phosphaticum*	Solubilises unavailable phosphorus and improves phosphorus uptake
Potassium Solubiliser (KSB)	*Frateuria aurantia* / specific *Bacillus* strains	Releases potassium from soil minerals and improves potassium availability
Potassium Mobilizer	*Bacillus cereus*	Enhances potassium availability and may reduce MOP requirement by about 25%
Vesicular-arbuscular Mycorrhiza (VAM)	*Glomus* species	Improves phosphorus uptake, root absorption area, and drought tolerance

Functional Importance of biofertilizers for cassava

Azospirillum

Azospirillum is a free-living or associative nitrogen-fixing bacterium that colonises cassava roots and helps fix atmospheric nitrogen. Its application can partially reduce chemical nitrogen fertiliser requirement while promoting better root development and nutrient uptake.

Phosphate Solubilising Bacteria (PSB)

Cassava requires adequate phosphorus during early root establishment and tuber initiation stages. PSB converts insoluble soil phosphorus into plant-available phosphate forms, thereby improving phosphorus use efficiency in acidic hill soils.

Potassium Solubilising Bacteria (KSB)

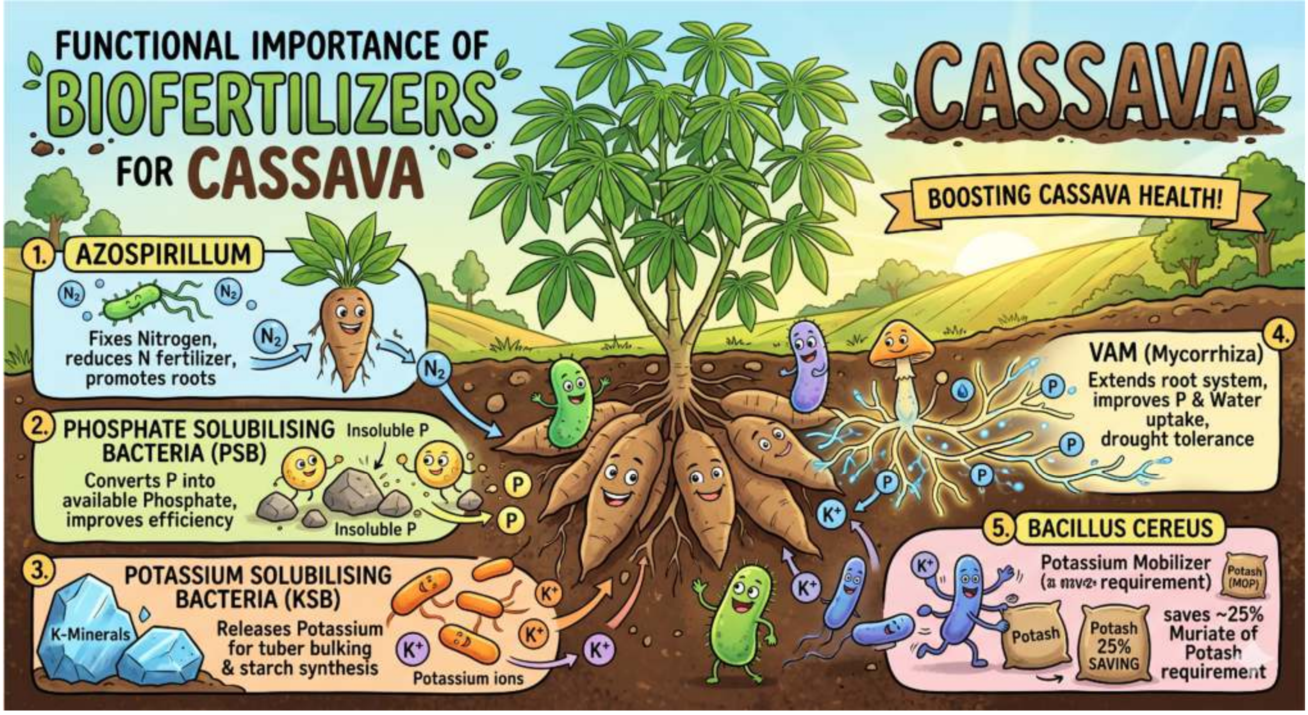
Cassava is considered a “potash-loving” crop because potassium is essential for starch synthesis, translocation of carbohydrates, and tuber bulking. KSB helps weather potassium-bearing soil minerals, releasing potassium into the soil solution for plant uptake.

Bacillus cereus

Certain strains of *Bacillus cereus* function as potassium mobilizers and may help save approximately 25% of the muriate of potash (MOP) requirement under suitable soil conditions.

VAM (Vesicular Arbuscular Mycorrhiza)

VAM is often considered one of the most important bio-inoculants for cassava cultivation under poor upland soils because the fungal hyphae extend the effective root system and greatly improve phosphorus absorption, moisture uptake, and drought tolerance.



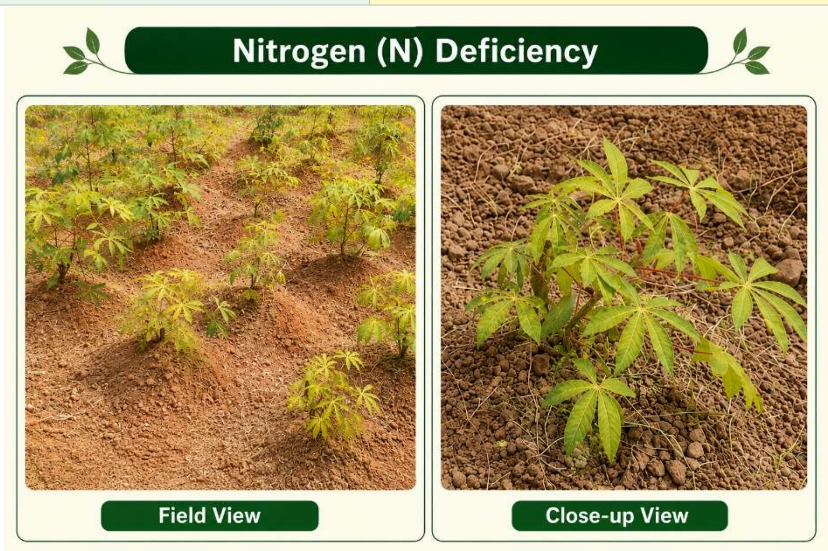
FUNCTIONAL IMPORTANCE OF
BIOFERTILIZERS
FOR CASSAVA
CASSAVA
BOOSTING CASSAVA HEALTH!
1. AZOSPIRILLUM
Fixes Nitrogen, reduces N fertilizer, promotes roots
N_2
2. PHOSPHATE SOLUBILISING BACTERIA (PSB)
Insoluble P
Converts P into available Phosphate, improves efficiency
Insoluble P
P
3. POTASSIUM SOLUBILISING BACTERIA (KSB)
K-Minerals
Releases Potassium for tuber bulking & starch synthesis
K^+
Potassium ions
4. VAM (Mycorrhiza)
Extends root system, improves P & Water uptake, drought tolerance
5. BACILLUS CEREUS
Potassium Mobilizer
requirement)
Potash (MOP)
Potash
Potash 25% SAVING
saves ~25% Muriate of Potash requirement

CHAPTER 5: Nutritional Disorders in Cassava

5.1. Micronutrient deficiencies of cassava

a. Nitrogen (N) Deficiency

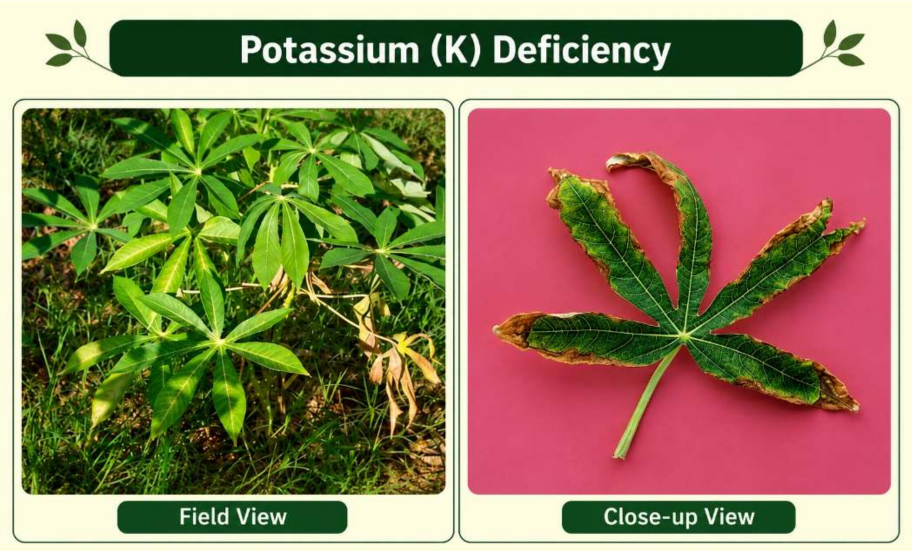
Symptoms	Management Measures
• General stunted growth and yellowing of mostly the lower leaves • In severe cases: necrosis and drying of older leaves, and eventually the whole plant	• Apply organic manures and NPK fertilizers as per recommended POP (NPK @ 100:50:100 kg/ha + FYM @ 12.5 t/ha) • If severe yellowing occurs and soil has no moisture, apply foliar spray of 0.1% urea to save the crop



Farmers Tip
Nitrogen is mobile — yellowing starts from older lower leaves and moves upward.

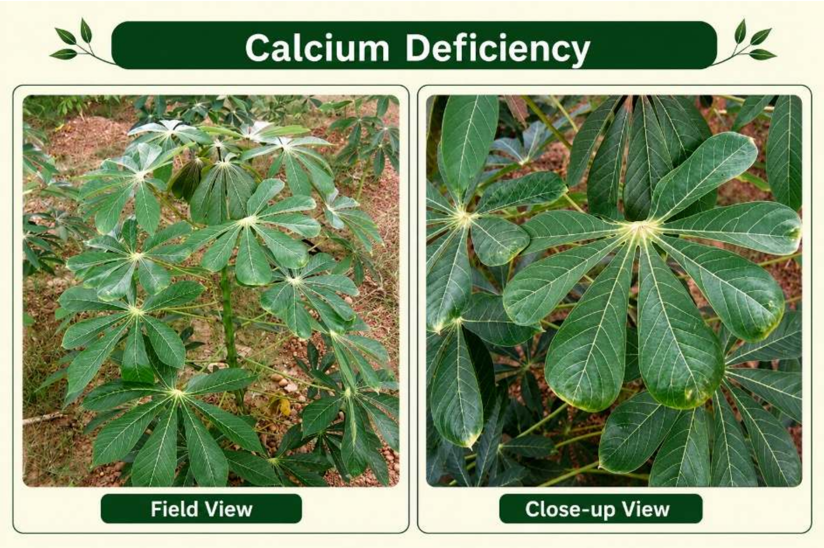
b. Potassium (K) Deficiency

Symptoms	Management Measures
• Drying of margins and tips of old lower leaves • In severe cases: complete drying of lower leaves, low vigour, and retarded growth	• Apply organic manures and NPK fertilizers as per recommended POP • At symptom initiation: apply MOP in soil if moisture is available • In later symptom stages: foliar spray of Sulphate of Potash (SOP) @ 0.5–1%



c. Calcium (Ca) Deficiency

Symptoms	Management Measures
• Symptoms appear only on younger/upper leaves (Ca is immobile in plants) • Leaf tips from middle to top turn round; slight curling of leaflets depending on variety	• Apply lime or dolomite in acid soils @ 1–2 t/ha to prevent symptoms • If symptoms appear: foliar spray of calcium nitrate ($CaNO_3$) @ 0.5–1% to save new emerging leaves



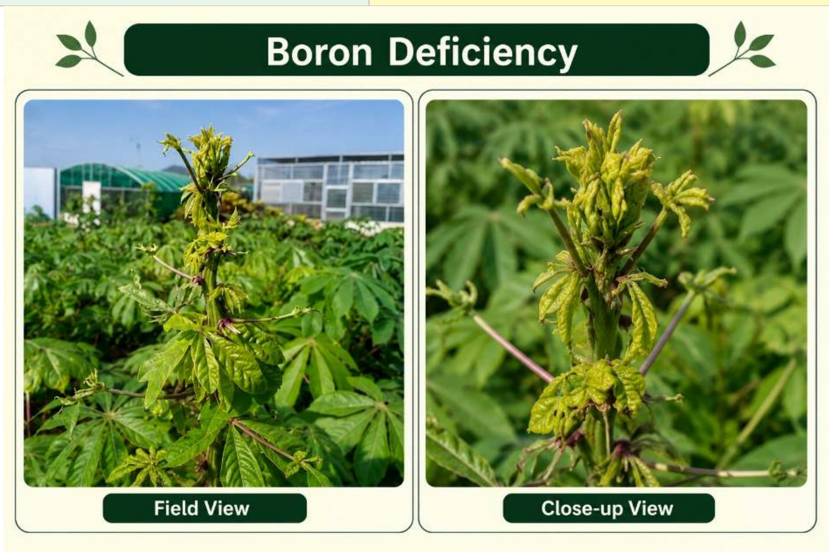
Farmers Tip
Calcium deficiency shows on young top leaves —due to the non-mobility of Ca in the plant system.

d. Magnesium (Mg) Deficiency

Symptoms	Management Measures
• Interveinal chlorosis of lower older leaves (yellowing between veins, veins stay dark green) • In severe cases: margins and tips of leaves turn necrotic and dry	• Basal soil application of dolomite @ 1–2 t/ha OR magnesium sulphate ($MgSO_4$) @ 20 kg/ha after top dressing • Severe cases: foliar spray of $MgSO_4$ @ 0.5–1% (check sensitivity of crop to sulphate injury)

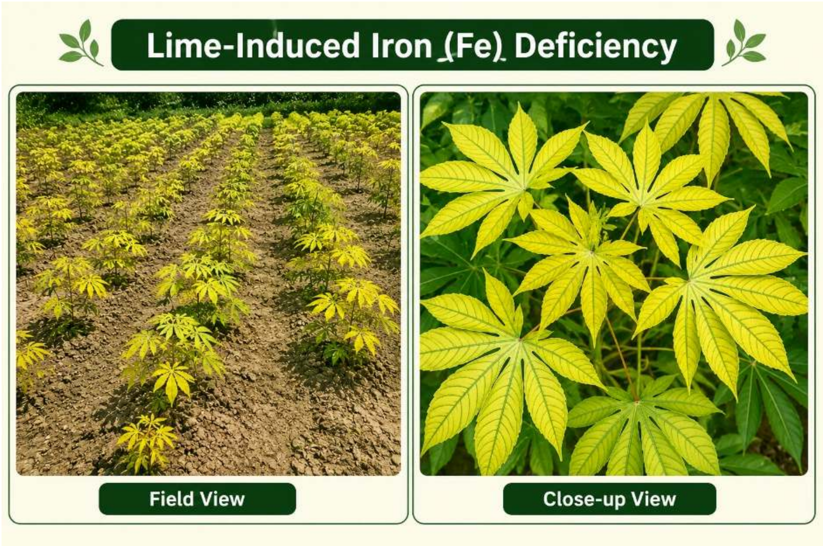
e. Boron (B) Deficiency

Symptoms	Management Measures
• Boron is immobile — symptoms appear on the growing tip • Rosette look with small sprouts in clusters or bunches • Reduced, crinkled, or distorted leaves affecting normal growth	• Soil application of borax or boric acid based on soil test (general: borax @ 10 kg/ha) • After symptoms appear: foliar spray of $CaNO_3$ (0.5%) + Solubor (0.05–0.1%) combined, at fortnightly intervals until plant recovers



f. Lime-Induced Iron (Fe) Deficiency

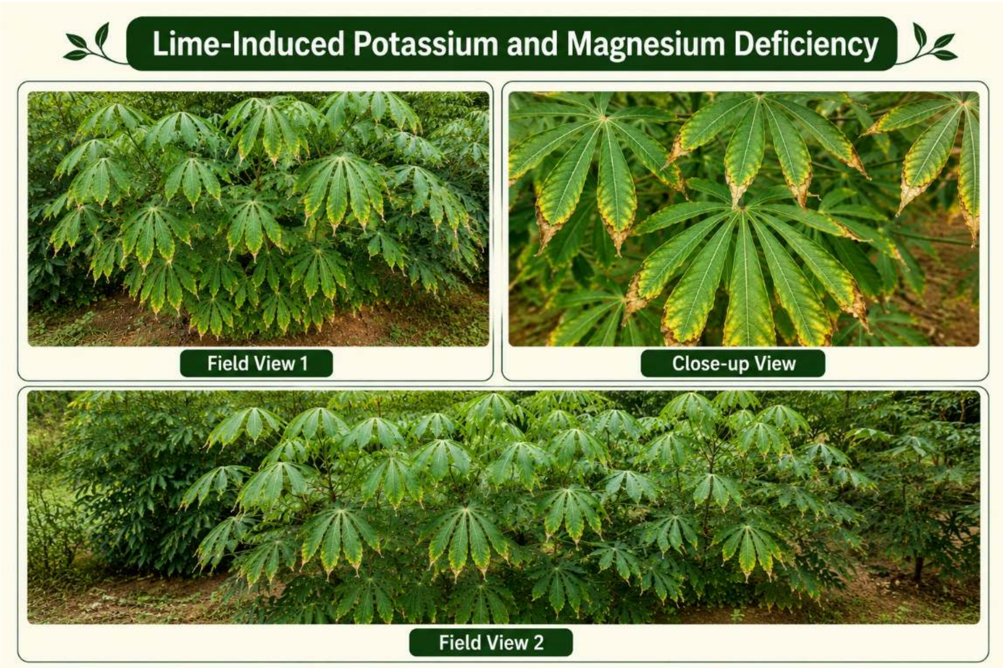
Symptoms	Management Measures
• Occurs in alkaline soils with pH above 8 — excess lime blocks iron uptake • Uniform yellowing (chlorosis) of entire plant leaves with stunted growth • Severe cases lead to complete crop devastation	• Spray 1% Ferrous sulphate ($FeSO_4$) + 1% Zinc sulphate ($ZnSO_4$) mixture upon visual symptoms • Apply elemental sulphur (S) @ 10–20 kg/ha or gypsum, or use sulphur-containing fertilizers (ammonium sulphate, single superphosphate, potassium sulphate) as basal dressing



Farmers Tip
Alkaline soils (pH > 8) lock up iron and zinc. Lowering soil pH with sulphur is a long-term remedy.

g. Lime-Induced Potassium and Magnesium Deficiency

Symptoms	Management Measures
• Common in alkaline soils of high pH • High calcium in alkaline soil blocks K and Mg uptake (antagonism) • K deficiency: marginal and tip drying of lower leaves, slight chlorosis; plant may dry and die in severe cases • Mg deficiency: interveinal chlorosis of lower leaves	• Manage soil alkalinity with S @ 10–20 kg/ha (elemental sulphur, gypsum, or sulphur-containing fertilisers) • Soil application of MOP at the recommended dose (usually 100 kg/ha) • Severe K deficiency: foliar spray of SOP @ 0.5–1% • Mg deficiency: soil application of $MgSO_4$ @ 20 kg/ha; if symptoms appear, foliar spray of 0.5–1% $MgSO_4$

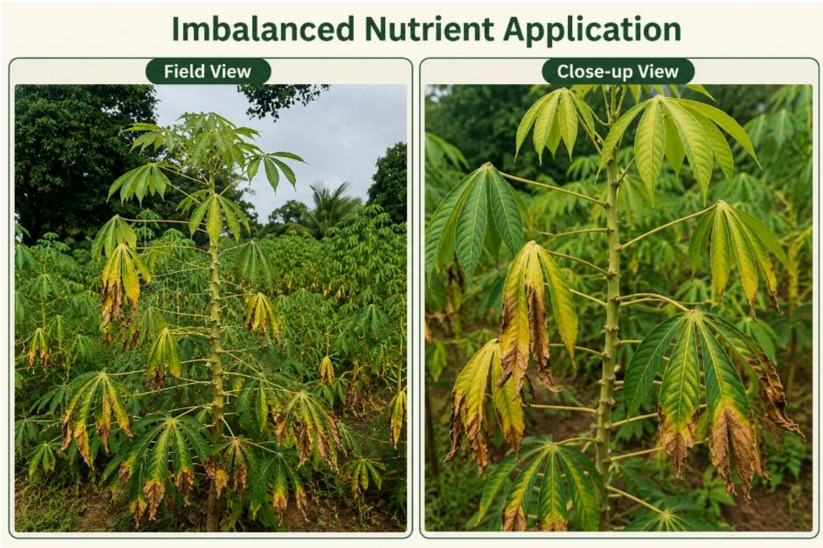


h. Zinc (Zn) Deficiency

Symptoms	Management Measures
• Usually in alkaline soils of high pH • Interveinal chlorosis of middle to upper leaves • Leaflets droop; petiole becomes horizontal with widening angle between petiole and main stem	• Basal soil application of $ZnSO_4$ @ 12.5 kg/ha to prevent occurrence • Foliar spray of $ZnSO_4$ @ 0.5–1% if symptoms appear, to prevent further expression

i. Imbalanced Nutrient Application

Symptoms	Management Measures
• Applying high N and P without adequate K leads to similar symptoms as K deficiency • Shedding of healthy leaves in the middle of the plant; petioles bending and drooping • Severe cases: upper middle leaves turn yellow, dry, and fall	• Apply balanced NPK as per PoP or soil test data • Soil application of MoP at initial stages of symptom manifestation • Foliar spray of SoP @ 0.5–1% to protect newly emerging leaves



5.2. Micronol – Tapioca Micronutrient Formulation for Tamil Nadu

a. What is Micronol

ICAR–Central Tuber Crops Research Institute (ICAR–CTCRI) has developed a crop-specific foliar micronutrient formulation for cassava cultivation in Tamil Nadu, marketed under the trade name Micronol–Tapioca (Fig 7). The formulation was specifically developed to correct hidden micronutrient deficiencies commonly observed in tapioca-growing red lateritic and upland soils in Tamil Nadu. The composition of Micronol Tapioca formulation is given in Table 16.

Fig 7. Micronol – Tapioca Micronutrient Formulation for Tamil Nadu

Table 16. Composition of Micronol Tapioca formulation

Micronutrient	Composition
Zinc (Zn)	1.5%
Copper (Cu)	0.3%
Boron (B)	0.15%
Iron (Fe)	0.75%
Manganese (Mn)	0.4%

b. Spray Schedule

The Micronol can be used as foliar spray at 0.5% concentration (5g in one litre of water). While the first spray is recommended 45-60 days after planting, the second spray at 75-90 days after planting.

c. Benefits of Micronol–Tapioca

- Corrects hidden micronutrient deficiencies
- Improves leaf chlorophyll content
- Enhances tuber bulking and starch accumulation
- Improves nutrient use efficiency
- Enhances drought tolerance and disease resistance
- Improves tuber quality under upland rainfed conditions

The Micronol–Tapioca is particularly useful under Kalvarayan Hills conditions because:

- soils are often low in micronutrient reserves,
- continuous cassava cultivation depletes nutrients,
- hill slopes are prone to nutrient erosion,
- and low organic matter reduces micronutrient availability.

Therefore, foliar micronutrient supplementation improves crop performance in low-input tribal farming systems.

CHAPTER 6: Nutrient Management for Sweet Potato

6.1 Yield Gap in Sweet Potato and Why It Exists

Sweet potato possesses very high biological yield potential under proper nutrient, moisture, and crop management conditions. However, a large yield gap exists between potential productivity and actual farmer-level productivity in many tribal and rainfed farming systems such as Kalvarayan Hills. The major reasons include poor soil fertility, low organic matter content, inadequate nutrient application, moisture stress, use of local low-yielding varieties, and limited adoption of scientific crop management practices.

Table 17. Yield gap in sweet potato

Particulars	Yield ($t.ha^{-1}$)	Main Reason
Potential yield	80–100	Achieved under improved varieties, balanced nutrition, irrigation, and scientific crop management
World – Average tuber yield (Range)	13-15	Moderate input use and partial adoption of improved practices
India – Average tuber yield (Range)	9-11	Mostly rainfed cultivation with moderate input use
Kalvarayan Hills - Average tuber yield (Range)	5 - 10	Low soil fertility, poor organic matter, soil acidity, nutrient deficiency, and low external input use

Farmers Tip
The large yield gap is mainly due to poor soil fertility especially soil acidity and improper nutrient management. Correcting these can multiply income 2–3 times.

6.2 Nutrient Removal by Sweet Potato

Sweet potato is a nutrient-exhaustive root crop and removes considerable quantities of nutrients from the soil during tuber harvest. Continuous cultivation without nutrient replenishment can rapidly deplete soil fertility, particularly potassium, which is critical for tuber bulking, carbohydrate synthesis, and storage root quality.

Table 18. Nutrient Removal by Sweet Potato

Nutrient	Nutrient removed per tonne of tuber ($kg.t^{-1}$)	Priority
Nitrogen (N)	6.15	High
Phosphorus (P)	0.78	Medium
Potassium (K)	8.75	Highest

(Source: Susan John et al, 2023)

Under Kalvarayan Hills conditions, continuous removal of tubers without adequate recycling of crop residues, organic manures, wood ash, and potassium sources can lead to progressive soil nutrient depletion and declining productivity over time.

6.3 Basic Fertilizer Recommendation

Based on recommendations for sweet potato cultivation under rainfed and upland production systems, the following fertiliser schedule is recommended for the Kalvarayan Hills. The recommendation emphasises the importance of adding organic matter and maintaining balanced potassium nutrition to improve tuber yield, quality, and soil health.

Table 19. Recommended dose of fertilisers for rainfed sweet potato

Input	Recommended Dose	Importance
Farmyard Manure (FYM)	25 $t.ha^{-1}$	Improves soil organic carbon, moisture retention, soil structure, and microbial activity
Nitrogen (N)	40 $kg.\ ha^{-1}$	Promotes vine growth, canopy development, and early crop establishment
Phosphorus (P)	80 $kg.\ ha^{-1}$	Essential for root initiation, tuber formation, and early root growth
Potassium (K)	120 $kg.\ ha^{-1}$	Critical for tuber bulking, starch synthesis, tuber quality, and drought tolerance

*Note: (i) If Azospirillum @ 20 kg/ha is applied, use only 2/3rd dose of nitrogen. In such cases, total nitrogen may be reduced from 40 kg N/ha to about 27 kg N/ha; (ii) It is preferable to apply nitrogen and phosphorus in the form of DAP (Diammonium Phosphate) wherever available.

Sweet potato is a potassium-demanding tuber crop. Under Kalvarayan Hills conditions, continuous cultivation without adequate potassium replenishment can lead to declining tuber size, poor storage root development, and reduced yield over time. Therefore, balanced application of organic manures and potassium sources is essential for sustainable sweet potato production.

6.4 Fertiliser Application Schedule – Sweet Potato

Proper timing and split application of fertilisers are essential for improving nutrient use efficiency, tuber development, and yield in sweet potato cultivation. Under Kalvarayan Hills conditions, split application helps reduce nutrient losses from sloping upland soils and ensures continuous nutrient availability during critical growth stages. The fertilizer schedule is given in Table 20.

Table 20. Fertiliser application schedule of sweet potato

Stage	Timing	What to Apply	Importance
Basal application	Day 0	Farmyard manure - Full	Incorporate thoroughly into soil during final land preparation
Basal application	Day 0	$N:P_2O_5:K_2O$: 20:40:60 $kg.ha^{-1}$	Apply in ridges before planting vine cuttings
Biofertiliser treatment	Before planting	Azospirillum 20 $kg.ha^{-1}$	Apply to soil or use for vine dipping before planting
Top dressing	30 days after planting (with first wedding & earthing up)	$N:P_2O_5:K_2O$: 20:40:60 $kg.ha^{-1}$	Apply near root zone followed by light earthing up

Farmers Tip
Do NOT apply nitrogen late in the season. Late nitrogen encourages vine growth and reduces tuber formation.

6.5 Managing Acidic Soils for Sweet Potato

Sweet potato performs best in slightly acidic to neutral soils with good drainage and adequate organic matter. The ideal soil pH for sweet potato cultivation is 6.0 – 7.0. Under Kalvarayan Hills conditions, many upland and lateritic soils tend to become acidic due to heavy rainfall, erosion, continuous cropping, and nutrient leaching. Strongly acidic soils can reduce nutrient availability, restrict root growth, and lower tuber yield and quality.

Application of agricultural lime or dolomite during land preparation helps to

- Neutralize soil acidity,
- Improve nutrient availability,
- Enhance microbial activity,
- Reduce aluminium toxicity,
- Improve sweet potato root and tuber development.

The lime requirement based on soil pH is given in Table 21.

Table 21. Lime Requirement based on Soil pH

Soil pH	Lime Required (per ha)
3.5	8 tonnes/ha
4.5	6 tonnes/ha
5.5	4 tonnes/ha
6.5	2 tonnes/ha

Important Field Recommendations

- Apply lime or dolomite at least 2–4 weeks before planting.
- Mix thoroughly into the soil during land preparation.
- Apply along with organic manures for better effectiveness.
- Dolomite is preferable where magnesium deficiency is also suspected.

6.6 Organic Farming Package for Sweet Potato

Organic nutrient management helps improve soil organic carbon, moisture retention, microbial activity, nutrient recycling, and long-term soil fertility in sweet potato cultivation. Under Kalvarayan Hills conditions, integrated use of organic manures, biofertilisers, wood ash, and biological nutrient sources can substantially reduce dependence on chemical fertilisers while sustaining tuber yield and quality.

The following organic nutrient management package is designed to approximately meet the recommended sweet potato nutrient dose of $N: P_2O_5: K_2O = 40: 80: 120\ kg/ha$ through organic and biological nutrient sources (Table 22).

Table 22. Organic inputs for sweet potato

Organic Input	Per Hectare	Per Acre	Major Contribution
FYM / Compost	5–7 t	2.0–2.8 t	Improves soil structure, organic carbon, and moisture retention
Vermicompost	1–1.5 t	400–600 kg	Supplies readily available nutrients and beneficial microbes
Neem Cake	250 kg	100 kg	Provides slow-release nitrogen and suppresses soil pests
Wood Ash	500 kg	200 kg	An important organic source of potassium for tuber bulking
Rock Phosphate	125 kg	50 kg	Supplies phosphorus gradually in acidic soils
Biofertilisers (Azospirillum + PSB)	10 kg	4 kg	Improves nitrogen fixation and phosphorus availability

Under sweet potato cultivation, adequate potassium nutrition is particularly important because potassium plays a major role in carbohydrate synthesis, storage root development, and tuber quality. The organic input application schedule is given in Table 23.

Split application of organic nutrient sources helps improve nutrient availability during critical crop growth stages and reduces nutrient losses under rainfed upland conditions. Integration of organic manures, biofertilisers, and foliar organic formulations also improves soil biological activity and crop resilience.

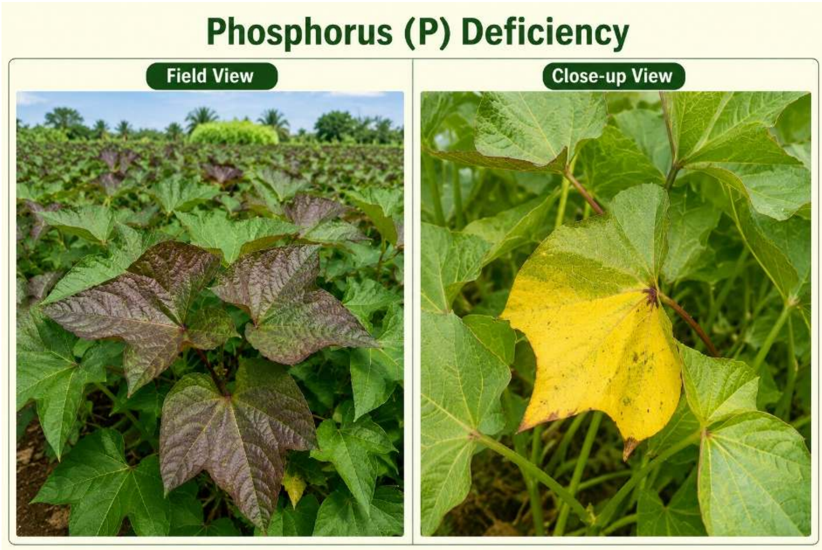
Table 23. Organic Input Application Schedule – Sweet Potato

Stage	Time	Input & Quantity (per ha)	Method
Basal (Ridge Formation)	Before planting	FYM (5–7 t) + Rock Phosphate (125 kg) + Neem Cake (125 kg)	Incorporate thoroughly into ridges during land preparation
Planting Time	Day 0	Biofertilisers – Azospirillum + PSB (10 kg)	Vine dipping or soil application mixed with compost
1st Top Dressing	25–30 DAP	Vermicompost (0.75 t) + Wood Ash (250 kg) + Neem Cake (60 kg)	Apply along ridges followed by light earthing up
2nd Top Dressing	45–50 DAP	Vermicompost (0.75 t) + Wood Ash (250 kg) + Neem Cake (65 kg)	Apply along ridges and lightly incorporate into soil
Foliar Spray	30 & 45 DAP	Panchagavya 3%	Uniform foliar spray during morning/ evening hours

CHAPTER 7: Nutritional Disorders in Sweet Potato

a. Phosphorus (P) Deficiency

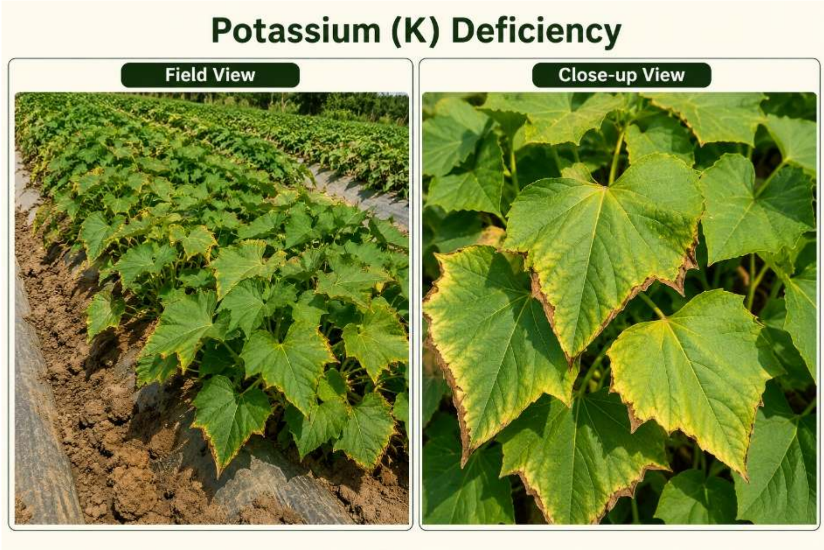
Symptoms	Management Measures
• Purplish discolouration of older leaves • Discoloured leaves turn yellowish, then dry and shed	• Apply recommended dose of P (usually 25 kg P/ha) or as per soil test — apply basally even in high-P soils • Severe cases: foliar spray of NPK @ 19:19:19 @ 0.5–1%



Farmers Tip
Purple colouration in older leaves is a classic early warning of phosphorus shortage.

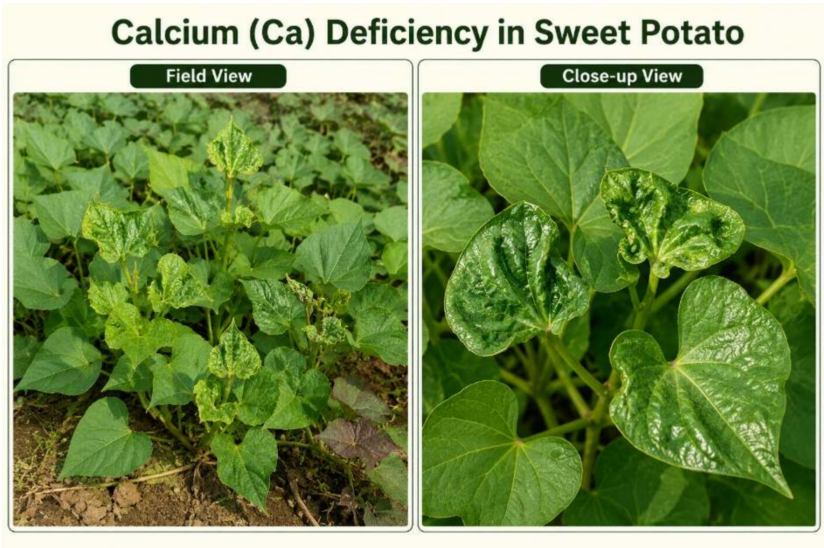
b. Potassium (K) Deficiency

Symptoms	Management Measures
• Marginal inward curling and drying of older leaves • Leaves turn yellow, then die completely — plant death in severe cases	• Apply K as per PoP (K @ 50 kg/ha) or soil test data in two splits; increase rate by 25–50% in very deficient soils • Foliar spray of SoP @ 0.5–1% at fortnightly intervals until symptoms disappear



c. Calcium (Ca) Deficiency

Symptoms	Management Measures
• Cupping, crinkling, and curling of young leaves • Affected leaves turn yellow, dry, and shed	• Apply liming materials (lime or dolomite) @ 2 t/ha • After symptom occurrence: foliar spray with 0.5% $CaNO_3$ at fortnightly intervals until new symptom-free leaves appear



d. Boron (B) Deficiency

Symptoms	Management Measures
• Leathery appearance of young leaves • Rosette appearance at the growing tip of vines • Black dots on tuber surface	• Soil application of borax or other borates before planting: @ 1–1.5 kg/ha (sandy soils) or up to 4 kg/ha (clayey, alkaline soils) • Regular soil testing and continuous B

(unmarketable) • Tuber flesh mottled or corky/woody inside • Short, blunt-ended, and deformed tubers with rough, wrinkled skin • Tubers split with cankers and deformities	application if found deficient • After symptoms appear: foliar spray of $CaNO_3$ (0.5%) + Solubor (0.05–0.1%) combined, at fortnightly intervals until plant recovers

B. Micronol – Sweet Potato Micronutrient Formulation

a. What is Micronol

ICAR–Central Tuber Crops Research Institute (ICAR–CTCRI) has developed a crop-specific foliar micronutrient formulation for sweet potato cultivation, marketed under the trade name Micronol–Sweet Potato (Fig 8). The formulation was developed to correct hidden micronutrient deficiencies commonly observed in sweet potato-growing upland, lateritic, and low-organic-matter soils under rainfed conditions.

Micronol–Sweet Potato is particularly useful for improving nutrient uptake efficiency, vine vigour, tuber initiation, and storage root development in nutrient-stressed environments such as the Kalvarayan Hills. The composition of Micronol–Sweet Potato formulation is given in Table 17.

Fig. 8. Micronol – Sweet Potato Micronutrient Formulation

Table 24. Composition of Micronol–Sweet Potato Formulation

Micronutrient	Composition
Zinc (Zn)	1.5%
Copper (Cu)	0.3%
Boron (B)	0.15%
Iron (Fe)	0.75%
Manganese (Mn)	0.4%

b. Spray Schedule

The Micronol–Sweet Potato can be used as foliar spray at 0.5% concentration (5 g in one litre of water). While the first spray is recommended 20–25 days after planting, the second spray is recommended at 40–45 days after planting. Foliar spraying should preferably be carried out during morning or evening hours for better absorption efficiency.

c. Benefits of Micronol–Sweet Potato

- Corrects hidden micronutrient deficiencies
- Improves vine growth and leaf chlorophyll content
- Enhances tuber initiation and storage root development
- Improves nutrient use efficiency
- Enhances drought tolerance under rainfed conditions
- Improves tuber size, colour, and quality
- Enhances yield performance in nutrient-deficient upland soils

Micronol–Sweet Potato is particularly useful under Kalvarayan Hills conditions because:

- soils are often low in micronutrient reserves,
- hill slopes are prone to nutrient erosion,
- low organic matter reduces micronutrient availability,
- and continuous cultivation gradually depletes micronutrients from the soil system.
- Therefore, foliar micronutrient supplementation can significantly improve sweet potato productivity and crop resilience under low-input tribal farming systems.

Farmers Tip
Boron deficiency severely affects tuber quality and marketability — early prevention through soil testing is essential.

CHAPTER 8: Green Manuring – Your Natural Fertiliser Factory

8.1 What is Green Manuring?

Green manuring involves growing certain fast-growing crops for 45–50 days, then ploughing their entire green biomass into the soil before planting cassava or sweet potato. The decomposing biomass releases nutrients naturally, improves soil structure, and builds organic matter.

Green manuring is the single most powerful low-cost practice for farmers in Kalvarayan Hills, especially as a contingency plan against chemical fertiliser shortages.

Farmers Tip
One crop of Daincha (45 days) adds up to 120 kg of Nitrogen – equivalent to 260 kg of Urea

8.2 Recommended Green Manure Crops for Kalvarayan Hills

Green manure crops are highly suitable for Kalvarayan Hills because the upland tribal farming systems are often characterised by low soil organic carbon, declining soil fertility, nutrient erosion from hill slopes, and limited use of external fertiliser inputs. Incorporation of green manure biomass helps improve soil organic matter, conserve moisture, reduce runoff losses, enhance microbial activity, and partially supplement nutrient requirements in cassava- and sweet potato-based farming systems.

Under Kalvarayan Hills conditions, short-duration drought-tolerant legumes such as cowpea, sunhemp, daincha, and pillipesara (Fig 9) are particularly suitable because they establish quickly under rainfed conditions and produce substantial biomass within a short period (Table 25) and low cost (Table 26).

Table 25: Recommended Green Manure Crops for Kalvarayan Hills

Crop	Suitability in Kalvarayan Hills	Biomass Added (t/ha)	Nitrogen Added (kg/ha)	Phosphorus Added (kg/ha)	Potassium Added (kg/ha)	Seed Rate (kg/ha)	Seed Rate (kg/ac)
Daincha (*Sesbania aculeata*)	Suitable in valley areas and moisture-retaining soils	15–20	90–120	30–40	75–100	25–30	10–12
Sunhemp (*Crotalaria juncea*)	Suitable under upland rainfed hill conditions	10–15	70–100	20–30	50–75	25–30	10–12

Crop	Suitability in Kalvarayan Hills	Biomass Added (t/ha)	Nitrogen Added (kg/ha)	Phosphorus Added (kg/ha)	Potassium Added (kg/ha)	Seed Rate (kg/ha)	Seed Rate (kg/ac)
Cowpea (*Vigna unguiculata*)	Highly suitable for cassava intercropping and tribal mixed farming systems	8–12	40–60	15–25	30–50	20–25	8–10
Pillipesara (*Phaseolus trilobus*)	Suitable for low-moisture marginal uplands	5–8	25–40	10–15	20–30	20	8

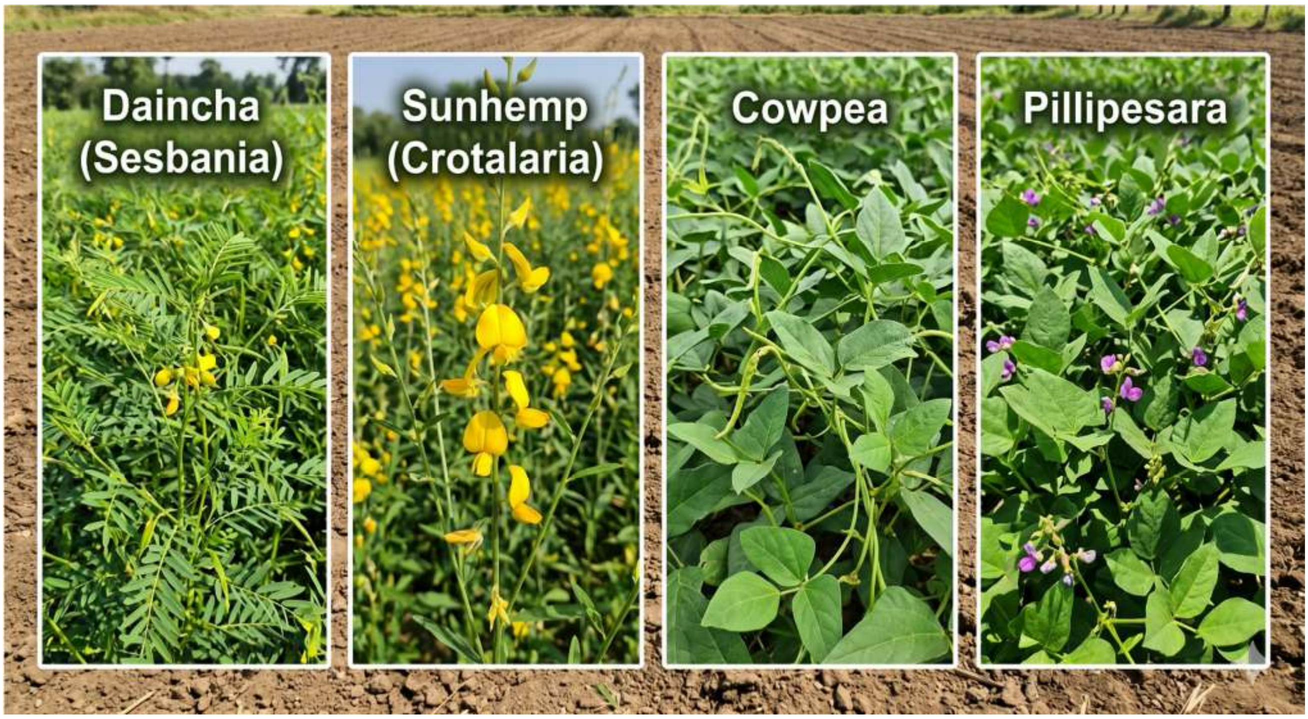


Fig 9. Recommended Green Manure Crops for Kalvarayan Hills

Table 26. Green Manure cost for one acre land in Kalvarayan Hills

Crop	Seed Rate (kg/ac)	Price (Rs/kg)	Cost per Acre (Rs)
Daincha	10–12	Rs 80–120	Rs 800–1,500
Sunhemp	10–12	Rs 120–140	Rs 1,200–1,700
Cowpea	8–10	Rs 80–120	Rs 700–1,200

Crop	Seed Rate (kg/ac)	Price (Rs/kg)	Cost per Acre (Rs)
Pillipesara	8	Rs 100–150	Rs 800–1,200

Farmers Tip
Daincha is the most recommended crop for Kalvarayan Hills due to its high biomass, drought tolerance, and adaptability to acidic, red soils.

8.4 How to Grow Green Manure – Step by Step

- Prepare the field with one ploughing
- Broadcast seeds evenly at the recommended seed rate
- Do a light harrowing to cover seeds with soil
- Allow crop to grow for 45–50 days (until flowering stage)
- Apply 1 irrigation or rain is needed during dry spells
- Plough/incorporate the green biomass into the soil at 45–50 days
- Allow 7–10 days for decomposition before planting cassava or sweet potato

Annexure 1

Common Mistakes Farmers Make in Soil Health Management

Common Mistake	Why It is Harmful	Correct Practice
Applying all fertilizer in a single dose	Causes nutrient leaching; wastes money	Always use split doses
Excess urea/nitrogen without organic matter	Promotes leaf growth, reduces tubers, and acidifies soil	Balance N with organic matter and K
No organic manure (FYM/compost)	Soil biology collapses; water-holding declines	Apply FYM every season
Planting without soil testing	Applying the wrong nutrients is a waste of money	Test soil before every planting season
Ignoring soil erosion on slopes	Loses top fertile soil; irreversible damage	Practice contour bunding and mulching
Continuous cassava monocropping	Depletes soil; increases pest build-up	Intercrop and rotate with pulses/millets

Annexure 2

Solil Health Management Checklist for Cassava

Before Planting Season

✓ Collect representative soil samples from 0–15 cm depth and submit for soil testing
✓ Obtain and interpret the Soil Health Card before fertilizer planning
✓ Prepare or procure well-decomposed FYM/compost at least 45 days before planting
✓ Procure seeds of suitable green manure crops (Cowpea, Sunhemp, or Daincha)
✓ Plan contour bunds, ridges, and drainage channels for sloping fields
✓ Assess the requirement for lime/dolomite if soil pH is below 6.0
✓ Arrange biofertilisers (Azospirillum, PSB, KSB, or VAM where available)

At Land Preparation

✓ Apply FYM/compost during final land preparation
✓ Apply rock phosphate and neem cake as basal organic nutrient sources
✓ Apply lime/dolomite uniformly in acidic soils and incorporate thoroughly into soil
✓ Sow green manure crops before planting or between cassava rows wherever feasible
✓ Prepare ridges and contour planting systems according to field slope and erosion risk
✓ Ensure proper drainage in heavy rainfall areas

At Planting

✓ Treat cassava setts with biofertilisers (Azospirillum + PSB) before planting
✓ Apply basal fertilizer dose (full phosphorus + half nitrogen + half potassium)
✓ Plant healthy disease-free cassava setts of recommended varieties
✓ Apply mulch between rows to conserve moisture and reduce soil erosion
✓ Maintain recommended plant spacing and ridge alignment across the slope

During Crop Growth

✓ Apply top dressing at 45–60 days after planting along with weeding and earthing up
✓ Monitor plants regularly for nutrient deficiency symptoms and pest incidence
✓ Apply Panchagavya (3%) or recommended foliar organic spray at critical growth stages
✓ Apply Micronol–Tapioca or micronutrient foliar spray if micronutrient deficiency symptoms appear
✓ Maintain field sanitation and remove severely diseased plants
✓ Conserve soil moisture through mulching and intercrop biomass recycling

After Harvest

✓ Incorporate crop residues and leaf biomass back into the soil wherever possible
✓ Prepare compost from cassava stems, leaves, and farm wastes
✓ Avoid leaving soil bare after harvest; establish cover crops or green manure crops
✓ Plan crop rotation or intercropping to improve soil fertility and reduce pest buildup
✓ Record yield performance and soil management practices for future planning

Annexure 3

Soil Health Management Checklist for Sweet Potato

Before Planting Season

✓ Collect representative soil samples from 0–15 cm depth and submit for soil testing

✓ Obtain and interpret the Soil Health Card before fertilizer planning

✓ Prepare or procure well-decomposed FYM/compost at least 45 days before planting

✓ Procure seeds of suitable green manure crops (Cowpea, Sunhemp, or Daincha)

✓ Plan contour bunds, ridges, and drainage channels for sloping fields

✓ Assess the requirement for lime/dolomite if soil pH is below 6.0

✓ Arrange biofertilisers (Azospirillum, PSB, KSB, or VAM where available)

✓ Select healthy disease-free vine cuttings of recommended sweet potato varieties

At Land Preparation

✓ Apply FYM/compost during final land preparation

✓ Apply rock phosphate and neem cake as basal organic nutrient sources

✓ Apply lime/dolomite uniformly in acidic soils and incorporate thoroughly into soil

✓ Form ridges across the slope to reduce runoff and soil erosion

✓ Ensure proper drainage in heavy rainfall areas

✓ Incorporate green manure biomass wherever available

At Planting

✓ Treat vine cuttings with biofertilisers (Azospirillum + PSB) before planting

✓ Apply basal fertilizer dose as recommended

✓ Plant healthy vine cuttings at recommended spacing on ridges

✓ Apply mulch between ridges to conserve moisture and reduce weed growth

✓ Maintain proper ridge height for better tuber development and drainage

During Crop Growth

✓ Apply top dressing at 25–30 days after planting along with weeding and light earthing up

✓ Monitor plants regularly for nutrient deficiency symptoms and pest incidence

✓ Apply Panchagavya (3%) or recommended foliar organic spray at critical growth stages

✓ Apply Micronol–Sweet Potato or micronutrient foliar spray if micronutrient deficiency symptoms appear

✓ Conserve soil moisture through mulching and biomass recycling

✓ Remove diseased or virus-infected vines immediately from the field

During Tuber Development

✓ Avoid water stagnation in ridges
✓ Ensure adequate potassium nutrition for proper tuber bulking
✓ Prevent exposure of developing tubers to direct sunlight
✓ Monitor for cracking, deformation, or nutrient deficiency symptoms in tubers

After Harvest

✓ Incorporate crop residues and vine biomass back into the soil wherever possible
✓ Prepare compost from sweet potato vines and farm wastes
✓ Avoid leaving soil bare after harvest; establish cover crops or green manure crops
✓ Practice crop rotation to maintain soil fertility and reduce pest and disease buildup
✓ Record yield performance and soil management practices for future planning

Tuber crops for.....

Food, Health, Wealth and Prosperity

"By improving soil health, adopting sustainable practices and leveraging science and support, **KALVARAYAN CASSAVA FARMERS CAN DOUBLE THEIR INCOME** and build a prosperous future for generations to come."

OUR APPROACH FOR SUSTAINABLE PROSPERITY

- RESTORE SOIL HEALTH
- USE BIOLOGICAL SOURCES OF PLANT NUTRITION
- INTEGRATED NUTRIENT MANAGEMENT
- SCIENCE-BASED RECOMMENDATIONS & EXTENSION SUPPORT
- COLLECTIVE ACTION & FARMER EMPOWERMENT
- HIGHER PRODUCTIVITY, BETTER INCOME, BRIGHTER FUTURE

SUSTAINABLE PRACTICES FOR BETTER INCOME

PROSPEROUS FIELDS, PROSPEROUS FUTURE

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