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## **UNIT 2 BANANA (*MUSA ACUMINATA* & *M. BALBISIANA*)**

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### **Structure**

- 2.0 Objectives
- 2.1 Introduction
- 2.2 Area and Production
- 2.3 Soil
- 2.4 Climate
- 2.5 Commercial Varieties
  - 2.5.1 Poovan
  - 2.5.2 Dwarf Cavendish
  - 2.5.3 Harichal
  - 2.5.4 Kanchkela
  - 2.5.5 Martaman
  - 2.5.6 Lalkela
  - 2.5.7 Nendran
  - 2.5.8 Gros Michel
  - 2.5.9 Safed Velchi
  - 2.5.10 Hill Banana
  - 2.5.11 Giant Governor
  - 2.5.12 Co1. Banana
- 2.6 Planting
- 2.7 Propagation
- 2.8 Nutritional Requirement
- 2.9 Cultural Practices
  - 2.9.1 Irrigation
  - 2.9.2 Inter-cropping
  - 2.9.3 De-suckering
  - 2.9.4 Weed Control
  - 2.9.5 Earthing Up
  - 2.9.6 Trashing, Propping, Wrapping and Mattocking
- 2.10 Insect-Pest and Diseases
  - 2.10.1 Insect-pest
    - 2.10.1.1 Banana stem borer
    - 2.10.1.2 Banana aphid
    - 2.10.1.3 Thrips
    - 2.10.1.4 Moth
    - 2.10.1.5 Banana beetle
    - 2.10.1.6 Nematodes

## 2.10.2 Diseases

2.10.2.1 Panama Disease or Banana Wilt

2.10.2.2 Leaf spot or Sigatoka Disease

2.10.2.3 Bacterial Wilt

2.10.2.4 Bunchy Top

2.10.2.5 Banana Mosaic

2.11 Harvesting

2.12 Storage

2.13 Packaging and Transportation

2.14 Let Us Sum Up

2.15 Key Words

2.16 Further References

2.17 Answers To Check Your Progress Exercises

## 2.0 OBJECTIVES

After going through this unit, you will be in a position to:

- explain the botany and uses of banana,
- assess status of area and production of banana in the world and country,
- describe the soil, climatic and nutritional requirement,
- identify the different varieties by their names and characteristics,
- describe the planting and propagation methods and other cultural practices,
- describe various pests-diseases and physiological disorders, and
- explain how and when the harvesting, storing, packaging and transportation to be done.

## 2.1 INTRODUCTION

Banana is an important fruit crop for majority of world population, especially in the tropics. It is one of the oldest fruits and second largest growing fruit crop in the world. It is also known as the “Adam’s Fig” and “Apple of Paradise”. The edible banana is native to old world especially South East Asia. The banana belongs to the family Musaceae. There are only two genera *viz.* **Ensete** and **Musa** with about 50 species in the family. *Ensete* is an old declining genus and has about 6-7



## Sub Tropical Fruits

species, *Musa* genus have 40 species of perennial, stooling or rhizomatous herbs are found in South Eastern Asia and Pacific. The genus *Musa* is divided into five sections. Out of these **Enmusa sections** the edible banana was related to two wild species viz. *Musa acuminata* and *M. balbisiana*.

Banana is a good source of vitamin A and a fair source of vitamin C and B<sub>2</sub>. Its fruits are rich source of minerals like magnesium, sodium, potassium and phosphorous and fair source of calcium and iron. Ripe fruits are delicious and are used for table purpose. The immature fruits are used for vegetable. Many products are made from banana such as banana chips, soft drink, flour and jam. The



end of inflorescence **technically known as pendant** is cooked as a vegetable in Bengal. Banana ash is rich in alkaline salts and therefore can check acidity in stomach, heart burn and colic. Ripe fruits taken with Tamarind and salt are said to control dysentery.

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## 2.2 AREA AND PRODUCTION

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Banana is widely grown in countries like Mexico, Philippines, Uganda, Thailand, Kenya, Brazil, Ecuador, Egypt, Ghana etc. Total area under banana in India is 883.77 thousand ha and production is 30807.50 thousand mt. Banana is the second largest fruit after mango accounting for 36.5 per cent of total fruit production from 11.0 per cent of area. Tamil Nadu, Maharashtra, Gujarat, Orissa, Karnataka, Kerala, West Bengal, Andhra Pradesh, Assam, Bihar and Madhya Pradesh are major banana growing states. Productivity is highest in Andhra Pradesh and lowest in Kerala.

**Table 1 :** Statewise area, production and productivity in total of banana during 2017-18.

Sl. No.	State	Area (000 ha.)	Production (000 mt.)	Productivity ha/mt
1	Tamil Nadu	82.63	3205.04	38.79
2	Maharashtra	80.88	4209.27	52.05
3	Gujarat	68.15	4472.32	65.63
4	Andhra Pradesh	88.96	5003.07	56.24
5	Karnataka	110.55	2328.90	21.07
6	Bihar	31.07	1396.39	44.94
7	West Bengal	49.30	1200.00	24.34
8	Madhya Pradesh	26.38	913.27	69.54
9	Assam	53.08	1834.03	17.20
10	Kerala	109.26	1119.16	10.24
11	Utter Pradesh	67.38	3172.33	45.73
12	Others	114.13	1953.72	17.12
	<b>Total</b>	<b>883.77</b>	<b>30807.50</b>	<b>462.89</b>

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## 2.3 SOIL

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Banana can be grown in almost all types of soils provided adequate soil moisture is available. Deep, well drained, friable loamy soil with adequate organic matter is ideal for its cultivation. Sandy soil of the coastal areas of Maharashtra, black cotton soils of plains, black and lighter soils of East Khandesh, alluvial to slightly open loamy soil of Tamil Nadu and Andhra Pradesh are also suitable for banana cultivation. This fruit has a restricted root zone. Therefore, depth and drainage are the two most important factors in selecting the soil for banana. The minimum depth necessary is about a metre. Alkaline soils are also preferable in banana cultivation to avoid the wilt disease, which is more severe in acidic soils.

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## 2.4 CLIMATE

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The banana is basically a plant of the humid tropics, but is adapted to a wide range of climatic conditions ranging from wet tropical to dry subtropical. It can be grown from sea level to an altitude of 1200 metre. It grows well to a temperature range between 10°C to 40°C. Unfavourable weather conditions leads to the breakage or uprooting of pseudo stem by storm, reduction in plant growth and malformation of bunches due to low temperature etc. Frost is the limiting factor for successful cultivation of banana. In cooler climate the crop requires longer time to mature. Hot winds blowing in high speed during the summer months, shed and desiccate the leaves. On an average 100 mm rainfall per month appears to be satisfactory for growth of banana. Stagnation of water is injurious and may cause diseases like Panama wilt.

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## 2.5 COMMERCIAL VARIETIES

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There are about 300 recorded cultivars of banana. The important cultivars are described below:

### 2.5.1 Poovan

Musa (AAB) Group. Syn. Poovan (Tamil Nadu), Champa (West Bengal), Lal Velchi (Maharashtra), Karpura Chakrakeli (Andhra Pradesh), Palayangodan (Kerala), Kadali (Tamil Nadu), Dora Vazhai (Nilgiris).



It is commercially grown in West Bengal, Andhra Pradesh, Tamil Nadu and Kerala. The plant is tall, hardy and grows vigorously under the ratooning system of cultivation. The fruit is small. Skin is yellow and thin, flesh firm, sweet with a pleasant sourish taste. There is rose pink colouration of the other side of the mid rib when leaves are young. It has a good keeping quality. It is resistant to Panama wilt and fairly resistant to bunchy top disease. The average bunch weight is about 15 kg and has 200-225 fruits.

### 2.5.2 Dwarf Cavendish

Musa (AAA) Group. Syn. Basrai, Loton (Maharashtra), Kabuli (West Bengal), Vaman Keli, Bhusaval (Andhra Pradesh), Pacha Vazhai, Mauritius, Kuzhivazhai (Tamil Nadu), Basrai Dwarf (Gujarat). This variety is grown commercially in Maharashtra.

The plant of this variety is dwarf with only 1.5-2.0 m in height. The fruits are large and curved. The skin is thick and greenish. The flesh is soft and sweet. The variety is susceptible to cold. Fruits ripened at high temperature, often develop black spots on it, hence name Chittidar. It a high yielding variety but keeping quality is poor. A bunch on an average weighs about 20 kg. The fruit tends to drop off from the bunch when ripe. It does not bear fertile male flowers. The variety is susceptible to bunchy top and leaf spot but resistant to Panama wilt.

### 2.5.3 Harichal

Musa (AAA) Group Syn. Bombay Green (Maharashtra) Peddapachaarti (Andhra Pradesh), Robusta (Tamil Nadu).

It is an important variety commercially grown in Maharashtra. It is a semi-tall sport of Dwarf Cavendish. It is similar to Basrai except that the fruit is more green and straight, the bunch is more symmetrical and the plant taller. Fruit large, skin thick, greenish to dull yellow, sweet and delicious. The fruits have better keeping quality than that of Dwarf Cavendish. It prefers a moist coastal climate. Average bunch weight is about 20 kg.

### 2.5.4 Kanchkela

Musa (ABB) Group. Syn. Khasdia (Gujarat), Monthan (Tamil Nadu), Bontha (Andhra Pradesh), Maduranga Bale, Aunda Bale, Mangakai (Karnataka), Khasdi, Bankel (Maharashtra), Bainsa (Bihar), Ponthan (Kerala), Batisa (Odisha), Bluggoe (Trinidad), Pisang Nanka (Malaysia).

This is the most important commercial culinary banana cultivar of India. The plant is tall, robust, light green leaves. The plant is hardy and somewhat drought tolerant. The skin is thick. The fruits having prominent three ridges. It can withstand cold better. Keeping quality is good. Average bunch weight is approximately 15 kg.

### 2.5.5 Martaman

Musa (ABB) Group. Syn. Rasthali (Tamil Nadu), Mutheli (Maharashtra), Malbhog (Bihar), Amruthapani (Andhra Pradesh), Rasabale (Karnataka), Sonkel (Kerala), Silkfig (Trinidad).

It is the most liked table variety of West Bengal. The plant is tall, yellowish-green stem, the brownish blotches, reddish margins of the petiole and leaf sheath. The average bunch weight is about 12 kg. Fruits are medium-sized and similar to that of Poovan in appearance. It is susceptible to Panama disease and ripe fruit drop off from the bunch. The plant has better root system and can resist wind better than other varieties.

### 2.5.6 Lalkela

Musa (AAA) Group. Syn. Chenkadali, Sevazhi (Tamil Nadu), Anupan (Bihar), Rathambala (Sri Lanka), Red banana (Trinidad).

This variety is grown throughout the world. This is the most robust of the bananas grown in India. The height of the plant goes up to 4-5 metres. The colour of the Pseudostem, petiole, midrib and fruit is purplish red. The fruit is of good size and has a characteristic aroma. The skin is thick, pulp is saffron coloured, firm, fairly moist and sweet. The variety has a free suckering habit.

### 2.5.7 Nendran

Musa (AAB) Group Syn. Nendran, Ethakai (Kerala), Rajeli (Maharashtra), Kochikehal (Sri Lanka) Plantain (Trinidad).

It is cultivated on commercial scale in Kerala. It has habit of producing more suckers. The pseudostem has a distinct shade of pink of colouration. The fruit is relatively longer and thicker than most other bananas. The bunch is not compact and average weight is 15 kg. Keeping quality is good. The variety is suitable for the preparation of banana flour, banana chips and drying as fig.

### 2.5.8 Gros Michel

Musa (AAA) Group. Syn. Anamalu (Sri Lanka), Blue Field (Hawaii).

The variety was introduced in South India from Trinidad. It is the best dessert variety and excels other varieties in length of bunch, number of fruits, flavour, attractive skin colour and resistant to bruising. It is susceptible to wilt disease.

### 2.5.9 Safed Velchi

Musa (AB) Group. Syn. Sonery (Maharashtra), Ney Poovan (Tamil Nadu), Nhali Poovan (Kerala), Kadali (Malabar), Nitka Bale, Deva Bale (Karnataka).

The variety is popular in Kerala and Maharashtra and mostly grown as intercrop in coconut and arecanut garden. The plant is tall, stem is slender. Pseudostem is yellowish having reddish petiole margin. The fruits are small, firm fleshed and sweet. Keeping quality is very good. The average bunch weight is about 10-12 kg.

### 2.5.10 Hill Banana

Musa (AAB) Group. Virupakshi Syn. Mala Vazhai.

The banana is a speciality of Tamil Nadu. These are perennial bananas of high quality. Sirumalai and Virupakshi are the two main types. Fruits of Sirumalai have better taste. The average bunch weight is about 12 kg. The duration of the variety is about 14 months.

### 2.5.11 Giant Governer

Musa (AAA) Group. It is popular in West Bengal. The plant is medium dwarf. The fruits are large, greenish to dull yellow in colour. The pulp is firm and

taste is sweet. It produces bunch weighing 15-18 kg. The variety is susceptible to leaf spot disease (Sigatoka) but resistant to wilt.

### **2.5.12 Co1. Banana**

It is a hybrid developed at Tamil Nadu Agricultural University, Coimbatore. It is a multi-crosses made among 'Ladan' as female parent and *Musa balbisiana* and 'Kadali' as a male parents. It takes about 14 month duration. The average bunch weight is 10 kg.

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## **2.6 PLANTING**

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The land should be deeply ploughed, harrowed and leveled properly. Pits of 60 x 60 x 60 cm are dug sufficiently ahead at points fixed for planting. The pits are filled with a mixture of top soil and farmyard manure or compost. The plant population per unit area depends on cultivar, topography, soil fertility, de-suckering, various aspects of management, duration of plantation etc. in general tall cultivars are given wider spacing than the dwarf ones. High density planting may be practiced in mono crop culture, while wider spacing is advocated for the ratoon crop. The suckers detached from the mother plants are planted in the centre of the pit and pressed well around the base. Immediately after planting, light irrigation should be given.

Planting time depends mainly on the climatic conditions and availability of water. Banana can be planted throughout the year except in severe winter and during heavy rains when the soil is very wet. In the areas of heavy or continuous rains, planting of banana should be done after Monsoon i.e. in September - October. In the areas where the rains are not so heavy, planting should be done during June - July. In the areas where assured irrigation is available, planting can be successfully done in February - March. The planting in the hill slopes of South India is done during February - March and on the banks of the Cauvery river in April.

A spacing of 2.7 m x 3.0 m (row x plant) for tall cultivar and 1.8 m x 1.8 m (row x plant) for dwarf cultivars were found most suitable. For dwarf varieties, the distance of 1.2 m x 1.2 m and 1.8 m x 1.8 m can also be kept profitably. On the other hand, for tall and semi-tall varieties, the distance of 2.4 m x 1.8 m, 2.4 m x 2.4 m and 2.5m x 2.5 m were also found equally suitable.

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## **2.7 PROPAGATION**

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Banana is commonly propagated by suckers. When plants are multiplied through suckers, two types of suckers namely sword suckers and water suckers are used. Sword suckers have a well developed base with narrow sword shaped leaf blades at the early stages. The water suckers are having broad leaves and they don't produce a healthy banana clump. Planters throughout the world usually plant sturdy and healthy sword suckers. The sword suckers are vigorous, produce bigger and heavier bunches in 11 months than the water suckers do in more than 15 months. The sword suckers are planted when they attain the height of 80-120 cm. heading back of tall sucker is beneficial. The suckers should be vigorously growing and must have attained 2 kg weight.

The suckers should have narrow, sword shaped leaves. The base of the suckers should be thick and tapering towards the top. Suckers should be free from any pests and diseases. Peepers (very young suckers) produce late and poor crop.



**Raising of the banana plants from the suckers in the pots**

Rhizomes either whole or pieces (1.5 to 2.0 kg or so in weight) may be planted first in the nursery for sprouting or directly in the main field. For quick multiplication of a variety, rhizome bits may be used, though the plants will require little longer time to fruit. The shape of the rhizome should be conical but not flat. It must have a sound heart bud and side buds.

## 2.8 NUTRITIONAL REQUIREMENT

The nutritional requirement of banana is very high. It is mainly exploited from a very limited soil depth due to shallow root system of the crop. The choice and the dosages of nutrients to be applied depend on the cultivar, initial soil fertility, stage of plant growth, climate etc. The growth of the plant severely affect due to nitrogen deficiency and older leaf showed sign of chlorosis. A complete dose of manures and fertilizers should be applied by six months after planting. Nitrogen hastens maturity and increases yield. Phosphorous promotes strong root system, healthy rhizome, favours fruit setting and accelerates ripening. Potash increases the number of hands/bunch and finger size, improves fruit quality, develops resistance to diseases and reduces water uptake in banana. Banana needs heavy manure near the soil surface because of their shallow rooting.

The application of nitrogen should be done at 2, 4 and 6 months after planting. Phosphorous should be applied at planting time. Potash should be given in two split doses i.e. one at planting and another at the time of initiation of flowers. The following doses of manures and fertilizers are given to banana crop in different important banana producing states. (Table-2).

**Table 2:** Manures and fertilizers doses for Bananan growing states.

States	FYM (kg/plant)	g/plant		
		Nitrogen	Phosphorous	Potassium
Andhra Pradesh	10 – 15	600	720	600
Bihar	9	125	80	225
Gujarat	10 – 15	180	90	180



## Sub Tropical Fruits

Karnataka	15	200	120	250
Kerala				
Irrigated	10	190	115	300
Rainfed	10	100	200	400
Madhya Pradesh	20	230	160	300
Odisha	10	80	32	90
Tamil Nadu	10	110	35	330
West Bengal				
Robusta	10 – 15	140	35	90
Cavendish	10 – 15	90	35	90

### Check Your Progress Exercise 1

**Note:** a) Space is given below for the answer.

b) Compare your answer with that given at the end of the unit.

1. Write down the soil and climatic requirement of banana.

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2. How can we propagate banana ?

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## 2.9 CULTURAL PRACTICES

### 2.9.1 Irrigation

Water requirement of banana varies according to topography, soil, climate, cultivar and type of culture. If there is no rain, the plants should be irrigated immediately after planting. The soil in banana plantation should not be allowed to dry completely. It is moisture loving plant, therefore water requirement is very high. It requires adequate soils moisture throughout the year. Banana is normally grown as a rainfed perennial crop in the western coast of India. In the hilly areas also no irrigation is applied. In Bihar, irrigation is given at every 10 days interval from December to June. More irrigation is required in north Gujarat and East Khandesh. In banana, trenches are dug between alternate rows which serve to drain off excess water during the rains and later as irrigation channels. In West Bengal, during dry periods the plants are irrigated at an interval of 10-15 days. Tall cultivars in West Bengal are grown under un-irrigated condition or marginally irrigated condition.

Drip irrigation can reduce quantity of water and increases yield and decreases number of days to harvest and increases leaf production. Dry soil conditions adversely affect the banana yield, because there is reduction in stomatal size which interferes with carbon dioxide supply and in turn it reduces the photosynthetic efficiency.

### **2.9.2 Inter-cropping**

At the earlier stages of growth, intercrops can easily be grown in banana plantation. Mixed cropping is also practiced in some parts of India. Depending upon the climatic conditions different vegetables crops like brinjal, colocasia, turmeric, chillies, okra, radish, cauliflower, cabbage should be grown as intercrops. In mixed cropping of banana; arecanut, coconut growing is a common practice along the coastal belts of Tamil Nadu. Paddy is also grown as mixed crop. Banana is grown as a shade plant for coffee, cocoa, rubber, young mango trees and orange in different parts of India.

### **2.9.3 De-suckering**

Suckers are produced from the rhizome of banana. The numbers of suckers produced per clump varies depending on cultivar, soil fertility, environment etc. Removal of unwanted suckers is one of the most critical operations in banana cultivation and is known as de-suckering. It is done either by cutting off the sucker or the heart may be destroyed without detaching the suckers from the parent plant.

Removal of all suckers up to flowering of mother plant and maintaining only one follower afterwards is the best de-suckering practice. However, under high density planting, it is better to leave the follower after harvesting 75-80 per cent of the plant crop so that uniform cultural practices can be followed.

### **2.9.4 Weed Control**

In banana, weed is a problem at the early stage of growth. Weed free environment is essential in banana field, for conservation of moisture, proper utilization of nutrients, as well as for effective control of pests and diseases. Spading is the usual method of controlling weeds. Shallow cultivation at early stage of crop is essential to keep down the weeds and to provide better conditions for plant growth. Weeds can also be checked with the use of herbicides. Diuron @ 4 kg/ha. and Simazine @ 6 kg/ha. control grasses and broad leaved weeds when applied after planting and repeated 30 days after planting.

### **2.9.5 Earthing Up**

Earthing up should be done during the rainy season to provide drainage and to avoid waterlogging at the base. During summer and winter the plants should be in furrows and on ridges during rainy season. There is a chance of the clump growing out of the soil.

### **2.9.6 Trashing, Propping, Wrapping and Mattocking**

Lot of undesirable material grows in the banana field which must be removed

## Sub Tropical Fruits

from time to time. Removal of undesirable material such as dried, diseased and decayed leaves, pseudostem after harvest, male bud, last end of inflorescence and withered floral parts is **known as trashing**.

**Propping** is a method by which support is given to banana bearing plants with the help of bamboo crutches, protecting them from bending or falling down, due to heavy bunch load and from any damage by wind. Propping is very essential for all tall varieties.

**Wrapping** is the covering of bunches with polythene or gunny cloth that protects the fruits, from intense heat, hot wind etc and improves the colour of fruits.

After the harvest of bunch, the plant stem should be cut in stages at least after 30-45 days to facilitate mobilization of the nutrients from the mother to the developing ratoon plant. The pseudostem should be cut leaving a stump of about 0.6 m height. This is **known as Mattocking**.

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### Check Your Progress Exercise 2

**Note:** a) Space is given below for the answer.

b) Compare your answer with that given at the end of the unit.

1. Define de-suckering.

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2. Differentiate between Trashing and Propping.

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## 2.10 INSECT-PEST AND DISEASES

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A number of pests and diseases attack the Banana plant which have been described below:

### 2.10.1 Insect-pest

The most common pests reported to cause heavy losses in banana are the following

#### 2.10.1.1 Banana stem borer (*Odoiporus longicollis*)

The larva of the insects feeds and tunnels inside the corm. The corm becomes riddled with a tunnel which rots into a blackened mass. Leaves turn yellow, wither and the whole plant dies.

The insects were controlled with Celphos @ 3 tablets/plant. After placing,

the tablets inside the pseudostem, the silt should be plastered with mud. Follow clean cultivation practices or remove all infested plants and destroy them. Apply 0.1 per cent Carbaryl dust to control the borers.

#### **2.10.1.2 Banana Aphid (*Pentalonia nigronervosa*)**

The pest is minor but of major importance. The nymphs and adult suck the sap from young and tender leaves. The aphids transmit virus causing bunchy top disease which is very harmful.

Spray 0.03 per cent Rogor 30 EC (dimethoate), or Phosphamidon or Monocrotophos or 0.05 per cent Malathion or 0.01 per cent Metasystox. Soil application of Phorate or Carbofuran at 4.5 kg/ha near the base of suckers or rhizome at the time of planting is beneficial.

#### **2.10.1.3 Thrips**

The damage done by thrips is by oviposition on the young fruits harm them and in severe cases they become rough.

It can be controlled by covering the bunches between February and May and by applying DDVP as piran (dichlorvos) at 19 per cent a.i. impregnated in 0.5 g plastic cones.

#### **2.10.1.4 Moth**

The damage done by the pest is primarily caused by larval feeding on the female flowers and young fruits.

Monocrotophos @ 0.02 per cent spray or Diazon @ 1 per cent spray gives effective control of scab moth (*Nacoleia octasema*).

#### **2.10.1.5 Banana Beetle (*Colaspis hypochlora*)**

The beetle feeds on young leaves and skin of young fruits. Occurrence of this pest is usually maximum during the rainy season. Severe scarring of fruit skin leads to underdeveloped fruit which fetches fewer prices in the market.

Clean cultivation, particularly the removal of grass weeds from plantations, where the population of this pest is high, can often reduce the population levels enough to avoid the use of insecticides. Dusting with Malathion is also effective.

#### **2.10.1.6 Nematodes**

Nematodes are now recognized as an important soil borne pathogens causing decline in yield of bananas. Affected plants don't response to fertilizer, irrigation and cultural practices. Small dark spots appear on the root. The nematode lays eggs in the root tissue. After hatching out, larvae also feed on the root. Plant growth is retarded and yield is adversely affected.

Banana sets may be disinfected either by paring, heat therapy, and chemical treatment or by combination of these methods. The paired sets can be disinfected by dipping them in a hot water bath at 55°C for 10 minutes or soil application of carbofuran at 2 kg a.i. per hectare can check the nematodes.

## 2.10.2 Diseases

Banana is much more vulnerable to diseases than to the insect-pests. The diseases often occur in epidemic proportions and bring about heavy losses. Of the diseases Panama disease or banana wilt, leaf spot or sigatoka disease and bunchy top have been found to profoundly alter banana production.

### 2.10.2.1 Panama disease or Banana wilt (*Fusarium oxysporum*)

The disease was first reported from Panama in early 1900 century. It is one of most important soil borne disease affecting banana plant. Symptoms of disease consist of successive wilting and drying up of leaves. Numerous brown and reddish streaks will be seen, running through the corm upwards.



**Banana Wilt**

The diseased plants should be uprooted and burnt. Highly infected soil should not be replanted with banana at least for 3-4 years. Use of disease free planting material and resistant cultivars are recommended. Other measures include use of quick lime near the base of the plant and soaking with water. Apply Bavistin @ 1 g per litre. Apply major portion of nutrients (NPK) in the form of farmyard manure and groundnut cake.

### 2.10.2.2 Leaf Spot or Sigatoka Disease (*Mycosphaerella musicola* – Sexual Stage and *Cercospora musae* – asexual stage)

This disease caused epidemic in Sigatoka valley in Fiji in 1913 and the name sigatoka disease comes from this place. It is a fungal disease. Infection occurs through the stomata of the young leaves. The size of bunch and fruit is reduced due to lesser leaf area available for photosynthesis. High humidity causes due to close planting, heavy weed or grass cover and failure to remove suckers, favour in spreading the disease.



**Leaf Spot Diseases of Banana**

Proper drainage of the field is very important for control of this disease. Avoid too close planting and remove suckers and weeds regularly. Affected leaves should be removed and destroyed. Application of three weekly sprays of Bordeaux mixture (4:5:50) is also effective. Fungicides mixed with oil have also been found effective to control the disease.

### 2.10.2.3 Bacterial Wilt (*Pseudomonas solanacearum*)

Commonly known as Moko disease is prevalent in Tropical America, but not uncommon in Asian and African countries. The symptoms of bacterial wilt

are very often confused with those of Panama wilt. Bunches of infected plants showing premature ripening of isolated fingers, often indicate the presence of Moko disease. The other symptom is blackened fruit rot. The disease is spread by soil contact, infected pruning knives, flower visiting insects and diseased planting material. The disease is most severe in wet land.

The disease is controlled by phyto-sanitation practices. In acute infection of fields, fallowing should be practiced. Destruction of infected plants and control of flower visiting insects minimize the incidence of the disease. Resistant varieties like “Morthoman”, “Rasthali” atc. may be considered for cultivation in the infected field.

#### 2.10.2.4 Bunchy Top

It is a viral disease transmitted to healthy plants by the aphid (*Pentalonia nigronervosa*). The dwarf bananas are very susceptible to this disease. The leaves of badly infected plants are bunched together at the top, forming a rosette. The diseased plants remain stunted in growth and does not produce bunch of any commercial value. Virus carrying aphid is most often found at ground level on the base of the plant.



**Bunchy top disease of Banana**

Always plant virus free sucker obtained from reliable nursery. Remove all affected plants along with complete rhizome. Spray of 0.3 per cent Rogor or Phosphamidon or Monocrotophos (0.05 %) is found beneficial. Never allow banana plants/clumps a place for more than 3 years. Herbicide like 2,4-D may be applied on the stool after cutting down for effective killing of the plant.

#### 2.10.2.5 Banana Mosaic

A viral disease caused by CMV. Abnormal thickening of leaf veins is one of the common symptoms. The possible vector is *Aphis maidis*, *A. gossypi* and *Pentalonia nigronervosa*. To check the spread of the disease, the field should be kept weed free. The infected suckers should not be planted and the insecticides should be sprayed regularly to control the vector.

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## 2.11 HARVESTING

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Banana is climacteric fruit. Fruit does not ripe early and uniformly on the plant. Banana comes into flowering in nine months or so after planting. The fruits become ready in 3-4 months after flowering. In this way, it is a one year crop under good crop management. They are harvested when they are green and fully mature. **The fruits are harvested when top leaves start drying.** The colour of the fruit changes from deep green to a lighter green. Shed the floral ends of the fruits with slightest touch of the hand. The angles or ridges of the fruits become less prominent or they become round i.e. after the attainment of 3/4<sup>th</sup> full stage.

The harvesting is performed by cutting the bunch retaining 15-20 cm stalk this will help in handling. Sometimes partial harvesting is done when fruits are required for vegetable purposes. Average yield of dwarf varieties is 300-400 quintals/ha and tall varieties 150-200 quintals/ha.

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## 2.12 STORAGE

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After harvesting banana is subjected to either storage or ripening. The fruits can be stored at a temperature of 13°C and a relative humidity of 85-95 per cent for about three weeks. At low temperatures, the banana fruits become black due to chilling injury and therefore they should not be placed in refrigerator. Storage life can be prolonged by keeping the fruit in relatively high concentration of CO<sub>2</sub> and low concentration of O<sub>2</sub>. Ripening of banana fruits can easily be retarded for 10-12 days at ambient temperature (about 30°C) held in sealed polythene bags. Mature green banana fruits after harvesting resulted in reducing ripening without affecting fruit quality when they are immersed in hot water at 50°C for 15 min. or 54°C for 10 min. Shelf life of banana fruits and their quality can also be extended with the use of ethylene absorbent like vermiculite blocks when they are soaked in potassium permanganate at 100 g/litre and inserted into polythene bags each holding one hand with 12 fruits.

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## 2.13 PACKAGING AND TRANSPORTATION

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The bananas are harvested in bunches which are intact without any injury to the fruits. For packing purpose, the fruits from the bunches may be separated carefully, packed in ventilated containers and transported to the distant market by rail, road, ship or air.

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### Check Your Progress Exercise 3

**Note :** a) Space is given below for the answer.

b) Compare your answer with that given at the end of the unit.

1. Write short note on Panama and bunchy top disease.

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2. What are the control measures of Banana stem borer and Banana aphid ?

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3. What are the maturity standards of banana ?

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## 2.14 LET US SUM UP

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In this unit, we have studied about the area, production nutritive value, uses and cultivation of banana along with its harvesting and marketing. You have also studied that how Banana can be planted through out the year except in severe winter and during heavy rains, at a distance of 1.2 to 1.8 m for dwarf cultivars and 2.4 m for tall cultivars. Besides this method of propagation, nutritional requirements. De-suckering, earthing up, trashing, propping, wrapping, mattocking, cultural practices with insects and diseases of banana and their controls have been also studied under this unit.

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## 2.15 KEY WORDS

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- De-suckering** : Removal of unwanted suckers from the base of the mother plant is known as de-suckering.
- Trashing** : Removal of undesirable material such as dried, diseased and decayed leaves, pseudostem after harvest, male bud, last end of inflorescence and withered floral parts is known as trashing.
- Propping** : Giving support to the banana bearing plants with the help of bamboo crutches.
- Mattocking** : The practice of removing banana pseudostem after harvesting of fruit.

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## 2.16 FURTHER REFERENCES

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1. Abdulkhadar, J.B.M. Md., Chellappan, K., Pillai, O.A.A. and Chattopadhyay, P.K. (1985). **Banana. In: Fruits of India. Tropical and Sub-tropical** (ed. T.K. Bose), Naya Prokash, Calcutta.
2. Singh, S.P. (2002). **Commercial Fruits**. Kalyani Publishers, Ludhiana.
3. Singh, R. (1969). **Fruits**. National Book Trust of India, New Delhi.

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## 2.17 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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### Check Your Progress Exercise 1

1. Deep, well drained, friable loamy soil with adequate organic matter is ideal for its cultivation. Banana is a crop of humid tropics, but it can be grown to an altitude of 1200 metre with a temperature ranges between 10 to 40°C.
2. Banana is commercially propagated by suckers. Suckers emerge from the base of the mother plants are called to be as sword suckers. These sword suckers are vigorous, produce bigger and heavier bunches. The sword suckers are planted when they attain the height of 80-120 cm.



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### Check Your Progress Exercise 2

1. Removal of unwanted suckers from the base of the mother plant is known as de-suckering. It is done either by cutting off the sucker or the heart may be destroyed without detaching the suckers from the parent plant.
2. Removal of undesirable material such as dried, diseased and decayed leaves, pseudostem after harvest, male bud, last end of inflorescence and withered floral parts is known as **trashing** while **propping** is the method of giving support to the banana bearing plants with the help of bamboo crutches, protecting them from bending or falling down due to heavy bunch load and from any damage by wind.

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### Check Your Progress Exercise 3

1. Panama disease could be first reported from Panama in early 1900 century. It is a soil borne fungus disease and most serious in poorly drained soil. It gets entry in the plant body through roots. Successive wilting, drying up of leaves, older leaves turn yellow from the margins are its symptoms. The whole plant is erect but dead to rot. The fruits become bottle necked. Such fruits mature unevenly and too rapidly. Uproot the infected plants and burnt them. Use of disease free planting material and resistant cultivars are recommended. Apply Bavistin @ 1 g/litre.

Bunchy top is a viral disease transmitted to healthy plants by the aphid (*Pentalonia nigronervosa*). Dwarf bananas are very susceptible. The leaves are bunched together at the top, forming a rosette. Margins of the leaves become wavy and slightly rolled upwards. The diseased plants remain stunted in growth. Always plant virus free suckers. Remove all affected plants. Spray 0.3 per cent Rogor or Phosphamidon or Monocrotophos (0.05 %) is found beneficial. Herbicide like 2,4 - D may be applied on the stool after cutting down for effective killing of the plant.

2. Banana stem borer could be controlled with Celphos @ 3 tablets/plant. After placing the tablets inside the Pseudostem the silt should be plastered with mud. Follow clean cultivation practices or remove all infested plants and destroy them. Spray 0.04 per cent Endosulphan or 0.1 per cent Carbaryl.

Banana aphid can be controlled by spraying 0.03 per cent Rogor 30 EC (dimethoate), or Phosphamidon or Monocrotophos or 0.05 per cent Malathion or 0.01 per cent Metasystox. Soil application of Phorate or Carbofuran at 4.5 kg/ha near the base of suckers or rhizome at the time of planting is beneficial.

3. Banana is a climacteric fruit. Fruits are harvested when the colour of the fruit turns from deep green to a lighter green, fully mature, top leaves start drying. The angles or ridges of the fruits become less prominent or they become round i.e. after the attainment of 3/4<sup>th</sup> full stage.