

# Banana

Banana is one of the most important fruit crops grown in India. In respect of area it ranks second and first in production only after mango in this country. India leads the world in banana production with an annual output of about 16.820 mt. In India, bananas are so predominant and popular among people that poor and rich alike like the fruit. Considering the year round availability of fruits, unlike the seasonal availability of other tree fruits, it has become an inevitable necessity in any household in India, for all functions. The banana cultivation in India is most popular agricultural practice.

## Origin and Distribution

- The edible banana is believed to have originated in the hot, tropical regions of South-East Asia. India is believed to be one of the centres of origin of banana.
- Its cultivation is distributed throughout the warmer countries and is confined to regions between 30°N and 30°S of the equator.
- Banana is also grown, in many other countries of the world namely Bangladesh, the Caribbean Islands, the Canary Islands, Florida, Egypt, Israel, Ghana, Congo, South Africa, Fiji, Hawaii, Taiwan, Indonesia, the Philippines, South China, Queensland and Sri Lanka.

## Soil:

Fertility of soil is very important for successful cultivation, as banana is a heavy feeder. Banana is one of the few fruits, which has a restricted root zone. Hence, depth and drainage are the two most important considerations in selecting the soil for banana. The soil suitable for banana should be 0.5-1 m in depth, rich, well drained, fertile, moisture retentive, containing plenty of organic matter. The range of pH should be 6.5-7.5. Alluvial and volcanic soils are the best for banana cultivation. Banana is grown in India on a variety of soils such as the heavy clay soil of the Cauvery delta, alluvial soils of the Gangetic delta, black loam in Maharashtra, coastal sandy loams and the red lateritic soil of the hilly tracts of Kerala. These areas are famous for growing good crop of banana.

## Climate:

Banana is essentially tropical plant requiring a warm and humid climate. However, it can be grown from sea level to all altitudes up to 1200 metres. It can be cultivated in a temperature range of 10°C and 40°C with high humidity but growth is retarded at temperatures of 20°C and less and more than 35°C. Yields are higher when temperatures are above 24°C for a considerable period. In cooler climate, the crop requires longer time to mature. Plants exposed to low temperature and humidity during active growth stage show reduced growth and yields. Hot winds blowing in high speed during the summer months shred and desiccate the leaves. It requires on an average, 1700 mm rainfall distributed throughout the year for its satisfactory growth. Stagnation of water is injurious and may cause diseases like Panama wilt.

## Varieties

**Dwarf Cavendish (AAA):** It is a popular commercial cultivar grown extensively for table and processing purpose in the states Maharashtra, Gujarat, Bihar and West Bengal. It is also popular in Tamil Nadu, Karnataka and Andhra Pradesh. 'Basrai' is the leading commercial variety of Cavendish group and is a leading commercial variety of Maharashtra. The plant stature is Dwarf making it less prone to wind damage. The bunch size, the fruit length and size is quite good though the keeping quality is rather poor. The average bunch weight with 6-7 hands and with about 13 fruits per hand is about 15-25 kg. The thick rind of the fruits retains to some extent the greenish colour even when the fruits are ripe. Gandevi selection known as 'Hanuman' or 'Padarre' is gaining importance inspite of its longer crop duration. The selection yields bunches weighing 55-60 kg. Performs well under light soils with high inputs. In combination with high-density planting and drip irrigation, Dwarf Cavendish is becoming a highly successful cultivar. It is highly susceptible to Sigatoka leaf spot disease in humid tropics restricting its commercial cultivation.

**Robusta (AAA):** It is a semi-tall variety, grown mostly in Tamil Nadu and some parts of Karnataka for table purpose. Andhra Pradesh and Maharashtra. It is a high yielding and produces bunch of large size with well developed fruits. Dark green fruits turn bright yellow upon ripening depending on ripening conditions. Fruit is very sweet with a good aroma. Bunch weighs about 25-30 kg. Requires propping. Fruit has a poor keeping quality leading to a quick breakdown of pulp after ripening, hence not suited for long distance transportation. Robusta is highly susceptible to Sigatoka leaf spot disease in humid tropics.

**Rasthali (Silk AAB):** It is a medium tall variety commercially grown in Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Bihar. Its unique fruit quality has made Rasthali popular and a highly prized cultivar for table purpose. Fruits are yellowish green throughout their development, but turn pale yellow to golden yellow after ripening. Fruit is very tasty with a good aroma. Longer crop duration, severe susceptibility to Fusarium wilt, requirement of bunch cover to protect fruits from sun cracking and formation of hard lumps in fruits make crop production more expensive.

**Poovan (Mysore AAB):** It is a leading commercial cultivar grown throughout the country with location specific ecotypes like palayankodan in Kerala, Poovan in Tamil Nadu, Karpura Chakkarakeli in Andhra Pradesh and Alpan in North Eastern Region. It is generally cultivated as a perennial crop. Tamil Nadu is the leading producer of Poovan cultivar owing to its climatic and marginal soil condition. Poovan is also commercially cultivated for leaf industry throughout Tamil Nadu and in certain parts of Kerala. Fruit is slightly acidic, firm and has typical sour-sweet aroma. Fruits turn to attractive golden yellow on ripening. Medium sized bunch, closely packed fruits, good keeping quality and resistant to fruit cracking is its plus points. But it is highly susceptible to Banana Bract Mosaic Viral (BBMV) disease and Banana Streak Virus, (BSV), which cause considerable reduction in yield.

**Nendran (AAB):** It is a popular variety in Kerala where it is relished as a fruit as well as used for processing. Commercial cultivation of Nendran has picked up rapidly in Tamil Nadu in the recent past. Nendran is known to display considerable diversity in plant stature, pseudostem colour, presence or absence of male axis, bunch size, etc. Bunch has 5-6 hands weighing about 12-15 kg. Fruits have a distinct neck with thick green skin turning buff yellow on ripening. Fruits

remain as starchy even on ripening. Nendran is highly susceptible to Banana Bract Mosaic Virus (BBMV), nematodes and borers.

**Red Banana (AAA):** Red banana is the most relished and highly prized variety of Kerala and Tamil Nadu. Its commercial cultivation is prominent in Kanyakumari and Tirunelveli districts of Tamil Nadu. It is also popular in Karnataka, Andhra Pradesh and to some extent in Western and Central India. In Bihar and other regions, it is popular as Lal Velchi while in Karnataka as Chandra Bale. The colour of the pseudostem, petiole, midrib and fruit rind is purplish red. It is a robust plant with bunches weighing 20-30 kg under good management practices. Fruits are sweet, orange yellow coloured and with a pleasant aroma. It is highly susceptible to bunchy top, fusarium wilt and nematodes.

**Ney Poovan (AB):** Ney Poovan is the choicest diploid cultivar, which is under commercial mono cultivation on a large scale especially in Karnataka and Tamil Nadu. In Kerala It is grown in backyards and now shifting to large-scale cultivation. Ney Poovan is a slender plant bearing bunches of 15-30 kg after 12-14 months. Dark green fruits turn golden yellow with a very good keeping quality. Fruit is highly fragrant, tasty, powdery and firm. Ney Poovan is tolerant to leaf spot but susceptible to Fusarium wilt and banana bract mosaic virus.

**Virupakshi (AAB):** It is an elite variety in South India especially grown for table purpose in Palani and Shevroy hills of Tamil Nadu under perennial cultivation. It is a vigorous and hardy variety though not a prolific one. Fruits show a typical curvature, possess a pleasant aroma and delightful taste. Virupakshi has the characteristic flavour only when they are cultivated in higher elevation. In the mixed cultivation it is well suited as a shade plant for young coffee. It has many ecotypes like 'Sirumalai' (grown on hills), 'Vannan', 'Kali' etc. well suited for cultivation in plains. Perennial system of cultivation aggravates Banana Bunchy Top Virus (BBTV).

**Pachanadan (AAB):** It is a popular variety in Tamil Nadu grown especially for its cooling effects in hot tracts in summer. The variety comes up well in marginal soils without any yield reduction. It is well suited as an intercrop in coconut/arecanut garden. The bunch weight ranges from 12-15 kg (after 11-12 months). Pachanadan could be used in the Nendran plantations for gap filling as it comes up for harvest along with Nendran. This variety is tolerant to leaf spot and Banana Bunchy Top Virus (BBTV) diseases, but susceptible to wilt disease.

**Monthan (ABB):** It is a widely cultivated variety for processing. Monthan is a fairly tall and robust plant bearing bunches of 18-20 kg after 12 months. Fruits are bold, stocky, knobbed and pale green in colour. The skin is usually green. The new prolific 'Monthan' type clones of economic value namely 'Kanchi Vazhai' and 'Chakkia' are recently becoming popular in Tamil Nadu. Apart from its culinary use of fruits, pseudostem core is a highly relished vegetable with many medicinal properties. Monthan is also cultivated for production of leaves in Trichy and Tanjore districts of Tamil Nadu. It has many desirable qualities like immunity to Banana Bunchy Top Virus (BBTV) diseases, salt tolerance and normal bunch mass even under marginal condition, but it is highly susceptible to Fusarium wilt disease.

**Karpuravalli (ABB):** It is a popular variety grown for table purpose in medium rich soils. Its commercial cultivation is spread over in Central and Southern districts of Tamil Nadu and

Kerala. In Bihar, cultivation is in patches under the name 'Kanthali'. Karpuravalli is a tall, robust plant well suited to marginal lands and soils, produced under low input conditions. It is also the sweetest among Indian bananas. Karpuravalli is occasionally seeded depending on the seasonal variability. Its ash coated golden yellow and sweet fruits have good keeping quality. Karpuravalli is highly susceptible to wilt disease, tolerant to leaf spot disease and well suited for drought, salt affected areas and for low input conditions.

**Safed Velchi Musa (A B Group):** This is considered a good quality fruit for table purpose and is cultivated in the Thane, Nasik districts of Maharashtra. It is grown under the shade of arecanut gardens in the South Kanara districts of Karanataka. This variety is medium sized with slender yellowish green pseudostem and can be recognised by the reddish petiole margin, large fruits, very thin and papery rind and white firm flesh that is very sweet. The average bunch weight is about 12 kg with about 150 fruits/bunch. The duration of the variety is about 13 months.

## **Propagation of banana:**

### **Vegetative Method:**

Commercial bananas are seedless and propagated exclusively by vegetative means. The banana has a reduced underground stem, called the rhizome, which bears several buds. Each of these buds sprouts and forms its own pseudostem and a new bulbous rhizome. These daughter plants are called suckers. Banana is mostly propagated by rhizomes and suckers viz. sword suckers and water suckers. Sword suckers have a well developed base with narrow sword-shaped leaf blades at the early stages. Suckers of 2-4 months age are selected. Other planting materials are whole or bits of rhizomes. Basrai variety in Jalgaon (Maharashtra) is as a rule propagated by dormant rhizomes. After cutting the parent plant, the rhizomes are removed from the soil, stored in cool, dry place for about 2 months. During the resting period the remaining part of pseudostem at the bottom falls off, leaving prominent heart bud. Conical rhizome should be selected while flat rhizomes to be rejected. The weight of the rhizomes should be 500 g-750 g. It should be 3-4 months age at planting. Very small rhizomes will give bigger size fruits with late flowering while bigger size rhizomes flower early but bear small size fruit/bunches. Since banana is highly unstable in genetic constitution, the suckers/rhizomes should be selected from plants, which are healthy, having all the desirable bunch qualities and high yielding ability possessing atleast 10 hands in a bunch.

### **Tissue Culture:**

Now-a-days banana plants are also propagated through tissue culture. Varieties like Shrimanti, Gross Michael and Grand Naine are commonly produced using tissue culture technique. Normally disease free plantlets with 3 - 4 leaves are generally supplied in pots for raising secondary nursery. Plants are initially kept in shade [50%] and as they harden, shade is reduced gradually. After 6 weeks, plants do not require any shade. Normally two months of secondary nursery is good enough before the plants to be planted in the field pits.

### **Planting :**

Planting can be done in May-June or in September - October

### Spacing :

Cultivar	Spacing (m)	No. of Suckers	
		Per ha	Per acre
'Poovan' 'Monthan' 'Rasthali' 'Kali ( Nadan)' 'Nendran'	2.13x2.13 or 2.1 x 2.1	2150	870
Dwarf Cavendish	1.7x1.7	3550	1440
('Basrai', 'Kabuli')	or 1.8 x 1.8	3000	1210
'Robusta' (Harichal)	1.8 x 1.8	3000	1210
'Nendran'	1.8x1.8 or 2.4 x 2.4	1700	684
'Hill Banana'	2.4 x 3.0	1350	545
	4.1 x 3.6	670	270
	4.8 x 4.9	420	170
Export quality banana	1.7 x 1.75		

In case of tissue culture plantlets a spacing of 1.65 x 1.65 m is adopted. Pits of size 45cm x 45cm x 45 cm are dug at the recommended spacing. The pits with equal quantities of top soil, well decomposed FYM and sand in 1:1:1 proportion. Polybag may be slit and removed and the plant be inserted into the centre of the filled pit without disturbing the roots. The soil level must be maintained at the same level as in the polybag.

### Methods of Planting:

#### Pit method :

Pits of 0.5m x 0.5m x 0.5m are dug for planting the rhizomes. However this method is very laborious and expensive. The only advantage is that no earthing up is required as planting is done at the required depth. This practice is not very popular at present.

#### Furrow method:

This is a very common method in which furrows of 20-25cm depth are opened by a tractor or ridger at a distance of 1.5m and rhizomes are planted in the furrows. In this method earthing up needs to be frequently done to cover the exposed rhizomes.

### Manure and fertilizers

The fertilizer dose depends upon the fertility of soil and amount of organic manure applied to the

crop. For a good yield, 40-50 t/ha of well-decomposed FYM is incorporated into the soil. The recommended fertilizer dose for optimum yield is as follows.

Varieties	Quantity of Fertilizers ( g/plant )								
	3rd month			4th month			5th month		
	Ure a	SS P	MO P	Ure a	SS P	MO P	Ure a	SS P	MO P
Poovan, Rasthali & Karpuraval li	140	155	130	230	155	320	90		175
D.Cavendis h, Robusta & Nendran	15	155	130	250	105	320	150		225
Other varieties	110	110	130	155	110	300	90		160

(Source : NRC Banana)

Fertilizer dosage for tissue culture banana is given below:

Days after Planting	Fertilizer Dose (g/plant)		
	Urea/ Ammonium Sulphate	SSP	MOP
30	45/100	125	50
75	90/195	125	85
110	110/245	125	85

150	110/245	125	100
180	90/195	125	100
At bunch emergence	- / -	-	85

### **Nutritional Deficiency in banana crop:**

#### **Nitrogen :**

Leaves of all ages become pale green. Mid ribs, petioles and leaf sheaths turn reddish pink and rosette in appearance. Plantations with poor root growth exhibit such symptoms. Bunch weight and fruit quality is affected.

Control: Application of urea (300g/plant) followed by irrigation is recommended.

#### **Phosphorus:**

Plants show stunted growth with poor root development. Old leaves show saw tooth marginal chlorosis, curling of leaves, breaking of petioles and bluish green colour of younger leaves.

Control : Application of DAP (50g/plant) followed by irrigation is recommended.

#### **Potassium :**

The deficiency symptoms include orange yellow colour of old leaves, scorching along the margins, reduction in total leaf area, curving of midribs etc. Choking of leaves delay flower initiation leading to reduction in yield and quality.

Control : Spraying Potassium Sulphate (1%) solution on the leaves is recommended.

#### **Calcium:**

The deficiency symptoms include deformation or absence of leaf lamina (spike leaf), marginal leaf necrosis and thickening of veins.

Control : Application of lime (50g/plant) followed by irrigation is recommended.

#### **Magnesium:**

Yellow discolouration is observed in the mid blade and midrib portion however the margins of the leaf remain green. Purple mottling of the petioles, marginal necrosis and separation of leaf sheaths from the pseudostem is also seen.

Control : Application of Magnesium Sulphate (25g/plant) followed by irrigation is recommended.

### **Sulphur:**

The deficiency symptoms include yellow or white appearance of young leaves, necrotic patches on the leaf margins, thickening of veins, stunted growth and small or choked bunches.

Control: Application of complex fertilizer (20:20:0:15) @ 20 g/plant followed by irrigation is recommended.

### **Manganese:**

Narrow green edge appears at the leaf margins of second or third youngest leaf, which further spreads along the main veins towards the midrib. However, the interveinal areas remain green giving comb tooth appearance.

Control: Spraying Manganese Sulphate (0.5%) on the leaves is recommended.

### **Zinc:**

Symptoms appear mostly in limed soils or soils with high pH. Young leaves become smaller in size and more lanceolate in shape. In the furling leaf high amount of anthocyanin pigmentation appear on its underside. The unfurled leaf has alternating chlorotic and green bands. Fruit is light green, twisted, short and thin.

Control: Spraying Zinc Sulphate (0.5%) on the leaves is recommended.

### **Iron:**

The younger leaves turn yellow or white.

Control: Spraying Iron Sulphate (0.5%) along with Urea (1%) on the leaves is recommended.

### **Copper:**

Both young and old leaves show symptoms of chlorosis and curve towards the base, which gives an umbrella like appearance to the plant.

Control: Spraying Copper Sulphate (0.5%) on the leaves is recommended.

### **Boron :**



Deficiency symptoms include reduced leaf area, curling of leaves, lamina deformation, appearance of white stripes perpendicular to the veins on the lamina of young leaves, thickening of secondary veins and inhibition of root and flower formation.

Control : Application of Borax salt (25 g/plant) in the soil around the root zone of the plant is recommended.

### **Intercultural operations**

#### **Weed Control:**

Regular weeding is important during the first four months. Spading is commonly used and normally four spadings a year are effective in controlling weeds. Integrated weed management by including cover crops, judicious use of herbicides, intercropping and hand weeding wherever necessary will contribute in increased production.

Pre-emergence application of Diuron (1kg a.i./ha) or Glyphosate (2 kg a.i./ha) is effective in controlling grasses and broad-leaved weeds without affecting the yield and quality of banana. Double cropping of cowpea is equally effective in suppressing the weed growth.

#### **Intercropping :**

Intercropping can easily be raised in banana plantation at the early stages of growth. Vegetable and flower crops like radishes, cauliflower, cabbage, spinach, chilli, brinjal, lady's finger, gourds, marigold, and tuberose can be successfully grown as intercrop. Mixed cropping with arecanut coconut and cassava is a common and widely adopted practice in South India.

#### **Desuckering :**

During the life cycle, banana produces number of suckers from the underground stem. If all these suckers are allowed to grow, they grow at the expense of the growth of the main plant and hence the growth of the sucker should be discouraged. Removal of unwanted suckers is one of the most critical operations in banana cultivation and is known as desuckering. Such suckers are removed either by cutting them off or the heart may be destroyed without detaching the sucker from the parent plant. Removal of suckers with a portion of corm at an interval of 5-6 weeks hastened shooting and increased the yield.

#### **Earthing Up:**

In case of furrow planting earthing up should be done during rainy season to avoid water logging while during winter and summer the plant should be in the furrow.

#### **Propping:**

Propping operation is carried out in areas with high wind speeds. Pseudostems are propped up with bamboo, especially, at the time of bunch emergence.

### **Leaf Removal :**

Pruning of surplus leaves helps to reduce the disease from spreading through old leaves. Leaf pruning can change light and temperature factors of microclimate. Pruning of leaves before bunch initiation delays flowering and harvesting cycle. For maximum yields a minimum of 12 leaves are to be retained.

### **Bunch Covering :**

Bagging (bunch covering) is a cultural technique used by planters where export quality bananas are grown. This practice protects bunches against cold, sun scorching, against attack of thrips and scarring beetle. It also improves certain visual qualities of the fruits. Bunch covering with dry leaves is a common practice in India.

### **Removal of Male Flower Bud:**

Removal of male bud after completion of female phase is necessary. Once the process of fruit setting is over, the inflorescence rachis should be cut beyond the last hand otherwise it grows at the cost of fruit development. This helps in early maturity of the bunch.

### **Harvesting of banana:**

Irrigation of banana plantations should be stopped well in advance of the harvest date, preferably a week, so as to facilitate drying of the soil for movement of labour, harvesting, loading, etc. Temporary sheds should be erected near banana fields and all operations such as cutting into hands, application of fungicidal paste should be carried out under the shade. Bunches selected should be green, three-fourths ripe, whole, free from rubbing, scratching, bruises, sunburns or other blemishes. Bunches having malformed fingers, octopus-shaped hands, broken, torn or split fingers etc. should be rejected. Three quarters full stage is recognized by sharp angularities of the fingers. In some banana growing countries, the bunches are marked with date and month as soon as the inflorescence is shot. Under irrigated conditions the variety 'Dwarf Cavendish' takes 99-107 days to reach three quarters full maturity. 'Dwarf Cavendish' banana at three-fourths full maturity shows a pulp skin ratio of 1.35 to 1.40 under normal conditions and this gives a fairly accurate index of maturity. For cutting (harvesting) the bunches, one cutter and one helper are required. The bunch should be cut in one stroke 20 cm to 25 cm above the first band or 7.5 cm to 10 cm from the tip of the fingers of the first hand. The helper should hold the same portion and place it carefully on the freshly cut leaves spread on the ground. The last hand is removed if undersized. For carrying bunches to packing shed it is necessary that after 15 minutes of harvest, when the latex flow ceases, the bunches should be taken two at a time on stretchers and should not be allowed to come into contact with soil.

### **Yield**

Varieties	Yield (t/ha)
-----------	--------------

a) Dwarf Cavendish	30-40
b) Robusta	38-45
c) Other varieties	20-30