

ORGANIC PRODUCTION OF BANANA (*Musa spp.*)

Banana prefers tropical humid low lands and is grown from the sea level to 1000 m above MSL. It can also be grown at elevations up to 1200 m, but at higher elevations growth is poor. Optimum temperature is 27°C. Soils with good fertility and assured supply of moisture are best suited.

Season

Rainfed crop: Irrigated crop:

April - May August - September

Adjust planting season depending upon local conditions. Avoid periods of heavy monsoon and severe summer for planting. Adjust the time of planting so as to avoid high temperature and drought at the time of emergence of bunches (7-8 months after planting).

Varieties

Nendran (clones)

Nedunendran, Zanzibar, Chengalikodan, Manjeri Nendran II*

Table varieties

Monsmarie, Robusta, Grand Naine, Dwarf Cavendish, Chenkadali, Poovan, Palayankodan, Njalipoovan**, Amritsagar, GrosMichel, Karpooravalli**, Poomkalli, Koopillakannan**, Chinali, Dudhsagar*, BRS-1*, BRS-2*, Poovan, Red banana

Culinary varieties

Monthan, Batheesa, Kanchikela**, Nendrapadathy

*Less susceptible to sigatoka leaf spot disease

**Less susceptible to bunchy top disease

Njalipoovan, Palayankodan, Robusta, BRS-1 and BRS-2 are particularly suitable for intercropping in coconut gardens both under rainfed and irrigated conditions. Dudhsagar is highly resistant to major pests and diseases. The variety Boldles Altafort is recommended for high range region.

Preparation of land

Prepare the field by ploughing or digging and dig pits for planting. Size of pits depends upon soil type, water table and variety. In general pit size 50 cm x 50 cm x 50 cm is recommended. In low lying areas, take mounds for planting suckers.

Selection of suckers

Select 3-4 months old disease free sword suckers from healthy clumps. Suckers should be removed one week after the harvest of the bunch. In the case of Nendran variety, cut back pseudostem to a length of 15-20 cm from corm and remove old roots. The portions of corm and roots infected by rhizome weevil (black tunnels) and nematode (darkened lesions) should be removed.

The rhizome should be dipped in hot water (50°C) for 20 minutes to prevent nematode infestation. The rhizomes are to be smeared with cow dung solution and ash and dried in the sun for about 3-4 days and stored in shade up to 15 days before planting. Soaking the suckers in *Pseudomonas fluorescens* solution (2%) for 30 minutes before planting is beneficial.

Table 5. Recommended spacing for different varieties

Variety	Spacing (m)	Suckers/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
Grosmichel	2.4 x 2.4	1730
Robusta Monsmarie Dwarf Cavendish	2.4 x 1.8	2310
Tissue culture Nendran banana	2.0 x 3.0 or 1.75x1.75	3332 plants in 1666pits 3265 plants/ha

The productivity of banana can be increased by cultivating good quality, uniform, pest and disease free tissue culture plants of selected ecotypes of different varieties.

Planting

Plant suckers upright in the centre of pits with 5 cm pseudostem remaining above soil level. Organic manures and *Trichoderma harzianum* (100:1) should be applied in the pit before planting. Press soil around the sucker to avoid hollow air spaces.

Manuring

1. FYM or compost or green leaves @ 10 kg/plant at the time of planting.
2. 500 g of lime in the pit and allow to weather.
3. Vermicompost @ 2 kg / pit at the time of planting.
4. Groundnut cake/ neem cake @ 1 kg /pit at the time of planting.
5. N, P and K biofertilizer- PGPR mix I @50-100 gm /pit should be applied at the time of planting. The biofertilizer should be mixed with 5 kg FYM. It should be ensured that there is enough moisture in the soil at the time of application.

6. Panchagavya 3% as foliar spray three times at 3rd, 6th, and 9th months after planting

After planting banana, sow sunnhemp /daincha/ cowpea adopting a seed rate of 50 kg/ ha (20gm per plant). Incorporate the crop into the soil 40 days after sowing. Repeat sowing of green manure crop and incorporate into soil 40 days after sowing. Compost made from banana leaves and bunch stalk is rich in potassium content. *In situ* vermicomposting is a novel technology for organic banana.

Additional nutrient requirement for different varieties

Varieties	Quantity / Plant		
	FYM/Compost (kg)	Rock phosphate (g)	Ash (kg)
Nendran	20	200	1
Palayankodan	10	300	2.0
Other varieties	15	300	1.5

It is preferable to apply organic manures in two equal split doses at 2nd and 4th month after planting.

Irrigation

1. During summer months, irrigate once in three days.
2. Ensure good drainage and prevent water logging.
3. About 6-10 irrigation per crop may be given depending upon soil conditions.
4. Banana var. Nendran (October planting) grown under deep water table conditions (below 2m from ground level) needs 10 mm (40 litres/plant) irrigation once in two days during summer season to ensure higher bunch yield and better water use efficiency. Mulching the basin with 3.5 kg paddy straw (waste quality) will considerably improve the bunch yield.

Weed control

During early stages, complete control of weeds could be obtained by raising cowpea in the inter spaces. Hand weeding by giving 4-5 surface diggings (depending upon weed growth) will give good weed control. Avoid deep digging. Do not disturb soil after plants start producing bunches. If green manure crop is grown, weeding operations can be reduced to 1-2 diggings. Mulching is an effective practice for controlling weeds.

Desuckering

Remove side suckers produced till the emergence of bunch. Retain one or two suckers produced after the emergence of the bunch.

Inter cropping

Amaranth, colocasia and elephant foot yam can be profitably intercropped with banana by adopting organic method of cultivation for all crops in the field.

Plant protection

Pests

Banana pseudostem weevil (*Odoiporus longicollis*)

Pseudostem weevil is a serious pest of banana. It attacks the crop from 6th month onwards. Adult female weevil inserts eggs into the air cavities of the pseudostem. The grubs which emerge out feed on the internal tissues, weakens the pseudostem and it collapses in due course.

Management

1. Field sanitation - remove all dried leaves over the pseudostem.
2. Remove severely infested plants with rhizome in full and destroy by burning the life stages of the insect.
3. Destroy pseudostem of harvested plants.
4. Remove the loose dry sheaths of the pseudostem of plants from 5th month onwards and follow any of the methods.
 - a) Swab mud slurry around the pseudostem:

If infestation is noticed, then mix neem oil emulsion @ 3 % in the mud slurry (30 ml/ litre) used for swabbing.
 - b) Spray neemazal (1% EC) on the pseudostem and fill the leaf axils at monthly intervals starting from 5th month onwards:

Spray application on the pseudostem and leaf axil filling with entomopathogens, namely, *Beauveria bassiana* or *Metarhizium anisopliae* @ 1×10^7 spores/ml.
 - c) Spray entomopathogenic nematode (EPN) @ one billion/ha over the pseudostem or place three cadavers containing EPN s in alternate leaf axils at fortnightly intervals.
 - d) Place split pseudostem pieces of 2 ft long in the ground when plants are 5 months old. Collect weevils in the trap and destroy daily.

Banana Rhizome Weevil (*Cosmopolites sordidus*)

Adult females puncture the rhizome and insert eggs through the holes. Grubs feed on the tissues and damage the rhizome. When growing point is damaged, the plant is killed. Symptoms are death of unopened pipe leaf, delay in emergence of new leaves and reduction in leaf number and bunch size.

Management

1. Select only healthy, pest free planting material.
2. Deep plough the land so as to remove old rhizomes and expose inner soil layer to sun.
3. Cut and remove outer layer of rhizome (Parring) to remove eggs and young ones of weevils. Dip suckers in a slurry made of cow dung and ash and dry in shade.
4. Keep split pseudostem in the field to attract adult weevils. Collect and destroy the adult weevils daily.
5. Use pheromone trap with Cosmolure / Cosmolure⁺ (an aggregation pheromone) to attract both sexes of weevil. Keep the trap throughout the year, changing the site when the number of weevils collected is reduced. Change pheromone sachet in every 45 days.
6. Drench soil around plants or spray the plants with entomopathogens *Beauveria bassiana* or EPNs (dosage same as for pseudostem weevil). The quantity needed will depend on stage of the crop.
7. Apply crushed neem seed to the pit @ 1kg/plant

Aphid (*Pentalonia nigronervosa*)

Aphid acts as a vector for the transmission of viral diseases of banana. The fungal biocontrol agent *Verticillium lecanii* is pathogenic to the aphids. Spray the spores of *V. lecanii* @ 1×10^7 spores/ml, whenever aphid population is noticed.

Nematodes

Major species attacking banana are burrowing nematode (*Radopholus sp*), root knot nematode (*Meloidogyne incognita*), root lesion nematode (*Pratylenchus coffeae*) and cyst nematode (*Heterodera orydicola*). Reduction in the number of leaves, bunch weight and number of fingers are the symptoms.

Management

1. Pare the rhizomes and dip in hot water at 45 -50°C for 20 minutes will control nematodes.
2. Apply neem cake @ 1kg/plant at the time of planting.
3. Intercrop banana with sunnhemp or marigold to reduce nematode population.

Diseases Fungal diseases

Sigatoka leaf spot (*Mycosphaerella sp.*)

1. Cut and burn all severely affected leaves.
2. Need based sprayings are to be given depending upon the severity of the disease.
 - i) Spray 1% Bordeaux mixture soon after the appearance of the initial symptoms of the disease. The disease appears with the commencement of southwest monsoon.
 - ii) Power oil (Mineral oil) 1 % emulsion is effective in controlling the disease.
 - iii) Bioagents like *Pseudomonas fluorescens* 20g/litre (2%) or *Bacillus subtilis* 5g/litre is effective against sigatoka leaf spot disease.
3. Grow resistant/less susceptible varieties such as BRS-1, BRS-2 and Dudhsagar. Among Nendran, the selection Manjeri Nendran II is least susceptible.

Panama Wilt (*Fusarium oxysporum* f. sp. *cubense*)

1. Remove and destroy affected clumps along with corms
2. Apply lime @500g per pit and allow to weather
3. Apply neem cake @1kg per pit at the time of planting and give irrigation.
4. Varieties such as Palayankodan, Robusta and Nendran are less susceptible to the disease
5. Application of soil based inoculum of AMF 500g (soil based inoculum containing 40 spores per gm of soil), *Trichoderma harzianum* (50g) and *Pseudomonas fluorescens* (50g) or PGPR mix 1 is effective.
6. Dip the planting material in 2% *Pseudomonas* before planting

Virus diseases Bunchy top disease

Virus disease of banana transmitted by aphids

1. Use disease free suckers for planting.
2. Eradicate disease affected plants.
3. Spraying neem based insecticide on the pseudostem to control the vector.
4. The fungal biocontrol agent *Verticillium lecanii* is pathogenic to the aphids. Spray the spores of *V. lecanii* @ 1×10^7 spores per ml whenever aphid population is noticed.
5. Varieties such as Karpooravally, Kanchikela, Njalipooovan and Kooppillakannan are tolerant

Banana Bract Mosaic Disease (Kokkan disease)

Virus disease transmitted by aphids

1. Use disease free healthy suckers for planting.
2. Eradicate disease affected plants as and when noticed .
3. Spray neem based insecticide to control the vector.

Infectious Chlorosis (Cucumber Mosaic Disease)

1. Use disease free suckers for planting
2. Eradicate infected plants.
3. Use neem based insecticide to control the insect vector.
4. Avoid growing cucurbitaceous vegetables as intercrop in banana.