CHAPTER II

HISTORY AND CULTIVATION OF BANANA

2.1 Origin

Banana is one of the oldest fruits known to mankind. Its antiquity can be traced back to the Garden of Paradise where Eve was said to have used its leaves to cover her modesty. It may be one of the reasons why banana is called 'Apple of Paradise' and botanically named 'Musa Paradisiaca'. Frequent mention is made of banana in the great Indian epics, Ramayana and Mahabharata.

Musa Paradisiaca are strictly old world plants and predominantly Asian. Many of the cultivated types are mostly in the Assam-Thailand area. The Malayan areas seem to be the primary centre of origin of cultivated bananas. They probably spread outward to areas such as India and Burma. In this peripheral area natural hybridisation occurred to produce hybrid progencies which show the greatest diversification in India.

The dispersal of edible bananas outside Asia might have been accomplished solely by the transport of vegetative materials to areas where the crop could encounter suitable ecological conditions. Its introduction to Africa and the west is comparatively recent. It was
introduced to the East Africa before the time of Christ and then spread to the West Coast of Africa across the tropical centre of the continent; it reached the Mediterranean at about 650 A.D. and was taken to the Pacific by Polynesian travellers at about 1000 A.D. The first introduction to the New World was in 1516 A.D. from the Canary Islands by the Portugues. The Central American Islands subsequently developed the high quality bananas from West Indian varieties. These islands today account for a large proportion of banana exports¹.

According to Rangaswami² banana's orginal home is believed to be India, but it is now a widespread, highly commercial crop in many countries, including Ecuador, Honduras, Panama, Columbia, Costa Rica, Jamaica, Mexico, and Sri Lanka.

It seems likely that bananas have been used by man throughout his history in South-East Asia. Probably, primitive communities in a food gathering stage of evolution would have used the male buds and innersheaths of the pseudostem as a vegetable, as these parts of the plant

are used in the same manner to this day. When settled agriculture began, bananas were probably among the first plants to be domesticated. South East Asia was the earliest home of agriculture and therefore, bananas were probably among the first crop plants.

The first as well as the crucial step in the evolution of the edible bananas was the origin of parthenocropy and seedlessness in Musa acuminata. The most primitive edible bananas were edible diploid strains of M. acuminata which persist in large numbers to this day in South-East Asia. Their area of origin cannot be precisely circumscribed; some, at least, originated in Malaya (or in the islands immediately to the south of the Peninsula) and this may even have been the primary centre of origin of the whole group. Clones of banana like AA, AAB, and ABB are characteristic to India. There appears to be a second centre of diversity of AAB and ABB types in the Phillipine region, on the eastern edge of Malaysia. It seems to be a reasonable assumption that the bananas evolved along with the earliest settled agriculture of South-East Asia and therefore may be some tens of thousands of years old.  

2.2 Early History

The earliest records of banana cultivation come from India. Unmistakable references to the banana occur in the

2a. Simmonds N.W. Banana (Great Britain: Western Printing service, 1959) p.308.
epics of the Pali Buddhist Canon of 600-500 B.C. From that time on references in Indian writings and art are numerous.

In China, the early civilizations were centred on the Yangtze and Yellow rivers and Chinese writings refer only to the cultures of the Cool North. The earliest Chinese reference is dated about 200 A.D.

A broad chronology of banana history is as furnished below:

<table>
<thead>
<tr>
<th>Period</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many Millennia B.C.</td>
<td>Origin of edibility in Musa acuminata spread throughout Malaysia of AA Group polyploidy and hybridization with Musa bolbisiana. Establishment of hybrid polyploid groups (AAB and ABB) in India and probably Eastern Malaysia.</td>
</tr>
<tr>
<td>First Millennium B.C.</td>
<td>Probable major introductions to East Africa, First records of the banana (India, 600-500 B.C.).</td>
</tr>
<tr>
<td>First Millennium A.D.</td>
<td>First Chinese record (100 A.D.); Arab contacts with East African Coast; Probable banana introductions from the East; Introduction to Mediterranean; Mohammedan conquest, 650 A.D.; spread into Polynesia (1000 A.D.).</td>
</tr>
<tr>
<td>Second Millennium A.D.</td>
<td>Introduction from West Africa to Canary Islands by Portuguese (early 15th century); Introduction to New World (Santo Domingo) from Canary Islands (1516) Development of banana export trades (19th Century).</td>
</tr>
</tbody>
</table>

Source: N.W. Simmonds
It seems likely, as we have seen above, that the bananas were distributed through Malaysia to the western fringes of the Pacific at a very early stage in the development. Their movement across the Pacific itself, however, presumably took place much later. It seems to be generally accepted that the Polynesian trans-Pacific movement did not take place until the latter half of the first millennium A.D. and were familiar in their earlier home, somewhere Malaysia. It has been pointed out that Polynesian edible bananas have not yet been identified in Malaysia and that there is some reason to think that they might have come from the Philippine area. Whatever be the route taken by the Polynesians it seems fairly certain that their colonization of the Pacific is of quite recent date.2b

In the Mediterranean in classical times the banana was known only by repute, having been seen in India in 327 B.C. by Alexander the Great and described by Magistrines, Theophrastus and Pliny. All authors seem to agree that the plant itself did not reach the Mediterranean until the Mohammedan conquest of 650 A.D. The time and mode of introduction of banana to Africa is still quite uncertain and widely varying views have been expressed on this subject.2c

2b. Ibid..... p.309
2c. Ibid..... p.310
The banana was carried to the Canary Islands by the Portuguese some time after 1402 and then to the New World. In 1516, Friar Thomas de Berlanga introduced an unidentified clone to Santo Domingo, the first of many introductions made down the years. The possibility of pre-Columbian presence of the banana in America was raised by Humboldt. 3

The clones first identified in the New World were "Silkfig" and French plantain on which were founded the Linnaean species, Musa paradisiaca and M. sapientum; they were present in the West Indies during the seventeenth century Gros Michel and dwarf cavendish were introduced early in the nineteenth century and several other clones were introduced to Dominica Kew in 1902. The time of introduction of other cultivars is unknown 3a.

Ranjit Singh 4 describes banana as one of the oldest fruits of the world. Its names "Adam's fig", Apple of Paradise and the botanical name M. Paradisiaca are suggestive of its antiquity. The edible banana is

3. Ibid.... p.308
3a. Ibid.... p.309
indigenous to the warm moist parts of Asia and probably originated somewhere in the mountainous regions of Assam, Burma, Thailand or Indochina. From here it has spread to tropical parts of America, Africa, Australia, the Philippines and Hawaii. When Alexander invaded India in 327 B.C. the Greek people were greatly impressed by the bananas growing in the Indus valley. The banana appears to have been taken to Palestine and Egypt from India in the 7th Century A.D. by the Arabs.  

It is not only the staple food of millions of people, but is also the most important commercial fruit of the tropical areas of the world now. Its cultivation has developed most in tropical America and has become highly industrialised. Honduras, Jamaica, Brazil and Mexico are the biggest exporters of banana. The United Fruit Company of Central America which grows, buys and exports banana in this area is an empire in itself and operates in several countries. It is the biggest farming organisation in the world and owns several refrigerated ships to take banana to North America and Europe.

Cherian believes India to be the original home of banana. It has been cultivated in this country since remote times. Greek, Latin and Arab writers have in their

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4a Ibid., p.1
old works referred to the banana as a remarkable Indian fruit. Commerce in banana, it is true, is of comparatively recent development, but the cultivation of the plant dates from the earliest historical times as evidenced by the monuments of Assyriya and Egypt. When Alexander the Great invaded India, he found large tracts of lands in the lower valley of the Indus devoted to banana cultivation. The existence of seeded varieties such as kaltavazha which occurs wild in the green forests of the Western Ghates of the Madras Province and elavazhai which occurs wild in the forests of Chittagong lends support to the view that India is the ancestral home of the banana. There are reasons to believe that the existing cultivated varieties have sprung from this stock by selection. Many forms and types must have also originated as bad-sports and ecological types.

Local names of some varieties of banana in the Malayalam language are mentioned in the Hortus malabaricus published in the year 1686. The same varietal names are current to this day on the Malabar Coast with slight variations only in respect of two of them indicating the antiquity of banana.

Many banana varieties were indigenous to Asia and Africa brought first to America in 1516, by a Spanish missionary. They grew well without any special attention in

\[\text{Ibid... p.1}\]
some of the tropical American Islands. In the year 1804, it is said that the captain of an American ship gathered about 30 bunches from Cuba and took them to New York. They were very much appreciated there; so regular cargoes started and the captain eventually became the millionus president of a large fruit company. The first importation of banana of any magnitude to the United States of America was a shipment of about 15,000 bunches from the same place in 1830. For about 20 years thereafter two or three cargoes were brought to New York annually. Around 1870, the bananas were first shipped from Costa Rica to New York by steam ship. In 1899 the banana industry really assumed large proportions by the formation of the United Fruit Company.\textsuperscript{5a}

Bananas are now cultivated in Jamaica in the West Indies, where one could see them growing for miles and miles. Bananas are now grown also in most of the tropical American countries such as Costa Rica, Mexico and certain other Central and South American regions. Bananas were first imported commercially in small quantities into England from Maderia in 1879.\textsuperscript{5b} Export from Jamaica to Great Britain was started by Elders and Fyffes Ltd. Although refrigerator steam ships were used from the beginning, the venture was not successful until the following year when

\footnotesize
\textsuperscript{5a} Ibid. p.2
\textsuperscript{5b} Ibid. p.3
the United Fruit Company acted as supplying agents of bananas from both Jamaica as well as Costa Rica.

From its original home in India, the banana has been introduced into various countries. Though the Indians have held the fruit in high esteem from time immemorial especially in connection with their religious and social functions, they have not shown any enterprise in the field of trade in order to improve its commercial importance. The result is that today the countries into which it has been introduced command the world banana markets, whereas India does not hold any place worth the name. It may be stated here that the Indian bananas could easily be exported to the western countries without much deterioration in transit by employing refrigerator ships.

Cheema et al\(^6\) consider the original home of this tropical fruit to be the Malayan Peninsula or its neighbourhood. It has also been suggested that the banana might have originated in some parts of the tropical forests of Asia. The cultivation of banana has now extended to many parts of the world, although it is limited to the tropics. The fruit has become so popular and is so widely used that is now available in all countries of the world,

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wherever transport facilities exist.

2.3 Important Clones (Cultivars) of Banana in the World

There are several hundreds of cultivars of banana spread throughout the world. Standard botanical descriptions and nomenclature are limited to a few groups. Simmonds\(^6\) has identified 15 diagnostic characters to distinguish between the two wild species M.acuminata and M.balbisiana. For each character in which the variety agreed with wild M.acuminata the score of 1 was given and for each character in which a variety agreed with wild M.balbisiana the score 5 was given and intermediate expressions of the characters were assigned scores of 2, 3 or 4 accordingly.\(^6\)

According to the scoring technique, the scores range from 15 (15 x 1) for M.acuminata to 75 (15 x 5) for M.balbisiana. A cultivar would have a larger score if it were derived from M.balbisiana and smaller if it were derived from M.acuminata. An analysis showed that cultivators belonged to six groups of which two were diploid, three triploid and one teraploid. Thus the cultivars have been divided into the following groups according to the ploidy and the taxonomic score.\(^6\)

\(^6\)a. Simmonds N.W., (1959) op.cit., p.76.
\(^6\)b. Ibid.... p.77
**Score 15-23**

1. Diploid  
2. Triploid  
3. Tetraploid

*Score: 26 or more (hybrid cultivars)*

1. Score 26-46  
2. Score about 49  
3. Score 56-63  
4. Score about 67

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**2.4 Important Banana Clones in India and their Distribution.**

**AA Group**

1. Chingan (S)  
2. Manniyillachingam (S)  
3. Kadali (S)  
4. Suryakadali (S)  
5. Namarai (S)  
6. Anai Komban (S)  
7. Sanna Chenkadali (S)  
8. Matti (S)

**AAA Group**

1. Amritsager, 'Singapuri' (NE)  
2. Pedda pachcharati (SP)
4. Padda pachachaarati (S) Harichal (NE) Bongalijahaji (NE)
5. Chakkarakeli, Rajabale (S)
6. Nella chakkarakeli Karivazhui, Manoranjittam etc.(S)
7. Chenkadali, Sawara (S), Lalkel (NE), Agniswar, Nichilakol Lalkera (NE).
8. Venkadali (S)
9. Eththa chingam (S)

AB Group
1. Ney Poovan (S)
   Safet velchi (NW), Chini champa (NW) (Ney Poovan)
2. Kunnan (S) (Ney Poovan)
3. Venmutu Kunnan (S)

AAB Group
1. Rasthali (S) Soni, Sonkal (NW) Sabsikola,
   Mulbhog, Morthoman, Kulpait, Sabari, Sapri (NE)
2. Ayiranka rasthali (S)
3. Poovan Karpura Chakkarakeli (S) Kaitsiem
   Champa (NW) Lalvelchi (NW).
4. Mott apoovan (S)
5. Nendra padaththi (S) Saker champa (NE)
6. Kullan, Rajapuri (S) Walha (NE)
7. Pacharaadan Kaali (S)
8. Vannan, Virupakshi sirimalai kapur (S)
9. Kvishna vazhai (S)
10. Eleri (S) Bhorot (NE) Rajeli (NW)
11. Nendran (S)
12. Kaalieththam (S)
13. Kalediththam (S)
14. Velaththam (S)
15. Myndoli (S)
16. Moongil (S)
17. Chinali (S)
18. Karim Kadali (S)
19. Thiru vananathapuram (S)
20. Adakka Kunnam (S)

ABB Group

1. Peyan, peyladan (S)
2. 'Pey Kannan' Kosthabontha (S)
3. Ney Mannan (S)
4. Vencettu mannam (S)
5. Nella bontha (S)
6. Thella bontha (S)
7. Nella bontha bathees (S)
8. Monthan (S) Dhussray, Kachakola Jatikol etc.(NE)
9. Palhamonthan bathees (S)
Among the varieties mentioned above the present study is concerned with the cultivation of poovan (AAB group) rasthali (AAB group) and nendran (AAB group). The detailed descriptions of poovan, rasthali and nendran are given below:

Poovan

Poovan banana is the foremost commercial variety of Tamil Nadu, Andhra Pradesh and West Bengal States. It is a hardy and popular variety and grows vigorously under the perennial system of cultivation adopted in the Cauvery delta of Thanjavur district of Tamil Nadu and in the Gangetic delta in the Hooghly district of West Bengal. Under wet land and garden system of cultivation, this variety thrives equally well. It is truly cosmopolitan, growing with equal vigour even in distant Trinidad. The distinguishing characters are the rose pink colouration of
the outer side of the mid-rib when young, heavy bunches, with closely packed fruits, hanging down vertically. The fruits are small to medium in size held firmly in the bunch and have a distinct mammillary tip. The rind is thin and pulp cream coloured with an agreeable sub acid taste. The fruits keep well and ripe rind is golden yellow with a tinge of rush red colouration. It is immune to panama disease and fairly resistant to leaf spot disease and is little attacked by bores. The duration when three to four month old suckers are planted varies from 11 to 14 months. The average bunch weight is about 15 kg. Bunch weight as much as 30 kg has been recorded.

**Rasthali**

This is a choice table variety and is priced high in all parts of India where it is cultivated. The plants are moderately vigorous but do not bear as heavily as poovan. Due to its better root system, it can resist wind better than other varieties. Its susceptibility to wilt and easy dropping of ripe fruits from the bunch are the main drawbacks. It is easily identified by the yellowish green stem with brownish blotches, reddish margin of the petiole and leaf sheath and a few persistent male flowers after the female flower phase. The bunch weight is medium. In
West Bengal, the fruits develop very well and bunches weighing up to 25 kg are not uncommon. In the other parts, the average bunch is about 12 kg, containing 60 to 80 fruits in five to seven hands. Sometimes under intensive cultivation large fruits develop stomy lumps in the flesh. It is reported that ripening under cold storage eliminates this defect. 6c

The fruit is almost similar to poovan in size but more rounded with a shade less of green colour and less pronounced apex. In West Bengal, however, a type with a pronounced apex has been observed. The flesh is white, rather firm, but very tasty and sweet with a pleasant apple flavour. When grown in marginal conditions, fruits are smaller but of good taste and flavour. In Tiruchirapalli and Erode in Tamil Nadu, rasthali is grown in rotation with paddy.

The duration is from 15 to 16 months from planting to maturity. Commercial cultivation of rasthali under wet land conditions is practiced in the Tiruchirapalli district of Tamil Nadu. Agiranka Rasthali is a 'sport' of this variety and is cultivated occasionally. The inflorescence has only pistillate flowers up to the tip, covering the entire

length of the axis. Fruits in the lower most hands are very small. If the plants are not well matured, gaps arise here and there and neutral flowers are produced in the hands occupied by these gaps. Reversion to rasthali has also been observed under continuous cultivation.

Nendran

The nendran fruit is known in all parts of the world as plantain. This is because the fruit is always cooked to make it more platable. In Kerala, this variety is considered both as a dessert and cooking variety. The fruits are eaten raw and also used for preparing various dishes. In Maharashtra banana figs are prepared from this fruit. The plant suckers profusely. The pseudostem has a distinct shade of pink colouration. Velatham (wine plantain) a type from Travancore has a very conspicuous pink colouration over the pseudostem, petiole and mid-rib. Kalethan, another type from the same place has hard flesh. Attunendran thrives even under rainfed conditions. Nan a nendran is always grown under irrigation, myndoli is of longer duration and has heavier bunches and bigger fruits. Chengazhikondan fruits are the tastiest. The thickness of rind and keeping quality of fruits also vary with the types. Generally, nendran fruits keep for as long as fifteen days after ripening.
The nendran fruit is relatively longer and thicker than most of other bananas. The bunch is not compact. The bunch weighs 12 to 15 kg with about 50 fruits per bunch. The duration of most of the types except myndoli is about 11-12 months after planting. Myndoli takes about 18 months and produces very large bunches. The fruits of all the types are curved and angular and have prominent pedicel as well as apex. Rind is thick and buff yellow when ripe. Pulp is firm and yellowish with a characteristic taste. Moongil (Horn plantain) is a sport of nendran with only one or two hands in the bunch. The other interesting type of this group is anil vazhai, a variegated mutant with young leaves and fruits showing different degrees of variegation. Other types in this group include the tiger plantain in which the fruit rind is spotted with round black circles resembling the spots on a leopard. In white plantain, the flesh colour is nearly white and not yellowish. All the known types, however have hard flesh and by cooking the flesh becomes softer and more palatable. 6d

Nendran chips are very popular on the west coast and there is great scope for this cottage industry as these chips keep without deterioration for many months.

6d. Ibid.... p.23.
2.5 Cultivation of Banana

2.5.1 Climate

According to Madhava Rao⁷ banana is essentially a humid tropical plant, coming up well in regions with a temperature range of 10 to 40°C and an average of 23°C. In cooler climate, the duration is extended, sucker production is affected and bunches are smaller. Low temperatures (less than 10°C) are unsuitable since they lead to a condition called choke or impeded inflorescence and bunch development. Otiswarren Barrett in his study⁷a finds that banana requires a fairly humid climate, moist deep rich soil with perfect drainage, protection from wind, full sun and much heat. Raman⁸ et.al point out that for successful growth, banana demands plenty of warmth and moisture in the air throughout the year. Heavy rainfall and high temperatures which vary little throughout the year are suitable for banana.

2.5.2 Season

Normally banana plantation is done in June-July, November-December or March-April of every year. However,

June-July plantation which gives about 1½ times yield is more preferred than any other period. Winter plantation gives the lowest yield. Banana suckers can be planted throughout the year especially the rainy season except during summer. According to Hali, May-June is the ideal time to plant red banana suckers. The planting is done generally in the beginning of the south-west monsoon. In later planting, the growth of the plants is checked by the onset of the cool weather and the yield is poor if planting is delayed till the end of the monsoon. Planting is done in September-October at the end of the south-west monsoon in Malabar, in December in Tranvancore, in February-March on the hill-slopes of South India with a high rainfall and in April in the wet lands on the banks of the Cauvery river. In the coastal area of Bombay, planting is done in April, June and August or October.

2.5.3 Soil

Two soil factors are important for bananas namely, depth and drainage. Some clay soils are compact, ill-drained and badly aerated, deficient in nutrients and

are also unresponsive to fertilizers. In such soils banana growth is very poor. The minimum depth necessary is about a metre.

Chundawat\textsuperscript{11} in his study shows that banana needs deep, well drained fertile, loam, calcium rich, river bank soil with neutral soil reaction. According to Raman et al\textsuperscript{11a} banana requires a rich free working soft deep and retensive soil containing plenty of organic matter. All the agricultural soils are suitable if they are deep and well drained. In Tamil Nadu, the padukai lands of the Cauvery delta, the reaty soils of the plains and the common paddy soils of the wet lands besides red loams have been used successfully for banana culture. Bananas are grown in a variety of soils in India. In coastal Maharastra soils are sandy and in the plains, banana is grown in well-drained black cotton soils. In East Khandesh the soils are medium black and lighter. In Tamilnadu and Andhra Pradesh soils vary from well drained delta types (alluvial) to the slightly open loamy type of the hill slopes. Banana trees of over 100 years of age are found thriving along the rich banks of the Cauvery river in Thanjavur district near Aduthurai.


2.6 Propagation

Banana is propagated vegetatively by means of suckers or off-sets, whole or bits of rhizomes of the parent plant or daughter suckers, with at least one sprouting bud. There are two types of suckers: (i) sword sucker; suckers with a well-developed base and a pointed tip with narrow sword-shaped leaf blades in the early stages and (ii) broad-leaved sucker or water sucker. These are small, undersized suckers of superficial origin, bearing broad leaves. These are grown near clumps out of small, diseased or injured corms. They are normally not produced in a healthy banana clump. They arise if the plantation is too old, overcrowded and shady not desuckered properly and not well-looked after.

Between the two, the sword sucker is more vigorous, grows faster and comes to bearing early. Investigations at the Central Banana Research Station, Aduthurai, showed that it is possible to use bits of rhizomes as well as developed maiden suckers. The type of planting material will have some effect on the rate of development taking larger time for small propagules but this has little or no effect on bunch size. Several good bits can be cut from an unbunched rhizome after trimming roots, each with a germinating eye centrally placed. It is important that very small corms or pieces of corms are avoided and also

the material is healthy. In sub-tropical climates, such as on hill slopes of India, the size of the corm may alter the rate of maturity and the time of fruiting may be of vital importance.

The size of the corm is important because it contains the reserve food for early growth of the future plant. About a kilogram weight of rhizome or bit well-trimmed around the growing sprout was found to be the best at Aduthurai. A uniform type of planting material will tend to produce a crop at one time. In the case of dwarf cavendish banana, the daughter rhizomes produced after harvest of the bunch are dug out and can be stored in shade (after removal of parts of pseudostem) for as long as two months after covering with dry banana leaves. In Kerala, rhizomes of nendran are sundried for 2-3 days after smearing with cowdung paste and ashes, stored in shade for a month before planting.

When seen in the present day context of preparing a clean sucker by paring the necrotic tissue and coating with nematicidal granules after dipping a mud-slurry, the above practice has to be commended. It is likely to free the nendran sucker to an extent at least from nematicides to which it is highly susceptible like cavendish clones. For 'hill bananas' (Virupakshi) in Tamil Nadu, sword-suckers with rhizomes of good size, 4 to 5 feet high and 4-6 months old are used. If used for a mixed crop in
coffee plantations, taller suckers are used while for new plantations, shorter suckers may suffice.

2.7 Preparatory Cultivation and Planting

Preparatory cultivation practices vary according to the type of cultivation.

2.7.1 Garden Land

The land is ploughed deep with ploughs or tractors or dug deep with spades. Pits are dug 1.5 metre deep, filled with farmyard manure, ash and soil. The suckers are planted after scooping out just enough soil to accommodate the corm. Suckers of similar corm size should be grouped and planted. The sucker is planted in the centre of the pit and soil pressed around. An inch or two of the pseudostem may remain above ground level. After planting 20 to 30kg of sunnhemp seed is sown and the crop incorporated at about the 40th day. In East Khandesh planting is done in deep plough furrows. This method is found to be as good as planting in pits.

2.7.2 Wet Land

In the wetlands of Tiruchirapalli and Thanjavur districts of Tamilnadu, since banana follows paddy, no elaborate preparatory cultivation is done. Planting is done in small pits sufficient to accommodate the corm.

2.7.3 Hill Bananas

The first operation in hilly areas is clearing of trees leaving a few on the outskirts as windbreaks. To prevent soil erosion stone embankments (4' x 2½') are erected at 30 to 60 feet spacing, catchment areas 22.5 x 45.0 cm depth are constructed at intervals of 120 to 240 cm &pits are dug just sufficient to accommodate the corms. They are filled with farmyard manure and 50 gm. of 10 percent BHC to control borers.

In Kerala, for planting nendran bananas, trenches of 30cm x 30cm, 2.1 m apart are dug. If drainage is a problem, hemispherical mounds one metre inside are raised 2.1 to 2.4 m apart. It is also cultivated in raised soil beds with deep drainage channels 60 cm wide and 90 cm deep every two rows. The height of the bed is at least 30 cm above the highest water level. 13a

2.7.4 Spacing

A number of factors influence spacing such as (i) cultivar, (ii) topography, (iii) soil fertility, (iv) pruning or desuckering practice (v) economics and (vi) various aspects of management.

Dwarf cavendish is planted 1.8 m apart, whereas poovan monthan and rasthalli are planted 2.1 to 3.3 m apart. If soils are more fertile and the crop receives higher doses of fertilizers, spacing is closer, thus accommodating a larger population. In many parts of India,

fruit is generally not bought by weight and hence dense planting may give greater number of bunches but the rate of maturity is delayed in the ratoon crop.

Various methods of inter-culture, spraying treatments, etc. influence spacing. Dense planting besides reducing weed growth affords protection against wind damage. The following are some common spacing schedules for the different cultivars. (Table 2.1). While the data given here represent the general spacings adopted, there are several modifications with varying populations.

2.8 General Hints on Manuring

Banana responds to nitrogen but beyond a certain level, the benefits are not proportional to dosage. Potash is also required in large doses. Phosphoric acid can be given in smaller quantities but all the three have to be applied. Calcium and magnesium are also necessary. Nitrogen is intended to promote growth. Deficiency of nitrogen leads to slow growth, pale leaves, reduced leaf area, reduced rate of leaf production, short leaf petiole, thin and compressed. Roots are thin and suckers are fewer in number. N deficiency leads to higher uptake of P. Excess nitrogen on the other hand leads to low rigidity of pseudostem, delay in shooting of the bunch, abnormally

Table 2.1  COMMON SPACINGS FOR DIFFERENT BANANA CULTIVARS

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Spacing</th>
<th>No. of suckers</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>'Poovan'</td>
<td>2.13m x 2.13m</td>
<td>2150</td>
<td>870 In perennial plantations 'Poovan' and 'Monthan' are planted</td>
</tr>
<tr>
<td>'Monthan'</td>
<td>or 2.1m x 2.1m</td>
<td>870</td>
<td></td>
</tr>
<tr>
<td>'Rasthali'</td>
<td>2.1m x 2.1m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Kali' ('Nadan')</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Nendran'</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Dwarf'</td>
<td>1.7m x 1.7m</td>
<td>3550</td>
<td>1440 3m x 3m.</td>
</tr>
<tr>
<td>'Cavendish'</td>
<td>(43/4 x 53/4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>('Basrai', 'Kabuli')</td>
<td>1.8m x 1.8m</td>
<td>3000</td>
<td>1210</td>
</tr>
<tr>
<td>(6' x 6')</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Robusta'</td>
<td>1.8m x 1.8m</td>
<td>3000</td>
<td>1210</td>
</tr>
<tr>
<td>(Harichal)</td>
<td>(6' x 6')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Nendran'</td>
<td>1.8m x 1.8m</td>
<td>3000</td>
<td>1210</td>
</tr>
<tr>
<td></td>
<td>(6' x 6')</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>or 2.4m x 2.4m</td>
<td>1700</td>
<td>684</td>
</tr>
<tr>
<td></td>
<td>(8' x 8')</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Hill Banana'</td>
<td>2.4m x 3.0m</td>
<td>1350</td>
<td>545</td>
</tr>
<tr>
<td></td>
<td>(8' x 10')</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.1m x 3.6m</td>
<td>670</td>
<td>270</td>
</tr>
<tr>
<td></td>
<td>(16' x 10')</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8m x 4.9m</td>
<td>420</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>(16' x 16')</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
wide distance of hands, reduced grade, poor keeping quality and decreased transportability.

Banana is a large consumer of potash. Potash demands are high as reflected in experimental findings and fertilizer formulae proposed in various parts of the world range as 1:1:4. Potash stimulates early shooting and significantly shortens the time required for fruit maturity. Provided other elements are in sufficient quantity, bananas respond to large doses of potash. It increases the number of hands per bunch and finger size, improves quality, flavour, sweetness, keeping quality, increases resistance to diseases and reduces water uptake.

Phosphorus requirement is low but helps to produce a healthy rhizome and strong root system. It gives good anchorage and prevents lodging. Phosphorus deficiency leads to poor growth, bad leaf colour, severe marginal scorching and shrinkage of old leaves; poor root development and rotting of corm. It is favourable for flower setting and accelerated in ripening. Excess of P leads to curved hands.

2.9 Time of Application of Fertilizers

In tropical conditions, nitrification of ammonia and leaching of nitrogen are rapid and therefore to ensure regular availability of N throughout the growth and to

15. Ibid.......p.40.
minimise waste of N it should be applied in small doses at short intervals. The annual dose of P and K may split into two, onehalf applied at planting and the other at the time of initiation of the flower (3 to 5 months). Nitrogen can be split into 3 to 5 doses and applied at intervals of 30-40 days.

The initiation of the bunch occurs at a very early stage i.e., within 5 months of planting. It is important that the growth within 3 months is kept in a satisfactory condition. For proper growth of leaves, early application is important. If leaf development is good in this period, bunch is also good. A few ounces of fertilizer applied during the first 3 months of plant life might be more important than large quantities later. Potash applied in the first 2 months has a great influence on the number of hands produced. K applied after shooting does not seem to affect the finger size. The uptake of phosphorus was most rapid at 2-3 months age. Early stages (three to five months) are therefore critically important in nutrient and fertilizer application. Third and fifth months are ideal. Split applications more than 3 times are even more beneficial.

2.10 Irrigation

It is generally believed that banana requires

copious irrigation. The irrigation needs vary considerably depending upon the topography, soil, climate, type of culture and economic factors. On an average, it is reported to require 3 acre-inches of water per irrigation during the warmer months from February to May. Near Jalgaon (Maharashtra) irrigation is given once in three or four days during the hot weather. After the rains, both the number of irrigations and the quantity of water are reduced. In Godavari delta, irrigation is done in trenches once in 10 days depending on weather conditions. In the perennial banana areas of Thanjavur district, it is a kind of sub-irrigation wherein water allowed in channels seeps through to the blocks of banana by capillary action. Under wetland conditions, irrigation consists of allowing channel water to fields immediately after planting and after application of fertilizers. Deep irrigation channels are formed for every two rows of bananas and cross channels of the same depth with 4 to 6 plants in each bed. Hill bananas are rainfed and do not receive any irrigation.

Four methods of irrigation are practised in the world: (i) basin, (ii) furrow, (iii) flood and (iv) sprinkler. The basin method is common in India, Hawaii, Israel and West Australia. In this method water is supplied to the plants themselves and not to the
intervening spaces which do not contain roots. It is an economical method. The spray method is in vogue in tropical America, especially in plantations owned by companies.

2.11 Pruning or Desuckering

Desuckering or pruning is the removal of unwanted suckers. These suckers have to be removed periodically as otherwise they compete with the mother plant for nutrients, resulting in lower bunch weight and therefore total yield. The sucker to be pruned should be killed outright. It may be destroyed without detachment from the parent plant by cutting the sucker at ground level, or push a chisel-shaped crow-bar between the sucker and parent with a twisting motion. Sometimes, kerosene is poured into the cavity left after digging the sucker. A pruning paste consisting of a mixture of 2,4-D, fuel oil and grease may also be applied.

One of the most critical operations is the selection of the sucker to be left as 'follower', (i) to have a reasonable interval between successive bunches on the same clump so that bunch quality does not suffer by competition and (ii) to produce fruit at a time of favourable weather or favourable market.

17. Ibid........p.45.
The number of suckers to be allowed besides the parent plant and the time at which to allow such 'followers' have been studied by several workers. Experiments conducted at Aduthurai (Tamil Nadu) showed that removal of all suckers except the one formed at flowering of mother plant is the best method in poovan. Unwanted suckers are headed off by pouring kerosene (5 to 20 ml per sucker) over the cut surface of the sucker. The number of followers depends on the parent plant's growth. When it is near about flowering stage, it may be allowed to produce a follower. One bunch, one follower is common. In fertile areas two suckers are allowed for the first ratoon and one follower for the next ratoon.

2.12 Harvest and Yield\(^\text{18}\)

The cultivars poovan, monthan, rasthali and dwarf cavendish are ready for harvest in 11 to 12 months from the date of planting. Dwarf cavendish ('Basrai') takes 14 months in Maharashtra. Some cultivars fruit in 10 months. In Godavari (Andhra Pradesh) the duration is 9 to 13 months. The fruiting age varies according to the size of the suckers at planting.

\(^{18}\) Ibid............p.50.
The planting and harvest periods of banana cultivars in Tamil Nadu are:

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Planting Period</th>
<th>Harvesting Period</th>
<th>Peak Harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. Jan-Feb.</td>
<td>2. Jan-Feb.</td>
<td>July</td>
</tr>
<tr>
<td></td>
<td>4. Throughout</td>
<td></td>
<td></td>
</tr>
<tr>
<td>'Poovan' (Trichy &amp; Tanjore)</td>
<td>1. Feb-March</td>
<td>1. March-May</td>
<td>April</td>
</tr>
<tr>
<td>'Hill Banana'</td>
<td>Perennial</td>
<td>Perennial</td>
<td>Nov-Dec.</td>
</tr>
<tr>
<td>'Nendran' (Trichy)</td>
<td>March-April</td>
<td>Feb-April</td>
<td>March</td>
</tr>
</tbody>
</table>

In Tamil Nadu and Maharashtra, banana is available throughout the year but August-October and December-March seem to be the periods when trade is brisk.

Poovan, rasthali and 'Hill Banana' are available for 9 months in the year and fruits of dwarf cavendish for
five months in South India. With the conversion of more and more areas under irrigation, it should be possible to adjust the planting so as to have harvests in the lean periods. The wetland bananas of Tiruchirapalli face a glut in February and March.

Yields are highly variable. The following are the yield figures for the major cultivars:

Dwarf cavendish in Tamil Nadu and Maharashtra 30 to 40 tonnes/ha
Poovan (Wetland or Gardenland) 20 to 25 tonnes/ha
Poovan (Syn. Champa) in perennial plantations in Tamil Nadu, West Bengal 15 to 20 tonnes/ha
Hill bananas perennial 15 to 17.5 tonnes/ha

2.13 Control of Pests and Diseases

A number of diseases affect banana. The more serious among them and those noted in India are discussed below.

2.13.1 Leaf-Spot Disease

Leaf-spot disease (Sigatoka leaf spot) is caused by Mycosphaerelia Musicola. It is distributed throughout the banana growing regions of the world.

This disease causes pre-mature death of large areas of the plant's leaf surface. Photosynthetic area is

reduced and in severe cases fruit does not mature at all. In less severe cases, bunch and finger sizes are reduced, fruit ripens prematurely. Fruits are unsuitable for transport. Earliest symptoms are small lesions on the leaves, pale yellow or greenish steaks, parallel to veins. The spot increases in size and several spots group together thereby killing large areas of the lamina. Death of lamina is followed by decay of midrib and petiole and the leaf hangs down. Bunch never matures. In case of severe infection, bunches are smaller, individual fingers are undersized and angular. Spread of disease is favoured by warm (23°-25°C) rainy or humid weather. Below 23°C there is decline in infection. Dry seasons with little dew are unfavourable for development of this disease.

The leaf-spot disease is controlled culturally by improving drainage, controlling weeds, removing suckers, adopting correct spacing, applying fertilizers in optimum dosage, and removing infected leaves and trash. The disease is also controlled chemically by the use of oil or oil fungicide mixtures in low volume sprays or by 1% bordeaux mixture with dithiocarbamates such as dithane M.45, zeneb, and cuman.
2.13.2 Panama-wilt Disease

It is widespread throughout the banana growing areas of the world. More than 50% of the gardens are affected. Cultivars affected are rashali, monthan, peyan and poovan.

The following are the symptoms of this disease. The lower leaves turn yellow and petioles collapse around pseudostem which sometimes splits upwards from ground level. If the base of the plant is cut vertically, numerous brown and black lines can be seen running in all directions through the corm and upwards into leaf bases and petioles. These are vascular bundles which may also be stained red or purple. Infected plant produces suckers which may be infected. Disease is worst in acid alluvial soils.

Control

Control measures include destruction of infected plants and application of lime to the pits after removal of suckers. Application of farmyard manures and groundnut cake considerably reduce incidence as compared to inorganic fertilizers. Drenching of soil with wet ceresan (1 kg. in 1000 litres of water) at the rate of 5 litres per plant and a second drenching 1½ months later may

20. Ibid. . . . . . . p. 56
prevent spread. In wetlands rotation with paddy is
helpful because of flooding. Rasthali is grown
successfully in the wetlands of Tiruchirapalli and
Coimbatore districts only because of the practice of
rotation with paddy. But quarantine and exclusion of
diseased material are the only effective methods of
control. Planting resistant variety is the best.

2.13.3 Virus Disease

The bunchy top is the most serious virus disease
affecting banana plantation. The aphid (Pentalonia
Nigrornervasa) is the vector that commonly feeds on banana.
But the virus is not present in the western hemisphere.
This disease is also known as 'Cabbage top'. It is now
serious in all States of the south and western India. All
wild and cultivated bananas are susceptible to it.

The first leaf affected by the virus shows green
streaks on the secondary veins on the underside of the
lamina and on the mid-rib and petiole. The streaks are
0.75 cm wide and vary in length up to 2.5 cm. A powdery
bloom covers the midrib and petiole. Subsequent leaves
show the same symptoms as the first one and are
progressively dwarfed. They also show marginal chlorosis
and curling. The leaves are brittle in texture. Pale
whitish streaks may be seen along the secondary veins when
the newly emerged leaf is still tightly rolled. The leaves become smaller and eventually the crown of the plant becomes composed of stunted leaves, the rosette or bunchy top which gives the disease its name. The opening bunches are constricted or choked by the pseudostem and may split it instead of emerging in the normal fashion. Bunches are reduced in size; lower hands of the bunches die off often.

The presence of broken dark green streaks along the secondary veins of the lamina or along the midrib or petiole, is a definite and reliable symptom of acute infection.

In some areas of Australia this virus disease has been controlled by phytosanitary methods, through co-ordination between growers and agricultural authorities. Eradication of disease-infected plants and planting disease free suckers are recommended. Infected plants should be first sprayed with insecticide like parathion, dimercron or endrin to kill the vector and prevent the transmission of the virus to the neighbouring plant. Plants adjacent to the healthy plants should also be sprayed. The affected plant should be killed with kerosene or herbicides such as 2, 4-D or 2, 4, 5-T. The rhizome should be dug out, cut into small sections and sprayed again so that no suckers can be produced which may harbour the virus.
2.13.4 Nematodes

*Radopholus similis* is a widely distributed nematode in banana growing regions of the world. Nematode infection has been reported from many centres in India. The first symptom of the nematode infection is a small dark spot on the root. The nematode deposits eggs in the root tissue and when these hatch the larvae also feed on the root. The damaged tissue is rapidly invaded by fungi. The number of fruits in the bunch is reduced and individual fruits are small. Affected plants do not respond to fertilizers, irrigation or cultural practices. Nematode population is built up rapidly in ratoon crops. Decline is accompanied by leaf chlorosis.

Phytosanitary measures are effective in controlling the nematodes. They involve two basic approaches: (i) application of nematicides to the growing infected plants and (ii) planting of nematode-free corms in fallowed soil. Several methods have been attempted for eliminating nematodes from banana corms notably the paring or peeling the corms free of all lesions, and dipping them in a nematicide solution, covering them with granular nematicides over a coating of mud slurry and hot water treatment at 55°C for 20 minutes following peeling away of all lesions from the corms. Recently granular nematicides are becoming popular. They are easy to apply by hand to the soil around the mat at times combined with
2.13.5 Insects

Banana weevil borer cosmopolites Sordidus is widespread in India. Injury is caused by the larva or grub of the weevil borer feeding and tunneling in the corm of the banana plant. The corm decays and becomes a mass of rotten tissue. In this condition, the corm is deserted by the weevil larvae. In some cases, larvae tunnels extend several feet up the stem. Injury to corm prevents nourishment going to the plant. Leaves turn yellow, wither and die prematurely. In heavily infected plantations, production is low.

Plantations should be clear of debris in which borers can survive. Pseudostems from which bunches have been cut should be chopped up and pieces scattered, so that they dry off as quickly as possible. Drying is important as it is the humidity of old stems that attracts the pest. After harvest, the cut surface of pseudostem should be covered with earth. It is most important to use clean planting material from fields, known to be free of weevils.21

21. Ibid........p.60.