SOIL TEST BASED INTEGRATED NUTRIET MANAGEMENT FOR BANANA – KERALA SCENARIO

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Banana Cultivation - Facts

India: Second most important fruit crop next to mango

Kerala: Stands 3rd position after Jack and Mango

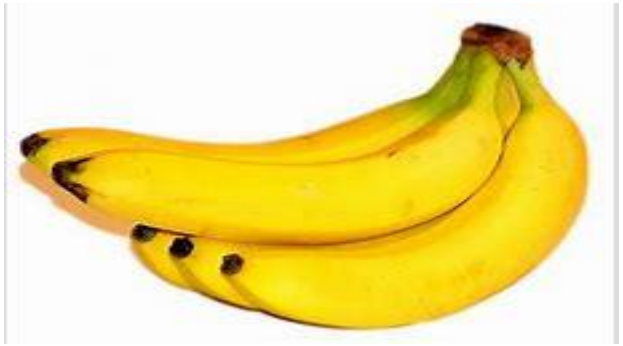
Area: 61,936 ha

Cultivated in all the districts of Kerala

Average productivity: 8.8 t/ha

Source: Farm Guide 2017, Govt. of Kerala

•Considered one of the healthiest fruit due to its high nutritional value



•Contains vitamin B5, B6, B12 , C, D and Potassium, iron, calcium, magnesium etc.

Agro Climatic and Soil Requirements

- Tropical crop, grows well in a temperature range of 15ºC – 35ºC with RH 75-85%
- Prefers tropical humid lowlands from sea level to elevation of 1000 m above MSL
- High velocity winds damage the crop
- Irrigated crop ; August-September
- Better avoid planting during heavy monsoon and severe summer
- Grows in a variety of soils, with good drainage, adequate organic matter, fertility and moisture
- Deep, rich loamy and clay loam soils with pH between 6-7.5 are ideal

Banana varieties cultivated in Kerala

Variety	Spacing (m)	Plants/ha
Poovan	2.1 x 2.1	2260
Chenkadali	2.1 x 2.1	2260
Palayankodan	2.1 x 2.1	2260
Monthan	2.1 x 2.1	2260
Nendran	2.0 x 2.0	2500
Gros michael	2.4 x 2.4	1730
Robusta	2.4 x 2.4	1730

Soil fertility management issues

- Inherent fertility of the soil
- Texture and structure
- Nutrient availability
- Soil problems like acidity, drainage
- Organic matter management
- Green manuring
- Mulching
- Maintaining microbial population
- Root health
- Intercropping

Fertilizer management

Input cost 30 to 50 per cent of cost of production

- **Nutrient needs- inherent soil fertility and crop requirements**
- **Soil acidity**
- **P-fixation**
- **Solubility**
- **Time and method of fertilizer application**
- **Fertilizer use efficiency**

Fertilizer recommendation for banana

(POP –Kerala Agricultural University)

Organic manure (at the time of planting)- 10 kg/plant

- **Farm yard manure**
- **Vermi compost**
- **Coir pith compost**

In addition

- ***In situ* green manure crops (sunhemp or dhaincha) to be incorporated 40 days after sowing (15g seeds per pit)**

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Plus

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Fertilizer recommendations (contd..)

Variety	Dose - NPK (g/plant)
Nendran	190:115:300
Palayamkodan	100:200:400
Other Varieties	160: 200:400

(Urea + Rock phosphate + MOP)

Method of fertilizer application – Nendran (NPK 190:115:300 in 6 split doses)

Time of application after planting	N : P : K (g/plant)
• One month	45 : 65 : 60
• Two months	30 : 50 : 60
• Three months	30 : 00 : 60
• Four months	30 : 00 : 60
• Five months	30 : 00 : 60
• Just after complete emergence of bunch	30 : 00 : 00

(Incorporation of cowpea grown in the inter-spaces of Nendran with 75 % recommended dose of fertilizer (143:85:225 g N: P: K /plant) can be done as INM practices for higher profit)

<u>Other varieties</u> - in 2 equal splits

First application: 2 months after planting

Second application: 4 months after planting

Method of fertilizer application: Apply the fertilizers 60-75 cm around the plant and irrigate immediately after application

NPK fertilizers only were recommended for bananas till 2012

Packages of Practices recommendations for secondary and micro nutrients issued by KAU in 2012

Calcium: Application of lime to correct acidity and supplement Ca

Magnesium: Magnesium sulphate @ 80 kg ha^{-1} or dolomite

Copper: Copper sulphate @ 2 kg ha^{-1} in soil or foliar application of 0.5 % solution

Zinc: Zinc sulphate @ 20 kg ha^{-1} in soil or foliar application of 0.5 % solution

Boron: Borax @ 10 kg ha^{-1} in soil or foliar application of 0.5 % solution

Organic Farming- POP (KAU, 2016)

- **Application of FYM or compost or green leaves @ 10 kg/plant at the time of planting**
- **500 g of lime in the pit and allow to weather**
- **Vermi compost @ 2 kg / pit**
- **Groundnut cake/ neem cake @ 1 kg /pit**
- **Bio fertilizers- PGPR mix I @ 50-100 g /pit or VAM 50-100 g/ pit should be applied at the time of planting mixed with 5 kg FYM**

(Ensure sufficient moisture in the soil at the time of application)

Organic Farming- POP (contd..)

- **Panchagavya (3%) as foliar spray three times at 3rd, 6th, and 9th months after planting**
- **Sow sunn hemp /daincha/ cowpea with seed rate of 50 kg/ ha (20 g per plant) after planting**
- **Incorporate the crop into the soil 40 days after sowing**
- **Repeat the above process and incorporate into soil 40 days after sowing**
- **Compost made from banana leaves and bunch stalk is rich in potassium content**
- ***In situ* vermi composting is a novel technology for organic banana**

Organic Farming- POP (contd..)

Additional requirement of manures for different varieties

Varieties	FYM/ Compost (kg/plant)	Rock Phosphate (g/plant)	Ash (kg/plant)
Nendran	20	200	1.0
Palayankodan	10	300	2.0
Other varieties	15	300	1.5

Fertility constraints of Kerala soils

- **Around 70 % soils are very strongly acid to moderately acid (pH 4.5 to 6.0) warranting regular lime application**
- **Nearly 68 % soils are high in available phosphorus (due to excessive use of P fertilizers and fixation)**
- **Magnesium deficiency is observed in 71 % soils**
- **Boron deficiency is noticed in 60 % soils**
- **Deficiency of Calcium, copper and zinc observed in limited areas**

Soil acidity management

Problems in Acid soil

- Toxicity of iron, aluminium and manganese
- Deficiency of calcium and magnesium
- Lesser availability of phosphorus
- Retards microbial activities and N fixation by legumes
- Poor structural development

- Application of lime or dolomite based on soil pH to alleviate acidity and to supplement Ca and Mg is essential

SOIL REACTION (pH) CLASSES

Classes	pH range	Lime (kg/ha)
1. Ultra acid	<3.5	1000
2. Extremely acid	3.5 -4.4	850
3. Very strongly acid	4.5- 5.0	600
4. Strongly acid	5.1-5.5	350
5. Moderately acid	5.6-6.0	250
6. Slightly acid	6.1-6.5	100
7. Neutral	6.6-7.3	
8. Slightly alkaline	7.4-7.8	
9. Moderately alkaline	7.9-8.4	
10. Strongly alkaline	8.5 -9.0	
11. Very strongly alkaline	>9.0	

Sub soil acidity

- In laterite soils, sub surface layers often have pH 4 to 4.5 with increasing acidity at lower depths
- Exchangeable Al in toxic levels inhibits root growth
- **Alleviated by combined application of lime and gypsum (1:1)**

Soil fertility status of Nemom Block

Grama Panchayats : 6
Panchayat Divisions : 16
Total Area : 12241 ha
Cropped Area : 11972 ha

Agro-ecological unit: Southern Laterite

Climate : Tropical sub humid monsoon climate with well distributed rainfall of SW and NE monsoon

Annual rainfall : 1884 mm

Mean annual temperature: 27.1 ^{0}C

Nemom Block (contd..)

Landform : Laterite terrain, low lands with poor drainage

Soils : Deep, acidic, low activity clay, and free of gravel and plinthite

Crops cultivated

Crop	Area (ha)*	Crop	Area (ha)
Coconut	7064	Rice	162
Tapioca	1501	Cashew	61
Rubber	1176	Areca nut	54
Banana	995	Others	612
Pepper	348		

***Area wise distribution of crops based on projections at the State level**

Soil fertility status of panchayats in Nemom Block

Panchayat	pH range	Fertility status								
		OC	P	K	Ca	Mg	S	Cu	Zn	B
Balaramapuram	4.5-6.5	Medium	Low	Low	D	D	A	D	D	D
Kalliyoor	5.6-7.8	Medium	Medium	Medium	A	A	A	D	A	D
Malayinkeezhu	4.5-6.5	Medium	Low	Medium	A	D	A	D	D	D
Maranalloor	5.1-7.3	Medium	Medium	Low	D	D	A	D	D	D
Pallichal	4.5-7.3	Medium	High	Medium	A	D	A	A	A	D
Vilappil	3.5-6.0	Medium	Medium	Medium	A	D	A	A	A	A
Vilavoorkal	4.5-6.0	Medium	Medium	Medium	A	D	A	A	A	A

D- Deficient

A- Adequate

Soil fertility constraints for crop production

Majority of soils (73 %) are very strongly to moderately acid with overall pH ranging from 4.5 to 6.0 (pH class 3 to 5)

Magnesium is deficient in soils of all the panchayats except Kalliyoor

Calcium is deficient in soils of Balaramapuram and Maranalloor panchayats

•Copper is deficient in soils of Balaramapuram, Kalliyoor, Malayinkeezhu and Maranalloor panchayats

•Zinc is deficient in soils of Balaramapuram, Malayinkeezhu and Maranalloor panchayats

•Boron is deficient in soils of all the panchayats except Vilappil and Vilavoorkal

Appropriate fertility management strategies to combat soil acidity and nutrient deficiencies are to be addressed for increasing crop productivity

Fertilizer recommendation of Panchayats based on soil test

Panchayat	Lime(kg ha^{-1})	% POP			Secondary and Micro nutrients (kg ha^{-1})			
		N	P	K	$MgSO_4$	$CuSO_4$	$ZnSO_4$	Borax
Balaramapuram	350	100	125	125	80	2	20	10
Kalliyoor	150	100	100	100	-	2	-	10
Malayinkeezhu	350	100	125	100	80	2	20	10
Maranalloor	250	100	100	125	80	2	20	10
Pallichal	150	100	75	100	80	-	-	10
Vilappil	550	100	100	100	80	-	-	-
Vilavoorkal	300	100	100	100	80	-	-	-

Root Health

Maintenance of a healthy root system is important from the point of view of proper anchorage, uptake of water and nutrients which are crucial for improving production and productivity of crops

Banana roots - Facts

- Root mass more in rainfed than irrigated
- Spreading in intercrop and compact in irrigated
- 90 % roots within 100 cm
- 70 % root mass in upper 40 cm
- Lateral spread 60 cm and depth 80cm
- Functional only for 5 months
- Root production stops on bunch emergence and starts in suckers
- At this stage healthy roots reduced to 17 %

Root health management

Maintenance of soil health is the key to root health

- Provide ground cover to reduce impact of rain drops and prevent soil erosion
- Maintain organic matter to improve soil structure and build up of biological diversity
- Composting of farm waste is cost effective
- Retention of crop residues around the base of the plant, suppress weeds, nematodes and recycle nutrients
- Match nutrient inputs to crop and soil needs
- Leachable nutrients to be applied in split doses
- Use amendments like lime, dolomite, gypsum to correct soil acidity and alleviate deficiency of Ca and Mg
- VAM allows to draw more nutrients, water, increased tolerance to drought, and overall improvement in quality and yield

Nutrient management Tips for improving productivity

- Adopt soil test based lime and fertilizers to combat acidity and need based inputs
- Maintenance of organic matter through organic inputs, green manures and recycling of crop residues
- Fertigation to reduce input cost and increase fertilizer use efficiency
- Time and method of fertilizer application as per POP
- Use of biochar, VAM and other biofertilizers for improving soil health, quality of produce and productivity

Nutrient imbalance in soil

Blanket fertilizer application can lead to nutrient imbalances affecting uptake of other nutrients

Excess N = Results in soil acidification

Excess P = Reduces uptake of Zn

Excess K = Affects availability of Mg, B

Excess lime = Reduces uptake of K, Mg, B

NUTRIENT DEFICIENCY DISORDERS OF BANANA

Nitrogen

The yellowing starts in the older leaves and then progress to younger leaves

In younger plants, deficiency often shows as pink or red colouring of the wings on the petioles or leaf stalk

Phosphorus

Symptoms are first seen in older leaves which become dark green

Purple/brown flecks and ‘sawtooth’ cell death on the leaf edges

Potassium

Yellowing of older leaves or leaf tips, leading to premature leaf death

Reduced bunch and fruit size

Calcium

Appears in the young leaves
When severe, leaves are completely deformed, with serrated edges
Deformed fruits, poor fruit quality and skin splitting

Magnesium

Yellowing in the middle of the leaf blade

In older leaves, the margins and near the petiole stay green and the leaf blade in between yellows

When yellowing becomes more intense, they turn brown and die

Sulphur

Yellowish-white colouration in young leaves

When severe, the leaf margins become necrotic

Plants appear stunted with small or choked bunches

Zinc

Leaves become smaller, thinner with young leaves showing a spearhead shape
When severe, leaves appear with a reddish coloration on the back of the leaves
Bunches are small and deformed

Boron

Newly emerging leaves do not fully expand

When severe, the leaves emerge with little or no leaf blade, often with dead margins, serious bunch deformation

Referencess

Kerala State Planning Board ,2017, Soil Fertility Assessment and Information Management for Enhancing Crop Productivity in Kerala, State Planning Board, Thiruvananthapuram, pp 514

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Thank You