

# BANANA



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## Introduction

Banana is the fruit of a plant of the genus *Musa* (family *Musaceae*), which is cultivated primarily for food and secondarily for the production of fiber



used in the textile industry is also cultivated for ornamental purposes. Almost all the modern edible parthenocarpic bananas come from the two wild species – *Musa acuminata* and *Musa balbisiana*. The scientific names of bananas are *Musa acuminata*, *Musa balbisiana* or hybrids of *Musa acuminata* and *Musa balbisiana*, depending on their genomic constitution. Bananas are vigorously growing, monocotyledonous herbaceous plants. The banana is not a tree but a high herb that can attain up to 15 meters of height. The cultivars vary greatly in plant and fruit size, plant morphology, fruit quality, and disease and insect resistance. Most bananas have a sweet flavour when ripe; exceptions to this are cooking bananas and plantains. Plantains are hybrid bananas in which the male flowering axis is either degenerated, lacking, or possesses relicts of male flowers. Plantains are always cooked before consumption and are higher in starch than bananas. The two groups of plantains, French and Horn, produce fewer fruit per plant than sweet bananas. The groups differ in whether the male parts of the inflorescence are present or absent.

## Soil

Soil for bananas should have good drainage, adequate fertility, and moisture. Deep, rich loamy soil with a pH between 6-7.5 is most preferred for banana cultivation. Ill-drained, poorly aerated, and nutritionally deficient soils are not suitable for bananas. Saline solid, calcareous soil is not suitable

for Banana cultivation. Avoided soil of low laying areas, very sandy & heavy black cotton with ill drainage.

A soil that is not too acidic & not too alkaline, rich in organic material with high nitrogen content, adequate phosphorus level, and plenty of potash is good for bananas.

## Preparation of land:

Plow the land thoroughly at least 3-4 times in summer. At the time of last ploughing add about 10 tonnes of well-rotten FYM or well-decomposed cow dung and mix it well in soil. To level soil use a blade harrow or laser leveller. In areas where the nematode problem is prevalent, nematicides and fumigants are also added to pits before planting.

## Varieties

*Grand Naine*: Released in 2008 and is suited best for growing in Asia. It bears an average 25-30kg bunch.



Other state varieties: Red Banana, Safed Velachi, Basarai, Rasthali, Dwarf Cavendish, Robusta, Poovan, Nendran, Ardhapuri, Nyali.

## Selection of Suckers:

Select 'Sword Suckers' with broad corm with narrow sword-like leaves, free from viral, fungal, and bacterial disease-free mother plants.

The suckers should be 3-5 months old, uniform in size, and weighing 1-1.5 kg for Nendran, Rasthali, Ney Poovan and Poovan Banana varieties.



For long-duration varieties like Karpuravalli and Red Banana, slightly big suckers weighing 1.5-2.0 kg should be used.

For planting 'Tissue Culture' plants, the secondary hardened plant should be about 30 cm tall, 5 cm girth with at least five fully opened healthy leaves and true to type.



### Sucker Treatment and Planting:

The selected suckers should be 'pared' by trimming all the roots along with surface layers superficially to remove any rotten portion of the corm.



Dip the pared suckers in 0.2% Carbendazim (2g/liter of water) solution for about 15 –20 minutes as a prophylactic measure against Fusarium wilt disease.

Keep the treated suckers in the shade overnight before planting. Plant the suckers in the centre of the pit and press the soil around the suckers firmly.

Apply 40 g of Carbofuran granules per pit to protect the plants against nematode attack and irrigate the field thoroughly.

In the case of tissue culture plants, one week before planting apply 10 g Carbofuran and 1.0 % bleaching. The transplanting method is used for sowing.

### Seed Rate

If the spacing of 1.8x1.5m is adopted, nearly 1452 plants fit per acre. For spacing of 2mx2.5m, 800 plants are accommodated in one acre.



powder or 0.2 % Emissan in 100 ml water as drench into the polythene bags to protect against nematode infestation and bacterial rot (Erwinia Rot) disease respectively. **Time of sowing**

Mid-February to the first week of March is the best time for sowing.

### Spacing

In north India, coastal belt and areas having high humidity and low temperature i.e. below 5-7°C, the planting distance should not be less than 1.8m x 1.8m.

### Sowing Depth

Banana sucker is planted in a pit size of 45cm x 45cm x 45cm or 60x60x60cm. Pits are left open in the sun; it will help in killing the harmful insects. Fill pits with topsoil mixed with 10kg of FYM or well-



decomposed cow dung, Neem cake@250gm and Carbofuran@20gm. Plant suckers in the center of the pit and gently pressed the soil around it. Avoid deep planting.

### Method of Sowing

#### Seed Treatment

For planting, use healthy and uninfected suckers or rhizomes. Before planting, wash suckers and then dip them in a solution of Soil Shakti and @ 1000 ml /100 Litre of water. To protect the crop from rhizome weevil, before planting, dip suckers in Carbofuran 3%CG@33gm/sucker and then dry them in the shade for 72 hours. To prevent suckers from nematode attacks, treat suckers with Estectra 750 ml/100 liter. For fusarium wilt control, dip suckers in Carbendazim @2gm/liter of water solution for about 15–20 minutes.



FERTILIZER (dose in KG)

Stages	FERTILIZER (dose in kg)						
DAT	NEEM DOC	Earthwise	10:26:26	Potash	SSP	Orgo	DAP
Day 00	25 kg	5 kg	50 kg	50 kg	0 kg	0	0
Day 45	0	5 kg	0	0	50 kg	0	50 kg
Day 120	0	0	50 kg	50 kg	0	50 kg	0
Day 155	0	5 kg	0	50 kg	25 kg	0	0

## Weed Control

Remove weeds before planting by deep plowing and cross-harrowing. Take pre-emergence application of Diuron 80% WP@800gm/150Litre of water/acre, if infestation by the weed species.

## IRRIGATION

Banana is a shallow-rooted crop that requires a large quantity of water for increasing productivity.

Overall it requires 70-75 irrigations for good yield.



Provide irrigation at an interval of 7-8 days in winter whereas in summer provide irrigation at an interval of 4- 5 days. In the rainy season, provide irrigation if required. Remove excess water from the field as it will affect plant establishment and growth.

Advanced irrigation technology like drip irrigation can be used. Research shows that the use of drip irrigation in bananas saves about 58% of water and increases yield by 23-32%. In drip irrigation, apply water@5-10 liters/plant/day from planting to 4th month, 10-15 liters/plant/day from 5th to shooting, and 15 liters/plant/day from shooting to 15 days before harvest.

## Special Operations

There are operations specific to banana crops that influence productivity and quality.

### Desuckering

Removal of unwanted suckers is a critical operation in bananas for reducing internal competition with the mother plant. Desuckering should be done regularly until the shooting. However, in areas where ratoon is also taken for the second crop, a follower is allowed after inflorescence has appeared and this should be managed so that planting space is not disturbed. The follower should be opposite to the inflorescence. It should not be far apart from the main plant.



## Deflowering

It consists of the removal of the withered style and perianth. This is generally not practiced. Therefore,



they remain attached to the fruit bunch & then removed after harvesting which is damaging to the fruits. It is therefore suggested that you remove them just after flowering.

## Pruning of leaves

Rubbing leaves to damage the fruit, therefore, such leaves should also be pruned during the regular check. Older leaves and infected leaves also be pruned as required. Green leaves should not be removed.



## Earthing up



Keep the soil loose by harrowing from time to time. Earthing up should be done at 3-4 months

after planting i.e. raising the soil level around the base of the plant by 10-12". It is better to prepare a raised bed and keep the drip line on bed 2-3" away from the plant. It also helps to protect plants from wind damage and production losses to some extent.

## Removal of male buds

(Denavelling) Removal of male buds helps fruit development and increases bunch weight. Male buds are removed from the last 1-2 small hands with a clean cut keeping a single finger in the last hand.



## Bunch Spray

*Spray on a bunch for the quality growth of the banana fruit is recommended*

Duration	Treatment	Dose
After cutting the flower from the bunch	Agro Shakti + Combishield Shakti	375 ml + 250 ml
After 10 Days	Agro Shakti + Combishield Shakti	375 ml + 250 ml
After 10 Days	Agro Shakti + Combishield Shakti	375 ml + 250 ml

## Bunch Covering

Covering the bunch using dried leaves of the plant is economical and prevents the bunch from direct exposure to sunlight. The bunch cover enhances the quality of the fruit. But in the rainy season, this practice should be avoided.



Sleeving of the bunch is done to protect fruits against dust, spray residue, insects, and birds. For this blue plastic sleeves are preferred. This also increases the temperature around the developing bunch and helps in early maturity.

## Dehanding of false hands of a bunch

In a bunch, some incomplete hands are not fit for quality produce. These hands should be removed soon after bloom. This helps in improving the weight of other hands. Sometimes the hand just above the false hand is also removed.

## Propping

Due to the heavy weight of the bunch, the plant goes out of balance and the bearing plant may lodge and production and quality are adversely affected.



Therefore, they should be propped with the help of two bamboos forming a triangle by placing them against the stems on the leaning side.

This also helps in the uniform development of the bunch.

## Pest and Disease Management

A large number of fungal, viral, and bacterial diseases and insect pests and nematodes infest the banana crop and reduce production, productivity, and quality. Summary details of major pests and diseases of bananas along with control measures are given herewith

### Diseases

#### Panama wilt

##### *Disease symptoms*

Yellowing of the lowermost leaves starting from margin to midrib of the leaves. The yellowing extends upwards and finally heart leaf alone remains green for some time and it is also affected. The leaves break near the base and hang down around the pseudostem. Longitudinal splitting of pseudostem. Discoloration of vascular vessels as red or brown streaks.

##### *Survival and spread*

The pathogen spreads through infected rhizomes

##### *Favorable conditions*

Continuous cultivation in the infested field or monocropping results in the build-up of inoculum/9





## Mycosphaerella leaf spot, yellow Sigatoka, black Sigatoka

### *Disease symptoms*



Early symptoms appear on the third or fourth leaf from the top, i.e., on young leaves. Small spindle-shaped spots on foliage with a greyish center and yellowish halo running parallel to veins. If the fruit is nearing maturity at the time of heavy infection, the flesh ripens but evenly individual bananas appear undersized and their flesh develops a buff pinkish color, and stores poorly.

### *Survival and spread*

The conidia of the fungus are carried by wind, rainwater, and old dried infected leaves and they help to spread the disease

## Anthracnose

### *Disease symptoms*

At the initial stage, small, circular, black spots develop on the affected fruits. Then these spots enlarge in size, and turn to brown colour. The skin



of the fruit turns black and shrivels and becomes covered with characteristic pink acervuli. Finally, the whole finger is affected. Later the disease spreads and affects the whole bunch. The disease results in premature ripening and shriveling of the fruits which are covered with pink spore masses.

Occurrence of black lesions on the pedicel causes withering of the pedicel and dropping of the fingers from the hands. Sometimes the main stalk

of the bunch may become diseased. Infected fruits become black and rotten

### *Survival and spread*

The spread of the disease is by air-borne conidia and numerous insects that frequently visit banana flowers also spread the disease

### *Favorable conditions*

The disease is favored by high atmospheric temperature and humidity, wounds and bruises caused in the fruit, and susceptibility of the variety

## Moko disease/bacterial wilt

### *Disease symptoms*

Leaves become yellow and progress upwards. The petiole breaks and leaves hang. When it is cut open, discoloration in the vascular region with pale yellow to dark brown color. The discoloration is in the central portion of the corm. Internal rot of fruits with dark brown discoloration. When the pseudostem is cut transversely, bacterial ooze can be seen.



### *Survival and spread*

The bacterium survives in infected plant material, vegetative propagative organs, wild host plants, and soil.

### *Favorable conditions*

High temperatures and high soil moisture generally favor disease



### Tip over or bacterial soft rot



#### *Disease symptoms*

This disease is more pronounced on young suckers leading to rotting and emitting of foul odor. Rotting of the collar region is the commonest symptom followed by epinasty of leaves, which dry out suddenly.

If affected plants are pulled out it comes out from the collar region leaving the corm with their roots in the soil.

In the early stage of infection, dark brown or yellow water-soaked areas are more in the cortex area. When affected plants are cut open at the collar region, yellowish to reddish ooze is seen.

#### *Survival and spread*

Bacteria survive in crop debris and are infected by water splashing through damaged tissues.

Worse in hot wet weather. The bacteria spread in contaminated water.

#### *Favorable conditions*

Higher temperatures and high humidity are ideal growing conditions for the bacteria.

### Bunchy top/curly top

#### *Disease symptoms*

Prominent dark green streaks on the petioles and midrib along the leaf veins.

Marginal chlorosis and curling of leaves.

Petioles fail to elongate.

Leaves are reduced in size, chlorotic, stand upright and become brittle and are crowded at the top (Bunchy top) and show dark green streaks with 'J hook' shape near the midrib.

Flowers display mottled and streaked discoloration.

### Plants show marked stunting



#### *Survival and spread*

**Vector:** banana aphid, *Pentalonia nigronervosa*

The disease can be spread by infected plant debris, plant wounds, and injuries.

#### *Favorable conditions*

Hot and damp weather with plenty of rainfall triggers the disease to occur.

### Banana bract mosaic virus (BBMV)

#### *Disease symptoms*

The disease is characterized by the presence of spindle-shaped pinkish-to-reddish streaks on the pseudostem, midrib, and peduncle.



Typical mosaic and spindle-shaped mild mosaic streaks on bracts, peduncles, and fingers were also observed.

Suckers exhibit unusual reddish-brown streaks at emergence and separation of leaf sheath from central axis.

The clustering of leaves at the crown with a traveler's palm appearance, elongated peduncle, and half-filled hands are its characteristic symptom.



### *Survival and spread*

The disease is caused by a virus belonging to the potyvirus group. The virions are flexuous filamentous

The virus is transmitted through aphid vectors such as *Aphis gossypii*, *Pentolonia nigronervosa*, and *Rhopalosiphum maidis*. In field, the disease spread mainly through suckers

## Banana streak disease (BSV)

### *Disease symptoms*

A prominent symptom exhibited by BSV is yellow streaking of the leaves, which becomes progressively necrotic producing a black streaked appearance in older leaves.

### *Survival and spread*



The virus is transmitted mostly through infected planting materials, though mealy bugs (*Planococcus citri*) and more probably *Saccharicoccus sacchari* are also believed to transmit it. Shoot tip culture does not eliminate it from vegetatively propagated materials.

## Infectious chlorosis (CMV)

### *Disease symptoms*

The disease manifests itself in all stages of crop growth.

Due to the repeated use of suckers from infected plants, the disease spreads and results in a gradual decrease in yield and quality.

The disease is known to occur in all banana-growing states.



Light yellow streaks run parallel to leaf veins giving the leaf a striped appearance.

The streaks run usually from mid-rib to the edge of the blade.

### *Survival and spread*

The virus is disseminated by suckers and *Aphis gossypii*.

## Pest and control measures

### *Corm weevil:*

**Appearance:** The adult banana weevil is a small black beetle, about 10 mm long, with a long snout.

**Lifecycle:** Banana weevils lay eggs inside the stems of banana plants. The larvae hatch and feed on the plant tissues, causing damage to the stem. This can weaken the plant and eventually lead to its death.

**Damage:** The damage caused by banana weevils can result in reduced yields and even the loss of entire banana crops if not managed properly. They can also facilitate the entry of fungal pathogens, further harming the plant.



**Control:** Controlling banana weevils often involves a combination of cultural, mechanical, and chemical methods. This can include practices **such** as removing and destroying infested plant material, using traps to catch adult weevils, applying insecticides, and planting resistant banana varieties

### *Rhizome weevil:*

**Name and Identification:** The rhizome weevil is also known as the banana pseudostem weevil or the banana rhizome borer. Scientifically, it's often referred to as *Cosmopolites sordidus*, similar to the banana stem weevil.

**Habitat and Lifecycle:** Rhizome weevils primarily infest the rhizomes (underground stems) of banana plants. The adult weevils lay their eggs in the rhizomes, and the larvae hatch and feed on the internal tissues, causing damage to the plant's root system and nutrient transport mechanisms.



**Damage:** Infestation by rhizome weevils can weaken the banana plant's root system, leading to stunted growth, reduced yields, and an increased susceptibility to other diseases and pests. Severe infestations can even result in the death of the plant.

**Control Measures:** Controlling rhizome weevils often involves similar strategies to those used for banana stem weevils. These methods can include cultural practices like removing and destroying infested plant material, using traps to catch adult weevils, applying insecticides, and planting resistant banana varieties.

### *Banana aphid:*

Banana aphids are small insects that feed on banana plants, causing damage by sucking sap and transmitting diseases like Banana Bunchy Top Virus. They reproduce rapidly and can lead to reduced yields and plant stunting. Control measures include cultural, mechanical, and chemical methods, as well as integrated pest management strategies to minimize reliance on insecticides. Managing banana aphids is crucial for maintaining the health and productivity of banana crops.



### *Thrips and Lace wing bugs:*

Thrips are small insects that damage banana plants

by feeding on their sap and transmitting diseases like Banana Streak Virus and Banana Mild Mosaic Virus. Control measures include removing infested material and using insecticides if necessary.

Lacewing bugs, on the other hand, are beneficial predators that feed on pests like thrips, offering natural pest control in banana plantations. Integrating both pest management and beneficial insect conservation is crucial for sustainable banana cultivation.



## Nematode:

Nematodes are soil-dwelling worms that can either benefit or harm banana plants. Beneficial nematodes help decompose organic matter and control pests, while harmful ones feed on plant roots, causing damage and reducing yields. To manage nematode problems, farmers use various



methods like crop rotation, resistant banana varieties, biological controls, and sometimes chemical treatments, aiming to maintain soil health and sustain banana production.



## Harvesting



Bananas should be harvested at the physiological maturity stage for better post-harvest quality. The fruit is climacteric and can reach the consumption stage after the ripening operation

### Maturity indices

These are established based on fruit shape, angularity, grade or diameter of the median figure of the second hand, starch content, and number of days that have elapsed after flowering. Market preferences can also affect the decision to harvest a slight or fully mature fruit.

### Removal of bunch

The bunch should be harvested when figures of the second hand from the top are 3/4 rounded with the help of a sharp sickle 30cm above the first hand. Harvest may be delayed up to 100-110 days after opening of the first hand. The harvested bunch should generally be collected in a well-padded tray or basket and brought to the collection site. Bunches should be kept out of light after harvest since this hastens ripening and softening. For local



For export, hands are cut into units of 4-16 fingers, graded for both length and girth, and carefully placed in polylined boxes to hold different weights depending on export requirements.

At the collection site injured and over-mature fruits are discarded and for the local market, bunches should be delivered through lorries or wagons. However, for more sophisticated export markets where the quality is predominant, bunches should be deheaded, fruits are cleared in running water or



Yield

Thus, over a period of 28-30 months, it is possible to harvest three crops i.e. one main crop and two ratoon crops. Under drip irrigation combined with Fertigation yield of Bananas as high as 100 T/ha can be obtained with the help of tissue culture technique, even a similar yield in the ratoon crops can be achieved if the crop is managed well.







## Cost of Cultivation of Banana

### Banana Crop Details

Crop	Specifications
Crop Name	Banana
Variety	G9
Planting distance in ft	5 x 5   6 x 5
No. of Plants per Acre	1400 – 1700

### Cost Of Cultivation (per acre)

Particulars	Cost
Spraying Cost	10005
Fertigation cost	47800
Saplings	24000
Drip	10000
Manpower Cost	5000
Harvesting Cost	15000
Rent	10000
Land Preparation	9000
Insurance	12000
Protection Bag	4000
<b>Total</b>	<b>146805</b>

### Total Income (per acre)

Total Production (per acre)	Buyback Rate	Total Income
300 QTLs	1000 Rs	3,00,000 Rs
<b>Total Expense</b>		<b>1,46,805 Rs</b>
<b>Total profit</b>		<b>1,53,195 Rs</b>

**Note:** The above given figures are for educational purposes only actual figures may vary depending upon the climate, soil, variety of seed, season & agronomical practices



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