

# CYTOTAXONOMICAL STUDIES ON BANANA CULTIVARS

By

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## THESIS

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the requirements for the degree of

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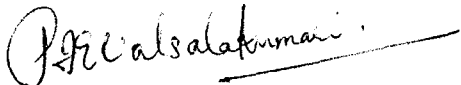
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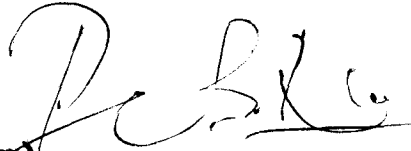


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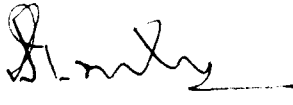
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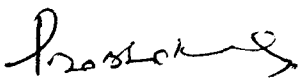
We the undersigned, members of the Advisory Committee of Mrs. P.K. Valsalakumari, a candidate for the degree of Doctor of Philosophy in Horticulture, agree that the thesis entitled "Cytotaxonomical studies on banana cultivars" may be submitted by Mrs.P.K.Valsalakumari in partial fulfilment of the requirement for the degree.

  
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# *Introduction*

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## INTRODUCTION

Banana is one of the most important tropical fruit crops, and its delicious fruits are favoured throughout the world. The improvement of this crop depends on a thorough understanding of the genus Musa to which it belongs. Systematic investigations on the different species of Musa have been limited by the wide variations in diagnostic characteristics used in taxonomic studies and by the wide range of growing conditions.

Cheesman's classification of the family Musaceae was mainly based on chromosome number (Cheesman, 1947). Jacob (1952) classified cultivated bananas of South India, based on morphological characters. Simmonds and Shepherd (1955), considering the bispecific origin of cultivated bananas from the two wild species Musa acuminata Colla. and Musa balbisiana Colla., suggested the genomic classification based on morphological characters and ploidy level. Further research based on exhaustive descriptions of all available species of Musa and available cultivars of banana, in the different regions of the world would contribute to a precise knowledge on the crop.

The morphological variations in the cultivars of banana, which consist mainly of triploids and diploids,



are quite wide and complex, with combinations of different degrees of expression of the parental species. The cultivars grown for commercial purposes are many, and the range of productivity and quality characters are also very wide. The wide variations occurring in South Indian bananas definitely require a detailed study for proper understanding.

Two criteria, ploidy level and genome constitution, have enriched plant classification. Cheesman (1947) and Simmonds and Shepherd (1955), considered ploidy level and genome constitution as important criteria for the classification of banana. In cultivated banana it is difficult to find out the ploidy level from the morphological characters. In view of the complex polyploid nature of the genus Musa, it is important to determine the quantitative chromosome content of the cultivars.

The improvement of banana is still in its early stages, because of the three phenomena exhibited by the crop, namely, polyploidy, parthenocarpy and female sterility. Precise information on the extent of genetic divergence is critical and essential for a breeding programme. It is useful to discriminate banana populations genetically.

The Banana Research Station of the Kerala Agricultural University at Kannara, maintains a good collection

of banana cultivars from different parts of the country. The existence of synonyms and the lack of proper varietal descriptions, complicate the nomenclature. The present investigation was taken up with an intent to describe the cultivars properly by morphological characters, and to verify their ploidy level.

The main objectives of the study are the following:

1. to study the morphological, quantitative and quality characters of the banana cultivars
2. to assess the somatic chromosome number of the cultivars, to assign the cultivars to the correct genomic status, and to classify them correctly
3. to estimate the variability for different characters, and to ascertain the influence of genomic constitution of the cultivars on the growth, quantitative and quality characters of the cultivars
4. to study the pollen fertility, the size of pollen and the pollen productivity, as influenced by the ploidy and genomic constitution in banana
5. to estimate the heritability, the genetic advance and the genetic gain of different characters, for the purpose of selection

6. to estimate the extent of genetic diversity existing among the cultivars, by applying multivariate techniques

7. to estimate the relative contribution of various characters towards total genetic diversity

8. to group the cultivars into different gene constellations (clusters), on the basis of genetic divergence, for the purpose of exploiting heterosis.

# *Review of Literature*

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## REVIEW OF LITERATURE

The taxonomic status of the banana cultivars may be examined on a well merited basis. The word 'banana' includes all edible varieties eaten as ripe fruits or only as cooked food. The origin of cultivated bananas from Musa acuminata or as hybrids of this wild parent with wild Musa balbisiana is widely accepted (Cheesman, 1947; Dodds and Simmonds, 1948; Simmonds and Shepherd, 1955).

The various degrees of expression of the basic characters of the parental species is taken as useful data in the classification of banana. Based on this basic information the literature on the taxonomy, origin and evolution of banana along with cytological studies and genetic variability, which are also relevant to the present studies, are reviewed in this chapter.

### 1. Systematic position of banana

Banana belongs to the genus Musa of the family Musaceae in the order Scitaminae. The earlier classifications of this crop were based on morphological characters. Sagot (1887) divided the family Musaceae into three sections. The first section included giant bananas (Musa ensete), the second section included bananas with fleshy edible fruits (Musa sapientum) and the third section included

ornamental bananas with upright inflorescence and brightly coloured bracts.

Baker (1893) divided the genus Musa into three sub genera - Physocaulis, Eumusa and Rhodochlamys. Physocaulis included plants with bottle-shaped stem and inedible fruits. Eumusa consisted of plants with cylindrical stem and edible fruits. The third sub genus Rhodochlamys included plants with cylindrical stem and brightly coloured bracts with inedible fruits.

#### 1.1. Classification by Cheesman

The systematic classification of the family Musaceae, based on chromosome number, was by Cheesman (1947) who divided the family into two genera - Musa with basic chromosome number 10 and 11 and Ensete with basic chromosome number 9. The genus Musa included many species of perennial stooling and rhizomatous herbs in South Eastern Asia and the Pacific and the genus Ensete was composed of monocarpic herbs with inedible fruits.

De Langhe (1969) summarised the classification of the genera Ensete and Musa making use of the findings of Cheesman (1947, 1949, 1950), Simmonds (1956a), De Langhe and De Vreux (1960) and Vakili (1965). The genus Musa was divided into five sections. The first two, Eumusa and Rhodochlamys, had basic chromosome number as 11, Callimusa and Australimusa 10, and the last section Incertae sedis

had 7 as the basic chromosome number. All the edible cultivated bananas were included under the section *Eumusa* except the Fe'i bananas which belonged to the section *Australimusa*. The section *Eumusa* consisted mainly of eight species viz., *Musa acuminata* with sub species *malaccensis*, *microcarpa*, *burmanica*, *burmanicoides*, *siamea*, *banksii* and *errans* Allen; *Musa flaviflora*, *Musa itinerans*, *Musa basjoo*, *Musa nagensium*, *Musa schizocarpa*, *Musa cheesmanii* and *Musa ochraceae*.

Cheesman (1947, 1949 and 1950) after exhaustive studies, traced the origin of the edible cultivated parthenocarpic bananas under the *Eumusa* section to the two widely occurring wild species, *Musa acuminata* Colla and *Musa balbisiana* Colla, which was later confirmed by Dodds and Simmonds (1948) and Simmonds and Shepherd (1955).

Based on the bi-specific origin, Cheesman (1947) divided the edible bananas of the *Eumusa* section into three groups. Bananas showing predominant characters of *Musa acuminata* were grouped to *Musa x paradisiaca* group; bananas showing blend characters of *Musa acuminata* and *Musa balbisiana* were grouped to *Musa x sapientum* group and bananas showing predominant characters of *Musa balbisiana* were grouped as *Musa balbisiana*.

## 1.2. Classification by Simmonds and Shepherd (1955).

Following Cheesman's classification, the concept of genome was suggested by Simmonds and Shepherd (1955) as a key to the classification of bananas. Since the edible bananas of the *Eumusa* section were evolved either from *Musa acuminata* or from crosses of *Musa acuminata* with *Musa balbisiana*, according to this system, 'A' represented a genome with 11 chromosomes from *Musa acuminata* and 'B' represented a genome with 11 chromosomes from *Musa balbisiana*.

To distinguish cultivars, Simmonds and Shepherd (1955) used a taxonomic scoring method to indicate the relative contribution of the two wild species, *Musa acuminata* and *Musa balbisiana*. Using 15 diagnostic morphological characters, they showed how the contributions made by the two wild species could be clearly discerned. For each character in which the cultivar agreed with wild *Musa acuminata*, a score of 1 was given and for each character in which the cultivar agreed with *Musa balbisiana* a score of 5 was given. Intermediate expressions of the character were assigned scores of 2, 3 or 4 according to their intensity of expression.

The edible bananas of the *Eumusa* section were further divided into the diploids with genomic groups AA



and AB, the triploids with genomic groups AAA, AAB and ABB and the tetraploids with genomic groups AB BB, AAAB and A ABB. The genomic group AA included 60 cultivars; AB, 2 cultivars; AAA, 30 cultivars; AAB, 100 cultivars and ABB, 30 cultivars. Each of the tetraploid genomic groups, consisted of one cultivar (Simmonds and Shepherd, 1955; Simmonds, 1956 a and b, ~~1956~~, 1959 and Richardson et al., 1965).

A tetraploid hybrid banana, 'Bodles Altafort' produced at the Imperial College of Tropical Agriculture from a cross between 'Gros Michel' x 'Pisang Lilin' was released for cultivation (Osborne, 1962).

The classification was complicated by polyploidy. It was not possible to determine the ploidy of the cultivar from the external appearance without counting the chromosomes (Simmonds, 1948, 1950, 1962).

## 2. Evolution of cultivated banana

The essential events occurred millions of years, rather than centuries ago, in the evolution of banana (Simmonds, 1962). The various events in the evolution of edibility in the wild species and the evolution of cultivated forms from the wild parents Musa acuminata and Musa balbisiana are reviewed here.

The key to the understanding of banana evolution lies in the analysis of parthenocarpy and sterility in the edible diploids. Dodds (1943) clearly explained the existence of vegetative parthenocarpy in the cultivated banana, where fruit formation was not disturbed even if pollen was excluded from the inflorescence. In wild diploid species, if unpollinated, the ovaries did not develop and remained immature. The fruit growth was proportional to the seed content and the growth of the pulp depended on the stimulus from the developing seeds. In edible bananas the stimulus for the fruit growth was explained to be autonomous, without pollen or fertilization (Simmonds, 1953, 1962, Shanmugavelu and Rangaswamy, 1962).

The typical edible seedless banana was proposed to be the product of two evolutionary processes - parthenocarpy and sterility due to genetic female sterility and pollen sterility (Dodds, 1943; Shepherd, 1960; Simmonds, 1960b, 1962). Edibility first evolved in Musa acuminata by these two processes. Parthenocarpy was due to the presence of three complementary genes present in this wild species (Simmonds, 1953, 1962). But studies on the existing species and cultivars and the results of some crosses showed that edibility did not depend upon ploidy and that parthenocarpy was not related to seedlessness (De Langhe, 1969).

## 2.1. Evolution of edibility in Musa acuminata

The species Musa acuminata was observed to be very variable and taxonomic evidence indicated the primary centre of origin to be Malay Peninsula (Simmonds, 1953, 1962). With high probability, human selection favoured parthenocarpy and seed sterility leading to male sterility consequent upon heterozygosity (Simmonds, 1976). There was no evidence to believe that Musa balbisiana ever evolved edibility on its own (Simmonds, 1962, 1976) but for a contrary view from Vakili (1967) who considered that there was natural evolution of parthenocarpy in Musa balbisiana as in the case of Musa acuminata. The hybrid groups of cultivars originated by outward migration of edible diploid, male fertile AA types into areas of Musa balbisiana.

## 2.2. Origin of natural F<sub>1</sub> hybrids

Natural hybridization between different Musa acuminata subspecies occurred (De Langhe, 1969). Most of the edible diploids investigated in Trinidad had only nine or ten bivalents against a normal number of eleven in the metaphase of male sporogenesis (De Langhe, 1969). After these Musa acuminata hybrids came into being, the probability of sporadically occurring restitution with the resulting diploid egg nucleus immediately

increased. In crosses with haploid pollen nuclei this would have given rise to Musa acuminata triploids. This took place immediately after their origin when the chromosomal balance was still in a disturbed condition as a result of fragmentation of certain chromosomes.

### 2.3. Species hybrids

The origin of various species and hybrids of banana was described by Dodds and Simmonds (1948), Krishnamurthy and Seshadri (1958), Simmonds (1966) and De Langhe (1969). AB diploids might have arisen as a result of a cross between Musa balbisiana and Musa acuminata diploid. In Trinidad AB diploid like Neypoovan (AB) of Indian origin was synthesised by crossing Musa balbisiana with edible Musa acuminata diploid (Dodds and Simmonds, 1948).

AAB triploids might have arisen probably in two different ways viz., (i) by crossing an edible Musa acuminata diploid with Musa balbisiana which presupposed single restitution (ii) by crossing AB diploid with Musa acuminata, also with restitution. Taking into account the tendency to matrocliny, it was assumed that the first way gave Musa acuminata like AAB's and the second way to balbisiana like AAB's with a more pronounced balbisiana phenotype than could be expected from the genomic ratio (De Langhe, 1969).

The ABB triploids were said to be the products of backcrossing 'AB' with Musa balbisiana (BB) (Krishnamurthy and Seshadri, 1958; De Langhe, 1969). The possibility of Musa balbisiana (BB) x edible Musa acuminata (AA) was inconceivable upto a few years ago because it was assumed that no sterile Musa balbisiana existed. The discovery of a semi-sterile Musa balbisiana in India (Govindaswamy, 1962) opened up a new horizon.

Tetraploids such as 'Klue Teparod' (ABBB) were products of back crossing (De Langhe, 1969).

The evolution of the present day cultivated banana had taken place through centuries of human selection (Krishnamurthy and Sheshadri, 1958). Various complex factors had influenced its evolution, either singly or together. There are more than 200 cultivars in existence (De Langhe, 1969). However, the evolution of cultivated bananas was suggested to be closely linked up with four factors, viz., vegetative propagation, parthenocarpy, sterility and polyploidy (Krishnamurthy and Sheshadri, 1958; De Langhe, 1969):

In a nut shell, the whole range of the favourable and economically important characteristics of fruits and bunches was the result of a lucky combination of species or subspecies (De Langhe, 1969).

### 3. Distribution and gene centres

Taxonomical, geographical and cytogenetical knowledge of the genus Musa as a whole indicated the region Assam - Burma - Siam - Indo China as the centre of origin of not only the cultivated bananas, but all other taxonomic groups of the genus also (Cheesman, 1947; Chakravorti, 1948a and b, 1951; Chandratna, 1951; Jain, 1963, 1965; De Langhe, 1969). The range of Musa acuminata covered Malayasia, Burma, Assam, Siam, Indo China and the Philippines. Musa balbisiana extended over Ceylon, India, Java, Malaya, Burma and Siam (Chandratna, 1951). A special form of this species was discovered in Ceylon viz., a semisterile form (Govindaswamy, 1962). There were some obvious differences between the Ceylon and Indonesian forms.

It was not possible to give a complete picture of the distribution of the common edible Eumusa forms since they were in cultivation long ago and were distributed over the tropical world (De Langhe, 1969). The predominance of the following groups could be stressed.

AAA 'Gros Michel' and AAA 'Lacatan' are predominant in Central and South America; 'AAA' Cavendish group in West Africa; 'AAB' Plantain group in Central Africa (De Langhe, 1969); 'AAA' Beer bananas in East Africa

(Shepherd, 1957); 'AA' edible diploids in the Malay Archipelago and New Guinea (Simmonds, 1956a and b); and AAB and ABB in India and South East Asia (Simmonds, 1966).

#### 4. Nomenclature of banana cultivars

The nomenclature of banana cultivars is complicated being interspecific hybrids. The two Linnaean epithets Musa sapientum L. for varieties suitable for ready consumption (dessert types) and Musa paradisiaca L. for varieties edible after cooking (Linnaeus, 1783) were misleading (Cheesman, 1948a and b). He stressed that the names should be applied to clones which resembled 'French Plantain' and 'Silk Fig' respectively.

The 'Dwarf Cavendish' had received several Latin names like Musa nana Lour, Musa cavendishii Lambert and Musa sinensis Sweet (Moore, 1957), Chandratna and Nanayakkara (1951) referred the dwarf bananas as Musa acuminata. Jacob (1952) combined the two Linnaean species of edible Musa, viz., Musa x sapientum and Musa x paradisiaca L. into a single species, Musa x sapidisiaca. Nayar (1962) questioned Jacob (1952) for considering all banana varieties as Musa x sapidisiaca since certain varieties like the cavendish bananas were only the cultivated forms of Musa acuminata. Similarly varieties like 'Bontha' had nearly all the characters of Musa balbisiana.

Simmonds (1966) suggested that it was botanically incorrect to refer all *Eumusa* cultivars by any one Latin name and that the formal reference to a cultivar could be made with the genome and common name with a prefix of the genus *Musa*. e.g. *Musa* (AAA Group) Cavendish sub group 'Robusta', *Musa* (AAB group) 'Mysore'.

For the sake of conciseness De Langhe (1969) suggested that it was preferable to write as AAA 'Gros Michel' and AB 'Neyypoovan'.

#### 5. Classifications of Indian cultivars

Much confusion existed in Indian Botanical literature on the classification and nomenclature of the species of *Musa*. Roxburgh (1824) described four species indigenous to India, but only one of them, *Musa x sapientum* was of economic interest.

Venkataramani (1946) gave a descriptive study of 24 banana varieties. Jacob (1952) classified 74 varieties of Madras bananas into nine groups based on morphological characters - Vamanakeli, Nendran, Kadali, Kaali, Kunnan, Peyan, Mannan, Monthan and seeded bananas. The chromosome number of some of the varieties were found out.

Gandhi (1955) described the history and botany of Bombay banana. Nayar and Bhakthavatsalu (1955) described the cavendish group of banana. Shukla and Roy (1956)



described 20 varieties of Bihar bananas. The 'Nanguneri peyan' and 'Nendran' varieties of banana were described by Nayar et al. (1957a and b). Gowder and Nambisan (1959) described the 'Matti' variety of Kanyakumari District. The 'Monthan' and 'Peyan' groups were described by Rao and Nambisan (1959).

Nayar (1962) classified banana varieties into four groups. He listed out 18 diagnostic characters of Musa acuminata and Musa balbisiana. Varieties which scored over 75 per cent of the characters of Musa acuminata were grouped into the first group, Musa acuminata group. The second, Musa x sapientum group included banana varieties of hybrid origin which scored nearly well balanced characters of Musa acuminata and Musa balbisiana. The third group - Musa x paradisiaca group included banana varieties of hybrid origin which showed a preponderance of the characters of Musa balbisiana over those of Musa acuminata. Banana varieties which nearly had all the characters of Musa balbisiana were included in the fourth group, Musa balbisiana group. Nayar (1962) had also described the taxonomic status of banana varieties 'Dwarf Cavendish' and 'Virupakshi'.

Simmonds (1966) assigned genomic status to some of the Indian cultivars. Cultivars 'Chingan', 'Maniyilla chingan', 'Kadali', 'Surya Kadali', 'Namarai', 'Anaikomban',

'Sanna chenkadali' and 'Matti', belong to the genomic group AA; 'Amritsagar', 'Pedda pachcha arati', 'Vamanakeli', 'Chakkarakeli', 'Nalla chakkarakeli', 'Venkadali' and 'Eththa chingan', belong to the AAA group; 'Ney poovan', 'Kunnan', 'Venneettu kunnan', to the AB group; 'Rasthali', 'Poovan', 'Nendra padaththi', 'Pacha nadan', 'Vannan', 'Krishna vazhai', 'Nendran', 'Chinali', 'Karim kadali', 'Thiruvananthapuram' and 'Adakka kunnan' to the AAB group; 'Peyan', 'Pey kunnan', 'Ney mannan', 'Venneettu mannan', 'Nalla bontha', 'Monthan', 'Pacha bontha bathees', 'Boothi bale', 'Thaen kunnan', 'Enna benian', 'Kuri bontha' and 'Kallu monthan' to the ABB Group.

Systematic status of individual cultivars of banana were described by several workers. Natural 'Klue Teparod' banana was described and compared with a hybrid from the cross between Ney vannan x Musa balbisiana (Shakthavatsalu et. al., 1968). Nair and Nair (1969) described the performance of some introduced varieties of banana in Kerala. Azakiamanavalan et. al. (1975) described 'Wather' banana. 'Hybrid 135', a hybrid banana evolved out of multiple crosses involving 'Ladan' (AAB) as female parent and Musa balbisiana and 'Kadali' (AA) as male parents resembled 'Virupakshi' phenotypically and was recommended for commercial cultivation (Azakiamanavalan and Rao, 1980).

## 6. Genomic classification of banana-merits and demerits

As for the hypothetical character of genomic classification, De Langhe (1969) repeated what Allard stated about Triticum genome. "Genomic designations are undoubtedly over simplifications. Nevertheless they seem to come close to the true picture and they serve a useful purpose in reconstituting the polyploidy in the group" (Allard, 1960).

Some deviations in the ABB group were noted by Vakili (1967). According to the scoring scheme developed by Simmonds and Shepherd (1955) when the sum of the scores for 15 morphological characters of a triploid variety fell between 59 and 63, the variety was considered to have secured one genome from Musa acuminata and two genomes from Musa balbisiana. Studies on the varieties by De Langhe (1969) indicated that scoring system besides its subjectiveness was influenced by the effect of growing conditions on the morphological characteristics of the plant. There are varieties in the ABB group eg. 'Saba' from the Philippines, which scored between 69 and 72. Actually variety 'Saba' looked like a triploid edible Musa balbisiana. Vakili (1962) developed BBB and BBBB by colchicine treatment which was similar to 'Saba' but for the parthenocarpic character. According to Simmonds (1966), the varieties in the ABB group inherited their parthenocarpic

character from some ancestral Musa acuminata. The studies on polyploid Musa balbisiana and edible varieties such as 'Saba' and 'Eluggoe' suggested that the karyotypes of the varieties were BBB rather than ABB. Also parthenocarpy might have evolved in Musa balbisiana. The correlation between ploidy and grouping on morphological grounds could not be considered appropriate in some of the Indian cultivars (Jacob, 1966; Raman et al., 1968, 1970, 1971). The cultivars under the 'Kunnan' group were all diploids though according to Simmonds (1966) genomic classification, they were diploids and triploids. The groups 'Kaali', 'Kadali', 'Mannan' and 'Nendran' also included both diploids and triploids and hybridity was indicated in cultivars that had been considered purely as Musa acuminata (Raman, 1976).

The concept of the origin of edible bananas from Musa acuminata and Musa balbisiana was questioned by De Langhe (1969). Several AAB hybrids like the plantains and 'Pisang Rajah' had at least one characteristic which occur neither in Musa acuminata nor in Musa balbisiana viz., the yellow orange colour of the compound tepal. This suggested that an extraneous species might have played a role in the origin of the cultivated bananas. In this respect, Musa flaviflora, Musa schizocarpa and Musa sikkimensis should be further investigated because

they occurred in the areas of the whole Eumusa section and were sympatric with Musa balbisiana in areas where Musa acuminata did not occur, De Langhe (1969) also mentioned the existence of a clone in United Kingdom which was certainly a  $F_1$  between Musa schizocarpa and parthenocarpic Musa acuminata.

Following Simmonds and Shepherd (1955) the taxonomy and descriptions of Musa clones grown in Venezuela was given by Borges (1972). Karikari (1973) described the plantains of Ghana on the basis of the contribution of Musa acuminata and Musa balbisiana to their origin.

A chemosystematic study of Musa cultivars was reported (Bonner et.al., 1974). Peroxidases from certain Musa spp., using horizontal polyacrylamide gel electrophoresis revealed four major zones of activity and 15 separate peroxidase bands. When composite zymograms were constructed from gel data for cultivars of different ploidy groups and compared to the taxonomic classification good agreement was obtained with genomic groups. Three clones of unknown origin were genotypically classified based on the results.

## 7. Cytological studies in banana

Investigations on the cytogenetics of the banana complex provided information on the evolutionary mechanisms in the genus and the genetic systems operating

to bring about the characteristics associated with cultivated varieties.

Tischler (1910) found that chromosome number of some of the Java bananas were 24 and 16, the basic number being 8. But later on Cheesman (1932 a and b) found that the haploid number of banana is 11, the most common form among edible banana being triploids. This was confirmed again by Agharkar and Bhaduri (1935), Cheesman (1935), Cheesman and Larter (1935), Larter (1935, 1938). The cytology of five established edible triploid bananas was described by Dodds (1943). Wilson (1946 a, b and c) studied meiosis of triploids. The significance of interspecific hybridization and polyploidy in the evolution of the banana complex was emphasized by further studies (Dodds and Pittendrigh, 1946; Dodds and Simmonds, 1946, Simmonds and Dodds, 1949). Chakravarti (1951), on the basis of meiosis in triploid cultivars revealed that the respective karyotypes were variable even within the same individual. As a part of the breeding programme in Bihar, chromosome studies of important banana varieties were made and most of the varieties were found to be triploids (Roy and Sharma, 1951).

Eight hybrids between triploid edible bananas and wild Musa acuminata were investigated for chromosome number and most of them were found to be tetraploids (Raman et. al., 1963).

Studies on chromosome numbers of cultivated South Indian bananas indicated the greater prevalence of diploid clones (Jacob, 1966). Simmonds (1966) had included the cultivars under Kunnan group (Jacob, 1952) into different genomic groups. 'Kurman' and 'Venmeettu kunnan' were assigned to the genomic group AB; and 'Adakka kunnan' and 'Thattilla kunnan' to AAB group and 'Thaen kunnan' and 'Thattilla kunnan' to the ABB group. Cytological studies revealed that all the cultivars under 'Kunnan group' were diploids and should be given the genomic status 'AB' (Jacob, 1966). Later, cultivars 'Nattu poovan', 'Sirumalai', 'Ney mannan', 'Vannan', 'Ali poovan', 'Valpari', 'Devabale', 'Rasakadali', 'Poovan kadali' and 'Ambala kadali' were added to the diploid group (Raman et al., 1970).

The cytology and morphology of 11 varieties of Philippines banana were studied by De Leon et al. (1968) and all of them were found to be triploids ( $n = 11$ ).

The cytomorphological features of the progenies from the crosses of cultivated bananas with wild parents were studied (Raman et al., 1971). The progenies consisted mainly of tetraploids and triploids.

#### 8. Genetic variability in Indian bananas

Most of the cultivated varieties of Indian bananas exhibited a vast range of genetic variability. Venkataramani

(1946) in his descriptive study of the Indian bananas recorded variations in pseudostem colour, shape of leaves, colour and texture of the bracts, the nature of sterile axis and the number of flowers per bract. Jacob (1952) and Nayar (1957, 1962) observed variation in South Indian bananas in characters like plant height, number of leaves, weight of bunch, number of fruits, colour of pseudostem, colour and shape of bracts and flowers.

High degree of variability in morphological characters like fruit volume, peduncle hairiness, number of hands per bunch, length of pedicel, shape of fruit, width of petiolar canal and length/breadth value of bracts was reported in diploids and triploids of Indian bananas (Raman, 1968). An analysis of morphological variations in South Indian varieties showed a considerable degree of introgression of the gene complex of Musa balbisiana into them. The introgression appeared to be widely distributed in different varieties, both diploid and triploid in constitution (Raman et. al., 1968). The metroglyph analysis of the clones considered to have AA genome, showed a wide dispersion over the diagram and exhibited expression of characteristics of Musa balbisiana and characteristics of those intermediate between Musa balbisiana and Musa acuminata (Raman, 1970, 1976; Raman et. al., 1970).



Nair et.al. (1979) observed wide and significant variation in dessert bananas in characters like plant height, girth, number of leaves, weight of bunch and fruit, number of hands and fruits, and weight, length and breadth of fruit. High heritability combined with genetic advance were recorded for fruit weight, bunch weight and plant height. Later Nair et.al. (1980) studied the genetic variability in 32 cultivars of culinary banana for 13 morphological characters viz., height and girth of plant; number of leaves, weight of bunch, hand and finger; number of hands and fingers; length and breadth of finger; number of fingers per hand; length of pedicel and number of roots per plant. For all the characters wide and significant variation was observed. The high heritability values recorded along with the high genetic advance for number of fruits per bunch, weight of hand and fruit and length of pedicel indicated the further improvement possible in those characters by proper selection.

Somatic analysis of characters like height and girth of plants, days to flowering, bunch weight and length and number of fruits per bunch in 12 dessert and 6 culinary bananas, indicated high heritability and genetic advance in number of fruits per bunch, weight of bunch and number of fruits (Sreerangaswamy et.al., 1980).

9. Influence of genomic constitution and ploidy on the growth, quantitative characters and pollen characters of banana.

The specific origin and the ploidy level were reported to influence the growth, development and pollen characters of banana. Triploids and tetraploids have a stronger vegetative development than diploids (De Langhe, 1969). The nutrient uptake and dry matter accumulation were influenced by the ploidy level of cultivars (Anon, 1982). The accumulation of dry matter was the highest in triploids. The triploids also accounted for the highest nitrogen uptake.

The leaf production and associated growth characters were influenced by the specific origin of banana (Nambisan and Rao, 1980a). The total number of leaves, leaf area and leaf duration progressively increased with Musa balbisiana genome in the ancestry of the clones. The chlorophyll and protein contents of leaves also increased with B genome in the genetic make up of the clones (Nambisan and Rao, 1980b).

Studies on the physiological aspects of banana cultivars relating to genomic constitution and ploidy level revealed a strong relationship between pseudostem height and girth in triploids and tetraploids. Such a relationship could not be noticed in diploids (Anon, 1982). There was a wide range of pulp:peel ratio in triploids as compared to diploids and tetraploids.

Alexander (1976) studied the pollen and female fertility of banana cultivars and found that cultivars belonging to AB and ABB genomic groups were male sterile. Sathiamoorthy and Rao (1980) reported that clones belonging to AA genome produced abundant pollen. Among the triploids, 'AAA' clones contained larger amount of pollen than clones of 'AAB' and 'ABB' genomes.

#### 10. Multivariate analysis

The information about the extent of genetic divergence is crucial for the improvement programme of any crop. Multivariate analysis by means of Mahalanobis  $D^2$  statistic (Mahalanobis, 1936) was found to be a powerful tool for quantifying the degree of divergence between biological populations, to understand the trend of evolutionary pattern and to assess the relative contribution of different characters towards total divergence. In many field crops and vegetables  $D^2$  analysis was often resorted to, for estimating the genetic distance among varieties (Yadav et. al., 1974; Chaudhury and Singh, 1975; Chandrasekhar, 1978; Asawa et. al., 1981; Mukherjee et. al., 1981; Chauhan and Singh, 1982; Sukhija et. al., 1982; Varma and Gulati, 1982).

Mercy (1981) studied the genetic diversity in banana through  $D^2$  analysis, in 30 dessert and 56 culinary

cultivars, on the basis of 13 morphological characters and formed seven distinct clusters. In dessert bananas weight of the bunch and in culinary bananas weight of finger contributed maximum towards diversity.

# *Materials and Methods*

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## MATERIALS AND METHODS

The investigations were carried out at the College of Horticulture, Vellanikkara during 1981-83.

### 1. Materials

One hundred banana cultivars were collected from the germplasm collection of Banana Research Station, Kannara, Trichur. Eight suckers of each cultivar were planted in the Orchard of the College of Horticulture in a Randomised Block Design with two replications, during February, 1981. The recommended package of practices were followed uniformly (Kerala Agricultural University, 1978).

The suckers from the first crop were planted in February, 1982 and the experiment was repeated. The following cultivars were used for the study.

'Adakka kunnan', 'Adukkann', 'Agniswar', 'Alukehel',  
 'Ash monthan', 'Ashy batheesa', 'Basrai', 'Beela',  
 'Bluggoe', 'Bodles Altafort', 'Boodi', 'Burrharia',  
 'Chakkia', 'Chara padaththi', 'Chenkadali', 'Chetty',  
 'China', 'Chinali', 'Chingan', 'Chinia', 'Chirapunchi',  
 'Dakshinsagar', 'Dudhsagar', 'Elavazhai', 'Eraichivazhai',  
 'Galanamalu', 'Gros Michel', 'Harichal', 'Highgate',  
 'Hybrid Sawai', 'Jurmoney kunthali', 'Kali', 'Kallu monthan',

'Kapok', 'Kapur', 'KNR 2/75', 'Kari bontha', 'Karim kadali', 'Karpooravally', 'Kostha bontha', 'Kothia', 'Krishna vazhai', 'Kullan', 'Lady's finger', 'Malai monthan', 'Malakali', 'Mannan', 'Manoranjithm', 'Matti', 'Mauritius', 'Muthia', 'Nalla bontha', 'Nallabontha bathees', 'Nalla chakkarakeli', 'Nanguneri peyan', 'Namarai', 'Nendran', 'Nendra kunnan', 'Nendra padaththi', 'Nendra vannan', 'Ney mannan', 'Ney poovan', 'Ney vannan', 'Neyvanna Sawai', 'Njali poovan', 'Pacha bontha bathees', 'Pacha chingan', 'Pacha kadali', 'Pacha nadan', 'Padali moongil', 'Padaththi ponnani', 'Palayankodan', 'Pedda pachcha', 'Peyan', 'Pey kunnan', 'Pisang ambon', 'Pisang awak', 'Pisang mas', 'Pisang raja', 'Poocha kunnan', 'Poomkalli', 'Rasthali', 'Red banana', 'Redjasirre', 'Sanna chenkadali', 'Sapumal anamalu', 'Sirumalai', 'Sugandhi', 'Suwandal', 'Thaen kunnan', 'Thella bontha', 'Thiruvananthapuram', 'Tongat', 'Vadakkan kadali', 'Valiya kunnan', 'Vannan', 'Venmeettu mannan', 'Virupakshi', 'Walha' and 'Wather'.

## 2. Morphological scoring and description of cultivars

The cultivars were scored based on the fifteen morphological characters, diagnostic of Musa acuminata and Musa balbisiana as suggested by Simmonds and Shepherd (1955). (Table 1 and Plate I).

Table 1. Characters used in taxonomic scoring of banana cultivars

Characters/ Plant parts	<u>Musa acuminata</u>	<u>Musa balbisiana</u>
Pseudostem colour	More or less heavily marked with brown or black blotches	Blotches slight or absent
Petiolar canal	Margin erect or spreading, with scarious wings below, not clasping pseudostem	Margin inclosed, not winged below, clasping pseudostem
Peduncle texture	Usually downy or hairy	Glabrous
Pedicel length	Short	Long
Arrangement of ovules	Two regular rows in each loculus	Four irregular rows in each loculus
Bract shoulder	Usually high (ratio < 0.28)	Usually low (ratio > 3.0)
Bract curling	Bracts reflex and roll back after opening	Bracts lift up, but do not roll
Bract shape	Lanceolate or narrowly ovate tapering sharply from the shoulder	Broadly ovate, not tapering sharply
Bract apex	Acute	Obtuse
Bract colour	Red, dull purple or yellowish outside; pink, dull purple or yellow inside	Distinctive brownish purple outside, bright crimson inside

(Contd.)



Table 1. (Contd.)

Characters/ Plant parts	<u>Musa acuminata</u>	<u>Musa balbisiana</u>
Colour fading	Inside bract colour fades to yellow towards the base	Inside bract colour continuous to base
Bract scars	Prominent	Scarcely prominent
Free tepal of male flower	Variably corrugated below tip	Rarely corrugated
Male flower colour	Creamy white	Variably flushed with pink
Stigma colour	Orange or rich yellow	Cream, pale yellow or pale pink

1. Score 15-23 (Musa acuminata cultivars)

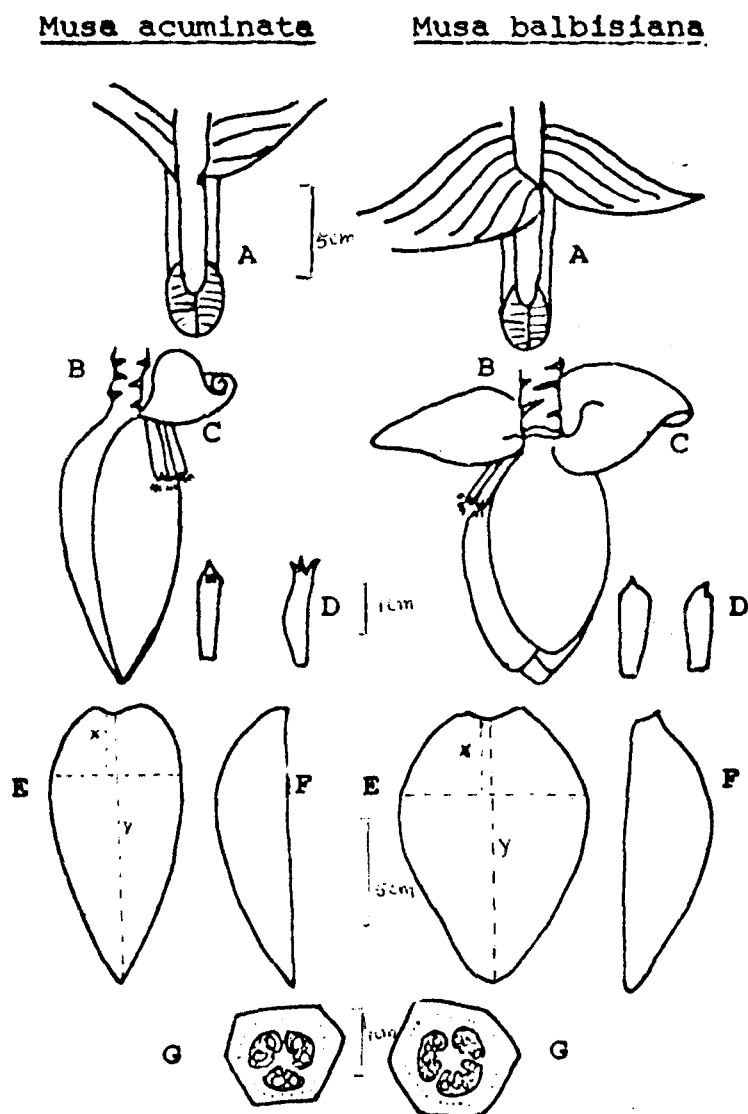
1. Diploid - AA
2. Triploid - AAA
3. Tetraploid - AAAA

2. Score 26 or more (hybrid cultivars)

1. Score 26-46, triploid - AAB
2. Score about 49, diploid - AB
3. Score 59-63, triploid - ABB
4. Score about 67, tetraploid- ABBB

3. Score 75 - Musa balbisiana

Plate 1. Petiole, bract and ovule characters used in the taxonomic scoring system.



A petiole, B bract scars, C bract curling, D free tepal of male flower, E bract shoulder (ratio =  $x/y$ ), F bract shape, G ovule arrangement

The cultivars were assigned to the genomic groups. Synonymous cultivars were identified and the cultivars were described based on morphological characters. Ploidy levels were confirmed by cytological studies.

### 3. Cytological observations

Cytological observations consisted of making somatic chromosome counts of all the cultivars in the root tips. Squash preparations were made following Fuelgen squash method (Hillary, 1939, 1940; Battaglia, 1957; Darlington and La Cour, 1976).

#### 3.1. Collection of material

Tips of freshly emerging roots were taken from potted young plants. For this purpose small banana suckers were planted in pots in sand. Freshly emerging root tips were collected after 15-20 days of planting. Root tips were also taken from the field in the rainy season. The best time for taking root tips for obtaining maximum number of cells in metaphase was found to be between 9.30 - 10 a.m. Root tips were collected carefully using forceps and washed in water.

#### 3.2. Fixation

The root tips were fixed in 1:3 fresh acetic alcohol for reducing the staining of the cytoplasm

(Mc Clintock, 1929). Best results were obtained when the duration of fixation was 8 to 10 hours.

### 3.3. Squashing

After 8 to 10 hours of fixation in acetic alcohol, the root tips were washed in water and hydrolysed in Normal Hydrochloric acid for 10 minutes, washed in several changes of water and stained in Leuco-basic fuchsin for 30 minutes. Thin slices of root tips were teased out on a slide with a drop of distilled water. The cover slip was placed in position and pressure was applied under several thickness of blotting paper, allowing no movement of the cover slip sideways.

### 3.4. Permanent fixation

The slide and the coverslip were separated by turning the slide face down in a smearing dish containing 45% acetic alcohol, until the cover slip fell off. The cover slip and slide were then passed through a series of solutions containing acetic acid and butanol in different proportions (1:3, 1:1 and 3:1), keeping two minutes in each solution, and finally through butanol. The coverslip and slide were then mounted separately in canada balsam.

#### 4. Quantitative characters

##### 4.1. Growth parameters

Observations were recorded on plant height, girth, number of leaves, total leaf area and length of petiole at monthly intervals from the first month of planting till flowering. All the four plants in each replication were used for observations. The following were the procedures followed in taking observations.

###### 4.1.1. Plant height (cm)

The height of the plant was measured from the ground level to the axil of the youngest leaf.

###### 4.1.2. Plant girth (cm)

The girth of the pseudostem was measured at 20 cm above the ground level.

###### 4.1.3. Leaves per plant

The number of fully opened functional leaves was recorded at monthly intervals.

###### 4.1.4. Total leaf area per plant ( $m^2$ )

The leaf area was calculated by applying the formula, Length x Breadth x 0.8 (Murray, 1961). Length of the lamina was measured from the base to the tip and the breadth was measured at the broadest point in the middle.

#### 4.1.5. Petiole length

The length of the petiole was measured from the base to the emergence of the lamina.

#### 4.2. Duration

##### 4.2.1. Planting to flowering interval (days)

The number of days from planting to flowering was recorded.

##### 4.2.2. Flowering to harvest interval (days)

The number of days taken from bunch emergence to harvest was computed noting the date of bunch emergence and the date of harvest. The time of harvest was determined when the angularity of the skin disappeared, that is at the stage of 'round full' (Simmonds, 1960a).

#### 4.3. Bunch characters

##### 4.3.1. Bunch weight (kg)

The bunch was weighed with 10 cm length of the peduncle above the first hand and 5 cm length of the male axis below the last hand.

##### 4.3.2. Hand weight (g)

The weight of the second hand was taken as the average weight of a hand (Gottreich et al., 1964).

#### 4.3.3. Number of hands

The number of hands in each bunch was recorded.

#### 4.3.4. Number of fingers

The total number of fingers in each bunch was recorded.

#### 4.4. Finger characters

The middle fruit in the top row of the second hand was chosen as a representative finger (Gottreich et. al., 1964) for recording the physical characters of the finger.

##### 4.4.1. Pedicel length (cm)

The pedicel was split longitudinally and the distance from the base of the pedicel upto the pulp region was measured.

##### 4.4.2. Finger length (cm)

The length of the finger was measured from the base of pedicel to apex along the dorsal curve using a fine non-elastic thread and scale.

##### 4.4.3. Finger girth (cm)

The circumference of the finger was measured at the middle using a non-elastic thread and scale.

##### 4.4.4. Finger weight (g)

The weight of the finger was recorded.

#### 4.4.5. Finger volume (cc)

The volume of the finger was recorded using water displacement method.

#### 4.4.6. Percentage of pulp weight

After removing the peel, the weight of pulp and peel were recorded separately and the percentage of pulp on weight basis was calculated.

#### 4.4.7. Percentage of pulp volume

Volume of pulp and peel were recorded separately by water displacement method and the percentage of pulp on volume basis was calculated.

#### 4.4.8. Pulp/peel ratio

Pulp/peel ratio on weight basis, was obtained by dividing the weight of pulp by the weight of peel. Pulp/peel ratio was recorded on volume basis also.

### 5. Quality analysis of fruits

The fruits collected from well ripe bunches were used for quality analysis. The middle fruit in the top row of the second hand was selected as the representative sample. Samples were taken from each fruit from three portions viz., top, middle and bottom and those samples were then pooled and macerated in warring blender. Triplicate



samples from these were used for analysis of different constituents as described below.

#### 5.1 Total soluble solids (per cent)

Total soluble solids were found out by an Erma pocket refractometer and were expressed as percentage.

#### 5.2. Sugars (per cent)

Total, reducing and non reducing sugars in the sample were determined as per the method described by Association of Official Agricultural Chemists (1960).

#### 5.3. Acidity (per cent)

The macerated sample (10g) was mixed with distilled water and made upto a known volume. 10 ml of the filtered solution was titrated against 0.1 N NaOH using phenolphthalein as indicator. The acidity was expressed as percentage of citric acid (Association of Official Agricultural Chemists, 1960).

#### 5.4. Sugar/acid ratio

Sugar/acid ratio was arrived at by dividing the total sugars with titrable acidity and this was reckoned as a measure of fruit quality.

### 6. Pollen studies

Pollen fertility, size of pollen and pollen production per anther were studied. From a plant five samples of 10 anthers each were collected from the nodes between the

20th and 30th of the male rachis, prior to dehiscence and kept in vials.

### 6.1. Pollen fertility

Pollen grains were dusted in a drop of versatile stain (Alexander, 1980) on a clean microscopic slide and kept for 30 minutes for proper staining and examined under the low power of a compound microscope. Pollen fertility was estimated by counting fertile and sterile pollen grains. Pollen grains which were well stained, normal and plumpy were considered as fertile and unstained and shrivelled as sterile. Three microscopic slides were prepared and five fields from each slide were observed in each cultivar. Fertility of pollen grains was expressed as percentage of the total number observed.

### 6.2. Size of pollen

Diameter of 100 well developed, normal pollen grains from each slide was measured using a standardised ocular micrometer under low power of the microscope. Average pollen diameter was expressed in microns.

### 6.3. Pollen production

The Haemocytometer method was used for determining the pollen production per anther (Oberle and Goertzen, 1952; Pozzi, 1953; Gangolly et. al., 1961; Rao and Khader, 1962). The procedure standardised for banana by Sathiamoorthy

and Rao (1980) was followed. From a single plant, 5 samples of 10 anthers each were collected from the 10th node prior to dehiscence in vials containing 2.5 ml of distilled water and a drop of 'teepol' for getting a good suspension of pollen. The anthers were crushed gently with a blunt glass rod. The contents were thoroughly shaken and two drops of it were pipetted and placed on each of the counting chambers of a Spencer Brightline Haemocytometer. The number of grains in each of the eight corners was recorded. This was repeated 5 times for each sample and was designated as 'sub sample'. The average number of grains in a square multiplied by 2500 would give the quantity of pollen in one anther. This was calculated as follows.

The counting chamber was 0.1 mm in depth and could hold 0.1 mm<sup>3</sup> solution. The contents of 10 anthers were suspended in 2.5 ml of solution. Therefore 0.25 ml solution will have the contents of one anther. For calculation, the following formula was adopted.

If 'N' is the average number of pollen grains per corner square and 'X' is the number of pollen grains per anther, then

$$N : X = 0.1 : 250$$

$$\text{Therefore, } 0.1X = N \times 250$$

$$\text{and } X = 2500 N.$$

## 7. Statistical analyses

### 7.1. Analysis of variance and covariance

Before proceeding with detailed statistical analysis the data were analysed for analysis of variance for Randomised Block Design. Total variation was partitioned into variation between genotypes, and within genotypes. Variation between genotypes was further split to that between genomic groups and within genomic group.

Analyses of variance were carried out for all the characters. Significant differences among cultivars and among genomic groups were tested using the F Test.

Analyses of covariance were carried out for different pairs of characters to obtain the common dispersion matrix which was useful in further analysis.

### 7.2. Growth curves and assessment of growth rates

Exponential growth curves of the form  $\hat{y} = ab^t$ , where  $\hat{y}$  is the predicted value, 'a' is the intercept, 'b' the parameter to be estimated and t, the time interval, were fitted for plant height, girth, number of leaves, total leaf area per plant and length of petiole. The growth pattern was found to deviate from the exponential law. So a linear model of the form  $\hat{Y} = A+Bt$ ,

where 'A' is the intercept and 'B' the slope, was chosen and the growth rates of cultivars and genomic groups were calculated (Snedecor and Cochran, 1967).

### 7.3. Multivariate analysis

#### 7.3.1. Identification of characters for analysis

The following methods were employed to identify important characters to be used in analysis.

##### 7.3.1.1. Selection of characters on the basis of the relative magnitude of F ratios

Characters with high F ratios were selected for the analysis (Appendices 1 to 5).

##### 7.3.1.2. Selection of characters on the basis of their heritability

Heritability in the broad sense, genotypic and phenotypic coefficients of variation, genetic advance and genetic gain were calculated. The genotypic and phenotypic variance were estimated according to the formula given by Lush (1940). Phenotypic coefficient of variation ( $p_{cv}$ ) and genotypic coefficient of variation ( $g_{cv}$ ) were estimated following Burton (1952). The heritability in broad sense, genetic advance and genetic gain were derived by the method of Johnson et al. (1955). Characters with high heritability were selected for the Multivariate analysis (Table 21).

### 7.3.1.3. Selection of characters on the basis of correlation studies

Inter correlations among the characters were computed (Appendix 7). When two characters showed high correlation one of them was selected.

Based on the above three methods the following 22 characters were selected for Multivariate analysis.

Plant height (cm)

Plant girth (cm)

Leaves per plant

Leaf area per plant ( $m^2$ )

Petiole length (cm)

Planting to flowering interval (days)

Flowering to harvest interval (days)

Bunch weight (kg)

Hand weight (g)

Number of hands

Number of fingers

Pedicel length (cm)

Finger length (cm)

Finger weight (g)

Finger volume (cc)

Pulp/Peel ratio on weight basis

Pulp/Peel ratio on volume basis

TSS (%)

Total sugars (%)

Non reducing sugars (%)

Acidity (%)

Sugar/acid ratio

### 7.3.2. Wilks' Lamda criterion

Wilks' Lamda criterion (Wilks, 1932) was used to test the overall significance of the differences among the different cultivars with regard to the mean values of all the selected characters by the method suggested by Singh and Chaudhary (1977). The significance of the computed value of Lamda criterion was tested using the chi-square test. Since the value was significant further analysis to estimate the  $D^2$  values were done.

### 7.3.3. $D^2$ analysis

The genetic distance ( $D^2$  of Mahalanobis) among the 62 cultivars was calculated from the uncorrelated mean values of the 22 characters (Mahalanobis, 1936; Rao, 1952; Singh and Caudhury, 1977). Considering 62 cultivars, two at a time, 1891 ( $62_{C_2}$ ) squares of differences ( $D^2$  values) were obtained. The  $D^2$  value obtained for a pair of population was tested against the calculated value of chi-square for 22 degrees of freedom.

#### 7.3.3.1. Ranking of $D^2$ values

The  $D^2$  values for each combination were ranked in the descending order of magnitude. The ranks were

added up for each component  $D^2$  in all combinations to obtain the rank totals. The percentage contribution of each character towards total divergence was calculated.

#### 7.3.3.2. Cluster formation

The  $D^2$  values obtained were used to group the cultivars into different groups which were heterogeneous among themselves and homogeneous within themselves. The clusters were formed in such a way that the distance between two cultivars within a cluster was lesser than the distance between two cultivars in two clusters. The average intra and intercluster distances were calculated.

#### 7.3.4. Canonical analysis

Canonical analysis of the data was carried out for confirming the group of constellations arrived at by the  $D^2$  analysis (Rao, 1952). The first two canonical roots were calculated and the corresponding vectors were obtained. The canonical variates  $Z_1$  and  $Z_2$  were calculated based on the mean values of the different characters. A scatter diagram was prepared using  $Z_1$  and  $Z_2$  variates.



## *Results*

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## RESULTS

The studies on the morphological characters, taxonomic scoring and chromosome numbers of 100 cultivars of banana revealed that several of them were synonymous and ultimately the cultivars could be confined to 64 distinct ones.

### 1. Morphological description of cultivars

The 64 distinct cultivars of banana were morphologically described. The genomic grouping of the cultivars was based on taxonomic scoring and ploidy level (2 and Table 2).

#### 1.1 Musa (AA Group) 'Namarai'

The plant is  $128.00 \pm 2.1$  cm tall at flowering with a circumference of  $36.25 \pm 1.2$  cm at the base. It takes  $183 \pm 3.0$  days from planting to flowering and  $85 \pm 2.5$  days from flowering to harvest.

Pseudostem: yellowish green heavily marked with brown to black blotches.

Leaves: small and slender, petiole  $37.75 \pm 0.12$  cm long, not clasping pseudostem, margins of petiole spreading with scarious wings below, lamina  $130.00 \pm 0.5$  cm long,  $49.10 \pm 1.5$  cm broad, base of lamina unequal, base and apex cordate, number of leaves  $23 \pm 0.08$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis ageotropic, male flowers deciduous; peduncle short and hairy.

Bract: deciduous, shoulder <sup>high</sup>, reflex and roll back after opening, narrowly ovate, apex acute, colour yellowish purple outside and inside, inside bract colour fades to yellow towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $3.5 \pm 0.04$  cm long and  $2.5 \pm 0.02$  cm broad, colour creamy white, lobes 3+2, acute, free tepal  $2 \pm 0.01$  cm long,  $1.5 \pm 0.02$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $1.5 \pm 0.08$  cm long, creamy white with no anther lobes; pistil  $4.5 \pm 0.05$  cm long, stigma rich yellow with 3 lobes; ovary  $2 \pm 0.01$  cm long,  $1.5 \pm 0.01$  cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $3.6 \pm 0.06$  cm long,  $1.6 \pm 0.02$  cm broad, creamy white, lobes 3+2, acute, free tepal  $2.5 \pm 0.05$  cm long,  $1.5 \pm 0.03$  cm broad, dull white, below tip corrugated; stamens 5, all fertile, filament  $2 \pm 0.03$  cm long, colour creamy white, anther lobes  $2.5 \pm 0.04$  cm long, colour grey, pistillode  $3.5 \pm 0.12$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $85^\circ$  to the pseudostem, bunch weight  $3 \pm 0.30$  kg, number of fingers



PLATE 2. Musa (AA Group) 'Namarai'

87  $\pm$  2.2, number of hands 6  $\pm$  0.87, fingers in a hand compact.

Finger: 8.8  $\pm$  0.95 cm long and 7.13  $\pm$  0.84 cm in circumference, with two prominent sides, slightly tapering to the tip, apex distinct, finger weight 30.25  $\pm$  1.2 g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind medium thick, pulp yellowish cream, medium hard, medium sweet, TSS 15.50%  $\pm$  1.5, total sugars 6.52%  $\pm$  0.5, reducing sugars 5.99  $\pm$  0.8, non reducing sugars 0.50%  $\pm$  0.01, sugar/acid ratio 44.92  $\pm$  1.2, keeping quality good.

#### 1.2 Musa (AA Group) 'Chingan'

The plant is 207.50  $\pm$  1.8 cm tall with a circumference of 42.75  $\pm$  1.5 cm at the base. It takes 205  $\pm$  2.5 days from planting to flowering and 63  $\pm$  1.8 days from flowering to harvest.

Pseudostem: pale green, more or less heavily marked with brown or black blotches.

Leaves: petiole 38.5  $\pm$  1.7 cm long, not clasping pseudostem, margins of petiole pink, spreading, winged below, lamina 181.00  $\pm$  3.5 cm long, 55.00  $\pm$  2.2 cm broad, base of lamina unequal, base cordate and apex acute, number of leaves 27  $\pm$  0.18.

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis ageotropic, male

flowers persistent; peduncle short and hairy.

Bract: persistent, shoulder *high*, narrowly ovate, apex acute, colour yellowish purple outside, yellow inside, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.03$  cm long and  $1.3 \pm 0.01$  cm broad, colour creamy white, lobes 3 + 2, acute; free tepal  $2.5 \pm 0.02$  cm long,  $2.2 \pm 0.08$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.07$  cm long, creamy white, with no anther lobes; pistil  $9.6 \pm 0.12$  cm long, stigma rich yellow, with 3 lobes; ovary  $5.5 \pm 0.08$  cm long,  $45 \pm 0.03$  cm in circumference, colour creamy white, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.8 \pm 0.8$  cm long,  $1.3 \pm 0.3$  cm broad, creamy white, lobes 3 + 2, pale yellow, acute, free tepal  $2.7 \pm 0.06$  cm long,  $1.7 \pm 0.08$  cm broad, below tip corrugated; stamens 5, all fertile, filament  $1.7 \pm 0.1$  cm long, colour creamy white, anther lobes  $2.2 \pm 0.2$  cm long, colour yellowish brown; pistillode  $4.1 \pm 0.5$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $90^\circ$  to the stem, bunch weight  $4.25 \pm 0.5$  kg, number of fingers  $61 \pm 1.5$ , number of hands  $5 \pm 0.35$ , fingers in a hand loose.

Finger:  $13.1 \pm 0.3$  cm long and  $9.63 \pm 0.5$  cm in circumference, cylindrical with 5 indistinct sides, slightly tapering



PLATE 3. Misa (AA Group) 'Chingan'

to the tip, apex prominent, finger weight  $57.5 \pm 1.08$  g.

Ripe fruit: colour yellowish green, firmly attached to the hand, rind thin, pulp yellowish cream, medium hard, juicy, medium sweet, TSS  $24.25 \pm 0.8\%$ , total sugars  $19.27 \pm 1.25\%$ , reducing sugars  $14.87 \pm 0.60\%$ , non reducing sugars  $4.19 \pm 0.05\%$ , sugar/acid ratio,  $40.15 \pm 1.5$ , keeping quality good.

### 1.3 Musa (AA Group) 'Tongat'

The plant is  $179.5 \pm 2.1$  cm tall with a circumference of  $44.00 \pm 1.2$  cm at the base. It takes  $206 \pm 3$  days from planting to flowering and  $104 \pm 2.1$  days from flowering to harvest.

Pseudostem: greenish yellow with dark brown blotches.

Leaves: petiole  $28.28 \pm 1.5$  cm long, not clasping pseudostem, margins of petiole pink, spreading, winged below, lamina  $124.00 \pm 3.2$  cm long,  $72.00 \pm 2.1$  cm broad, base of lamina unequal, base tuncate, apex cordate, number of leaves  $26 \pm 3.2$ .

Inflorescence: with basal female and distal male flowers, male axis very long, ageotropic, male flowers persistent, peduncle short and hairy.

Bract: persistent, shoulder high, reflex and roll back after opening, narrowly ovate, apex acute, colour yellowish purple outside and inside, inside bract colour fades to yellow



towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $3.4 \pm 0.4$  cm long and  $1.8 \pm 0.02$  cm broad, creamy white, lobes 3 + 2, yellow, free tepal  $3 \pm 0.03$  cm long,  $1.6 \pm 0.04$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $1.6 \pm 0.01$  cm long, creamy white with no anther lobes; pistil  $9.4 \pm 1.2$  cm long, stigma rich yellow, with 3 lobes; ovary  $5.2 \pm 0.10$  cm long,  $3.5 \pm 0.08$  cm in circumference, greenish yellow, ovules arranged in two regular rows.

Male flowers: arranged in two rows, united tepal  $3.5 \pm 0.05$  cm long,  $1.7 \pm 0.07$  cm broad, creamy white, lobes 3+2, pale yellow, free tepal  $3 \pm 0.02$  cm long,  $1.6 \pm 0.04$  cm broad, below tip corrugated; stamens 5, all fertile, filament  $2.3 \pm 0.02$  cm long, light yellow, anther lobes  $2.8 \pm 0.03$  cm long, yellowish pink, pistillode  $4.8 \pm 0.04$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $35 - 45^\circ$  to the stem, bunch weight  $10.25 \pm 1.5$  kg with  $231.5 \pm 5.1$  fingers, number of hands  $12.5 \pm 1.5$ , compact.

Finger:  $8.8 \pm 0.8$  cm long and  $8.8 \pm 0.06$  cm in circumference, slightly angular with 5 unequal sides, slightly tapering to the tip, apex straight and stout, finger weight  $41.25 \pm 2.5$  g.



PLATE 4. Musa (AA Group) 'Tongat'

Ripe fruit: colour greenish yellow, firmly attached to the hand, rind thin, pulp yellowish green, thick, taste medium sweet, TSS  $23.01 \pm 0.8\%$  total sugars  $10.85 \pm 0.18\%$ , reducing sugars  $9.55 \pm 0.75\%$ , non reducing sugars  $1.24 \pm 0.04\%$ , sugar/acid ratio  $42.56 \pm 3.2\%$ , keeping quality good.

#### 1.4 Musa (AA Group) 'Matti'

The plant is  $230 \pm 2.5$  cm tall at flowering with a circumference of  $50.34 \pm 1.2$  cm at the base. It takes  $210 \pm 3.5$  days from planting to flowering and  $95 \pm 2.5$  days from flowering to harvest.

Pseudostem: yellowish green with dark purple blotches.

Leaves: petiole  $45 \pm 0.13$  cm long, greenish yellow, not clasping pseudostem, margins of petiole erect, with scarious wings below, lamina  $175 \pm 1.8$  cm long,  $80 \pm 2.1$  cm broad, base of lamina unequal, base and apex truncate, number of leaves  $23 \pm 1.5$ .

Inflorescence: female axis horizontal, male axis ageotropic, a few rows of male flowers persistent, peduncle short and hairy.

Bract: deciduous, shoulder high, reflex and roll back after opening, narrowly ovate, apex acute, colour dull purple outside, pink inside, inside bract colour almost continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $3.5 \pm 0.04$  cm long and  $2 \pm 0.01$  cm broad, colour creamy white, lobes 3 + 2, acute, free tepal  $2.8 \pm 0.02$  cm long,  $2.5 \pm 0.02$  cm broad, colour dull white, below tip corrugated; stamens not fertile, staminodes 5,  $1.2 \pm 0.01$  cm long, cream coloured with no anther lobes; pistill  $8.5 \pm 0.5$  cm long, stigma rich yellow with 3 lobes; ovary  $5 \pm 1.2$  cm long,  $3 \pm 0.03$  cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $3.6 \pm 0.06$  cm long,  $2 \pm 0.1$  cm broad, colour creamy white, lobes 3 + 2, acute, free tepal  $2.7 \pm 0.12$  cm long,  $2.2 \pm 0.2$  cm broad, dull white, below tip corrugated; stamens 5, all fertile, filament  $1.5 \pm 0.5$  cm long, dull white, anther lobes  $1.6 \pm 0.05$  cm long, colour yellowish brown; pistillode  $3.7 \pm 0.3$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $90^\circ$  to the pseudostem, bunch weight  $8 \pm 0.4$  kg, number of fingers  $125 \pm 5.1$ , number of hands  $8, \pm 0.8$ , fingers in a hand compact.

Finger:  $6 \pm 0.6$  cm long and  $5.2 \pm 0.2$  cm in circumference, slightly angular with 5 indistinct sides, tapering to the tip, apex distinct, finger weight  $60.75 \pm 1.3$  g.

Ripe fruit: colour golden yellow, fingers firmly attached to the hand, rind thin, pulp yellowish cream, soft, juicy, taste sweet and good flavoured, TSS  $21 \pm 1.2\%$ , total sugars  $9.51 \pm 0.5\%$ , reducing sugars  $11.28 \pm 1.2\%$ , non reducing sugars



PLATE 5. Musa (AA Group) 'Matiti'

3.2 ± 0.2%, sugar/acid ratio 42.15 ± 2.5, keeping quality good.

1.5 Musa (AA Group) 'Eraichivazhai'

The plant is 199.00 ± 2.8 cm tall at flowering with a circumference of 60.50 ± 1.5 cm at the base. It takes 203 ± 3.5 days from planting to flowering and 93 ± 1.5 days from flowering to harvest.

Pseudostem: light green with purple blotches near the petiole.

Leaves: petiole 28.25 ± 1.2 cm long, not clasping pseudostem, margins of petiole pink, spreading, winged below, lamina 146. ± 2.5 cm long 58 ± 1.8 cm broad, base of lamina unequal, base and apex truncate, number of leaves 27 ± 2.5.

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis geotropic, male flowers deciduous, peduncle medium long, hairy.

Bract: deciduous, shoulder low, reflex and roll back after opening, narrowly ovate, apex acute, colour brownish purple outside, pink inside, colour fades towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal 3.3 ± 0.03 cm long, 1.8 ± 0.02 cm broad, colour creamy white, lobes 3+2, acute, free tepal 3 ± 0.12 cm long, 2.5 ± 0.02 cm broad,

dull white, below tip corrugated; stamens not fertile, staminodes 5,  $2.6 \pm 0.5$  cm long, colour cream with no anther lobes; pistil  $14.3 \pm 0.10$  cm long, stigma rich yellow with 3 lobes, ovary  $10.8 \pm 0.06$  cm long,  $6.2 \pm 0.05$  cm in circumference, straight, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.2 \pm 0.20$  cm long,  $1.4 \pm 0.08$  cm broad, colour creamy white, lobes 3+2, acute, free tepal  $2.6 \pm 0.07$  cm long,  $1.5 \pm 0.12$  cm broad, dull white, below tip corrugated, stamens 5, all fertile, filament  $2.1 \pm 0.01$  cm long, colour creamy white, anther lobes  $1.8 \pm 0.02$  cm long, colour cream, pistillode  $3.9 \pm 0.12$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $45^\circ - 50^\circ$  to the pseudostem, bunch weight  $6.25 \pm 0.80$  kg, number of fingers  $53.5 \pm 1.5$ , number of hands  $6 \pm 0.8$ , hands and fingers loose.

Finger:  $13.75 \pm 0.8$  cm long and  $10.38 \pm 1.2$  cm in circumference, not angular, very slightly tapering to the tip, apex indistinct, round, finger weight  $74.60 \pm 1.3$  g.

Ripe fruit: Colour greenish yellow, separate easily from the hand, rind medium thick, pulp creamy white, soft, juicy, taste sweet with a good flavour, TSS  $19.00 \pm 1.2\%$ , total sugars  $6.87 \pm 0.08\%$ , reducing sugars  $5.69 \pm 0.05$ , non reducing sugars  $1.07 \pm 0.03\%$ , sugar acid ratio  $18.51 \pm 1.5$ , keeping quality medium.



PLATE 6. Musa (AA Group) 'Eraichivazhai'



### 1.6 Musa (AA Group) 'Sanna chenkadali'

The plant is  $202.50 \pm 3.2$  cm tall with a circumference of  $47.50 \pm 1.5$  cm at the base. It takes  $201 \pm 4.2$  days from planting to flowering and  $91 \pm 3.2$  days from flowering to harvest.

Pseudostem: light purple, heavily marked with brown to black blotches.

Leaves:  $46.75 \pm 0.75$  cm long, not clasping pseudostem, margins of petiole spreading, winged below, lamina  $178.00 \pm 2.8$  cm long,  $56.00 \pm 1.6$  cm broad, base of lamina, unequal, base and apex cordate; number of leaves  $22 \pm 1.2$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal till maturity, male axis ageotropic a few rows of male flowers persistent, peduncle short and hairy.

Bract: deciduous, shoulder low, slightly reflex and roll back after opening, ovate, apex acute, bract scars prominent, bract colour brownish purple outside, dull purple inside, colour continuous to the base.

Female flowers: arranged in two rows, united tepal  $4.3 \pm 0.02$  cm long and  $1.4 \pm 0.04$  cm broad, colour creamy white, lobes 3+2, acute, free tepal  $2.6 \pm 0.02$  cm long,  $2.2 \pm 0.3$  cm broad, creamy white, below tip corrugated; stamens not fertile,

staminodes 5,  $2.5 \pm 0.10$  cm long, creamy white with no anther lobes; pistil  $9.8 \pm 0.13$  cm long, stigma rich yellow with 3 lobes, ovary  $5.6 \pm 0.01$  cm long,  $4.3 \pm 0.03$  cm in circumference, colour pale yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.3 \pm 0.02$  cm long,  $1.5 \pm 0.01$  cm broad, lobes 3+2, acute, free tepal  $2.7 \pm 0.05$  cm long,  $1.5 \pm 0.01$  cm broad, below tip corrugated; stamens 5, all fertile, filament  $3.2 \pm 0.02$  cm long, dull white, anther lobes  $3.3 \pm 0.1$  cm long, colour grey, pistillode  $5 \pm 0.1$  cm long, stigma colour rich yellow, ovary pale yellow.

Bunch: position of mature bunch  $45^\circ$  to the pseudostem, bunch weight  $7.25 \pm 0.80$  kg, number of fingers  $110 \pm 3.5$ , number of hands  $10.88 \pm 1.8$ , fingers in a hand loose.

Finger:  $13.08 \pm 0.40$  cm long and  $9.25 \pm 0.58$  cm in circumference, with 5 indistinct sides, tapering to the tip, apex distinct, finger weight  $72.75 \pm 2.5$  g.

Ripe fruit: colour reddish purple, firmly attached to the hand, rind thin, pulp creamy white, medium hard, juicy, taste sweet with a good flavour, TSS  $24.03 \pm 1.3\%$ , total sugars  $10.51 \pm 0.02\%$ , reducing sugars  $9.90 \pm 0.80\%$ , non reducing sugars  $0.58 \pm 0.02\%$ , sugar/acid ratio  $47.77 \pm 4.2$ , keeping quality good.



PLATE 7. Musa (AA Group) 'Sanna chenkadali'

### 1.7 Musa (AAA Group) 'Gros Michel'

The plant is  $282.00 \pm 1.2$  cm tall with a circumference of  $57.00 \pm 1.10$  cm at the base. It takes  $198 \pm 2.1$  days from planting to flowering and  $107 \pm 1.8$  days from flowering to harvest.

Pseudostem: yellowish green with dark brown blotches.

Leaves: petiole  $42 \pm 0.43$  cm long, not clasping pseudostem, margins of petiole spreading, winged below, margins red, lamina  $221.00 \pm 1.2$  cm long,  $69.00 \pm 2.1$  cm broad, base of lamina unequal, base and apex truncate, number of leaves  $29 \pm 0.80$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis ageotropic, basal 3 - 4 rows of male flowers persistent; peduncle short and pubescent.

Bract: deciduous, shoulder *high*, reflex and roll back after opening, narrowly ovate, apex acute, colour dull purple outside, pink inside, inside bract colour fades towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.6 \pm 0.4$  cm long,  $2.8 \pm 0.2$  cm broad, colour creamy white, light brownish outside, lobes 3+2, acute, free tepal  $2.8 \pm 0.12$  cm long,  $2.3 \pm 0.13$  cm broad, colour dull white, below tip corrugated; stamens not fertile, staminodes 5,  $3 \pm 0.05$  cm

long, creamy white with no anther lobes; pistil  $15.2 \pm 0.07$  cm long, stigma rich yellow, ovary  $11.3 \pm 0.04$  cm long,  $7.4 \pm 0.12$  cm in circumference, colour light green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.5 \pm 0.01$  cm long,  $2.7 \pm 0.02$  cm broad, colour creamy white, lobes 3+2, acuminate; free tepal  $2.7 \pm 0.07$  cm long,  $2.1 \pm 0.02$  cm broad, dull white, below tip corrugated; stamens 5, all fertile, filament  $2 \pm 0.03$  cm long, colour creamy white, anther lobes  $2.3 \pm 0.03$  cm long, brownish black, pistillode  $4.5 \pm 0.04$  cm long, stigma rich yellow, ovary  $3.3 \pm 0.05$  cm long, colour yellowish green.

Bunch: Position of mature bunch  $25^\circ$  to  $30^\circ$  to the stem, bunch weight  $9.75 \pm 0.80$  kg, number of fingers  $97 \pm 1.2$ , number of hands  $7.45 \pm 0.01$ , hands and fingers compact.

Finger:  $14.38 \pm 0.2$  cm long,  $11.38 \pm 0.12$  cm in circumference, slightly angular with five unequal sides, slightly tapering to the tip, apex stout and round, finger weight  $121.75 \pm 1.2$  g.

Ripe fruits: Colour yellow, separate easily from the hand, rind medium thick, pulp colour cream, soft and melting, taste sweet with good flavour, TSS  $21.00 \pm 0.5\%$ , Total sugars  $12.90 \pm 1.2\%$ , reducing sugars  $11.95 \pm 0.04\%$ , non reducing sugar  $0.90 \pm 0.01\%$ , sugar/acid ratio  $83.24 \pm 1.2$ , keeping quality poor.



PLATE 8. Musa (AAA Group) 'Gros Michel'

1.8 Musa (AAA Group) 'Highgate'

The plant is  $197.50 \pm 1.2$  cm tall and with a circumference of  $60.50 \pm 1.5$  cm at the base. It takes  $198 \pm 2.8$  days from planting to flowering and  $109 \pm 2.1$  days from flowering to harvest.

Pseudostem: yellowish green with dark brown blotches.

Leaves: petiole  $32.5 \pm 0.5$  cm long, not clasping pseudostem, margins of petiole spreading, with scarious wings below, margins red, lamina  $185 \pm 2.5$  cm long,  $84 \pm 1.3$  cm broad, base of lamina unequal, base obtuse, apex acute, number of leaves  $28.00 \pm 1.2$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis ageotropic, basal 3 - 4 rows of male flowers persistent; peduncle short and pubescent.

Bract: deciduous, shoulder high, reflex and roll back after opening, narrowly ovate, apex acute, colour dull purple outside, pink inside, inside bract colour fades towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.04$  cm long,  $2.4 \pm 0.02$  cm broad, colour creamy white, light brownish outside, lobes 3 + 2, acute; free tepal  $2.5 \pm 0.02$  cm long,  $2.4 \pm 0.03$  cm broad, colour dull white, below tip corrugated; stamens not fertile, staminodes 5,

2.4  $\pm$  0.02 cm long, creamy white with no anther lobes; pistil 12  $\pm$  0.80 cm long, stigma rich yellow, with 3 lobes, ovary 8.2  $\pm$  0.20 cm long, 11  $\pm$  0.01 cm in circumference, colour pale green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 4.6  $\pm$  0.03 cm long, 2.8  $\pm$  0.02 cm broad, creamy white, lobes 3+2, acute, free tepal 2.8  $\pm$  0.12 cm long, 2.3  $\pm$  0.05 cm broad, dull white, below tip corrugated; stamens 5, all fertile, filament 2  $\pm$  0.01 cm long, colour creamy white, anther lobes 2.3  $\pm$  0.07 cm long, colour brownish black; pistillode 4.5  $\pm$  0.5 cm long, stigma rich yellow, ovary yellowish green.

Bunch: position of mature bunch 25<sup>o</sup> to 30<sup>o</sup> to the pseudostem, bunch weight 13.25  $\pm$  0.03, number of fingers 112.5  $\pm$  2.2, number of hands 10  $\pm$  0.20, hands and fingers compact.

Finger: 19.75  $\pm$  0.10 cm long and 10.5  $\pm$  0.05 cm in circumference, angular with 5 sides, slightly tapering to the tip, apex short, stout and round, finger weight 112.5  $\pm$  3.2 g.

Ripe fruit: colour yellow, separate easily from the hand, rind medium thick, pulp colour cream, soft and melting, taste sweet with good flavour, TSS 18.00  $\pm$  0.20%, total sugars 10.40  $\pm$  0.30%, reducing sugars 9.37  $\pm$  0.02%, non reducing sugars 0.99  $\pm$  0.01%, sugar/acid ratio 60.34  $\pm$  1.2, keeping quality poor.





PLATE 91. Musa (AAA Group) 'Highgate'

### 1.9 Musa (AAA Group) 'Pedda pachcha'

The plant is  $158.00 \pm 3.2$  cm tall with a circumference of  $42.50 \pm 1.2$  cm at the base. It takes  $174 \pm 3.0$  days from planting to flowering and  $105 \pm 2.5$  days from flowering to harvest.

Pseudostem: yellowish green with dark purple to black blotches.

Leaves: petiole  $27.5 \pm 0.75$  cm long, not clasping pseudostem, margins of petiole spreading, winged below, margins pink coloured, lamina  $141.00 \pm 4.2$  cm long  $65.00 \pm 3.1$  cm broad, base of lamina unequal, base truncate, apex cordate, number of leaves  $21 \pm 0.50$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis slightly ageotropic, bracts and male flowers persistent; peduncle short and pubescent.

Bract: persistent, shoulder high, slightly reflex and roll back after opening, ovate, apex acute, bract colour dull purple outside, pale pink inside, inside bract colour fades to yellow towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.05$  cm long and  $1.8 \pm 0.02$  cm broad, colour creamy white, lobes 3+2, acute, free tepal  $3 \pm 0.06$  cm long,  $2.8 \pm 0.01$  cm broad, dull white, below tip corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.06$  cm long, colour creamy

white, with no anther lobes; pistill 13.6  $\pm$  0.7 cm long, stigma rich yellow with 3 lobes; ovary 10  $\pm$  0.9 cm long, 7.2  $\pm$  0.6 cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5  $\pm$  0.05 cm long, 1.8  $\pm$  0.02 cm broad, colour creamy white, lobes 3+2, acute, free tepal 3  $\pm$  0.02 cm long 2.2  $\pm$  0.04 cm broad, dull white, below tip corrugated; stamens 5, all fertile, filament 2.3  $\pm$  0.05 cm long creamy white, anther lobes 2.8  $\pm$  0.12 cm long, brownish black; pistillode 4.3  $\pm$  0.04 cm long, stigma rich yellow, ovary colour greenish yellow.

Bunch: position of mature bunch 25<sup>o</sup> + 30<sup>o</sup> to the stem, bunch weight 8  $\pm$  0.25 kg, number of fingers 76  $\pm$  4.0, number of hands 6  $\pm$  0.5, hands and fingers compact.

Finger: 14.13  $\pm$  0.40 cm long and 10.88  $\pm$  0.80 cm in circumference, angular with 5 distinct sides, apex round, finger weight 94.38  $\pm$  1.62 g.

Ripe fruit : colour greenish yellow changing to yellow, do not easily separate from the hand, rind medium thick, pulp colour cream, soft, taste sweet, TSS 22.00  $\pm$  0.40%, total sugars 12.08  $\pm$  0.42 reducing sugars 8.13  $\pm$  0.44%, non reducing sugars 3.76  $\pm$  0.26%, sugar/acid ratio 89.41  $\pm$  3.1, keeping quality poor.

### 1.10 Musa (AAA Group) 'Basrai'

The plant is  $132.00 \pm 2.2$  cm tall at the flowering with a circumference of  $47.00 \pm 1.2$  cm at the base. It takes  $188 \pm 3.2$  days from planting to flowering and  $106 \pm 3.6$  days from flowering to harvest.

Pseudostem: yellowish green with dark brown to black blotches.

Leaves: petiole  $27.25 \pm 0.13$  cm long, not clasping pseudostem, margins of petiole spreading, with scarious wings below, margins pink, lamina  $126.00 \pm 1.5$  cm long,  $62.00 \pm 1.2$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $32 \pm 0.68$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis geotropic, male flowers persistent, peduncle short and pubescent.

Bract: persistent, shoulder *high*, reflex and roll back after opening, ovate, apex acute, colour dull purple outside, pink inside, *inside* colour fades towards the base, bract scars prominent.

Female flowers arranged in two rows, united tepal  $3.2 \pm 0.05$  cm long and  $1.9 \pm 0.04$  cm broad, colour creamy white, lobes  $3 + 2$ , acuminate, free tepal  $21 \pm 0.02$  cm long,  $2 \pm 0.01$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $1.5 \pm 0.02$  cm long, creamy white with a black tinge at the bottom, with no anther lobes; pistil

11  $\pm$  0.81 cm long, stigma colour rich yellow, with 3 lobes; ovary 9.5  $\pm$  0.75 cm long, 6.9  $\pm$  0.60 cm in circumference, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 3.6  $\pm$  0.02 cm long, 1.8  $\pm$  0.01 cm broad, colour creamy white, lobes 3+2, acuminate, free tepal 1.9  $\pm$  0.12 cm long, 1.8  $\pm$  0.05 cm broad, creamy white, below tip corrugated; stamens 5, all fertile, filament 1.6  $\pm$  0.10 cm long, anther lobes 2.1  $\pm$  0.80 cm long; pistillode 9.5  $\pm$  0.15 cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch 25<sup>o</sup> - 30<sup>o</sup> to the pseudostem, bunch weight 5.5  $\pm$  0.15 kg, number of fingers 83  $\pm$  1.8, number of hands 6  $\pm$  0.3, fingers and hands compact.

Finger: 13.25  $\pm$  0.75 cm long and 9.18  $\pm$  0.16 cm in circumference, slightly angular with 5 sides, tapering to the tip, apex distinct, round, finger weight 68.38  $\pm$  4.8 g.

Ripe fruits: colour greenish yellow, do not easily separate from the hands, rind medium thick, pulp colour cream, juicy, taste sweet, TSS 8.50  $\pm$  0.30%, total sugars 7.91  $\pm$  0.41%, reducing sugars 6.38  $\pm$  0.25%, non reducing sugars 1.46  $\pm$  0.05%, sugar acid ratio 56.47  $\pm$  4.2, keeping quality poor.



PLATE 10. Musa (AAA Group) 'Basrai'

### 1.11 Musa (AAA Group) 'Harichal'

The plant is  $212.50 \pm 2.1$  cm tall with a circumference of  $44.5 \pm 1.3$  cm at the base. It takes  $185 \pm 3.4$  days from planting to flowering and  $107 \pm 2.1$  days from flowering to harvest.

Pseudostem: yellowish green with purple to black blotches.

Leaves: petiole  $30 \pm 0.85$  cm long, clasping pseudostem, margins of petiole spreading with scarious wings below, margins pink, lamina  $190 \pm 3.8$  cm long  $40.00 \pm 2.9$  cm broad, base of lamina unequal, base obtuse, apex acute, number of leaves  $22 \pm 0.7$

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis ageotropic, male flowers deciduous, peduncle short and pubescent.

Braet: deciduous, shoulder high, reflex and roll back after opening, narrowly ovate, apex acute, colour dull purple outside, pink inside, inside bract colour fades towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.3 \pm 0.08$  cm long and  $2 \pm 0.03$  cm broad, colour creamy white, light brownish outside, lobes 3+2, acuminate, free tepal  $3.2 \pm 0.01$  cm long,  $2.7 \pm 0.02$  cm broad, dull white, below

tip corrugated; stamens not fertile, staminodes 5,  $2.2 \pm 0.07$  cm long, creamy white with no anther lobes; pistil  $13.8 \pm 0.13$  cm long, stigma rich yellow, with 3 lobes; ovary  $10.2 \pm 0.21$  cm long,  $7.1 \pm 0.12$  cm in circumference, yellowish green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.8 \pm 0.12$  cm long,  $1.7 \pm 0.03$  cm broad, colour creamy white, lobes 3+2, acuminate, free tepal  $3.2 \pm 0.13$  cm long,  $2.3 \pm 0.03$  cm broad, dull white, below tip corrugated; stamens 5, fertile, filament  $2.3 \pm 0.21$  cm long, colour creamy white, anther lobes  $2.7 \pm 0.32$  cm long, brownish black; pistillode  $4.5 \pm 0.72$  cm long, stigma rich yellow in colour, ovary 2.6 cm in length, greenish yellow.

Bunch: position of mature bunch  $25^{\circ}$  -  $30^{\circ}$  to the stem, bunch weight  $9.25 \pm 0.25$  kg, number of fingers  $83 \pm 4.8$ , number of hands  $8 \pm 0.57$ , hands and fingers compact.

Finger:  $14.75 \pm 0.85$  cm long and  $12.25 \pm 0.72$  cm in circumference, angular with 5 distinct sides, slightly tapering to the tip, apex short, round finger weight  $188.02 \pm 3.6$  g.

Ripe fruits: yellowish green, loosely attached to the hand, rind medium thick, pulp colour cream, soft, taste sweet, TSS  $18.50 \pm 1.5\%$ , total sugars  $13.05 \pm 0.12\%$ , reducing sugars  $12.00 \pm 0.26\%$ , non reducing sugars  $1.00 \pm 0.18\%$ , sugar/acid ratio  $79.19 \pm 3.5$ , keeping quality poor.





PLATE 11. Musa (AAA Group) 'Harichal'

### 1.12 Musa (AAA Group) 'Sapumal anamalu'

The plant is  $262.50 \pm 2.6$  cm tall with a circumference of  $58.00 \pm 2.6$  cm at the base. It takes  $197 \pm 3.8$  days from planting to flowering and  $106 \pm 3.7$  days from flowering to harvest.

Pseudostem: yellowish green with dark brown to black blotches.

Leaves: petiole  $33.25 \pm 0.82$  cm long, not clasping pseudostem, margins of petiole spreading, winged below, margins pink, lamina  $23 \pm 5.2$  cm long  $57.00 \pm 2.5$  cm broad, base of lamina unequal, base and apex truncate, number of leaves  $3.2 \pm 0.75$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis ageotropic, peduncle short and pubescent.

Bract deciduous, shoulder high, reflex and roll back after opening, narrowly ovate, apex acute, bract colour yellowish purple outside, pale pink inside, inside bract colour fades to yellow towards the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.8 \pm 0.12$  cm long and  $3 \pm 0.06$  cm broad, lobes 3+2, acuminate, free tepal  $3.2 \pm 0.12$  cm long,  $2.5 \pm 0.03$  cm broad, below tip corrugated; stamens not fertile, staminodes 5,  $3 \pm 0.10$  cm long, creamy white, with no anther lobes; pistil

15.6  $\pm$  0.30 cm long, stigma rich yellow with 3 lobes; ovary 11.2  $\pm$  0.23 cm long, 7.4  $\pm$  0.21 cm in circumference, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 4.6  $\pm$  0.21 cm long, 2.9  $\pm$  0.01 cm broad, lobes 3+2, acuminate, free tepal 3.2  $\pm$  0.03 cm long, 2.9  $\pm$  0.10 cm broad, below tip corrugated; stamens 5, all fertile, filament 2.5  $\pm$  0.08 cm long, anther lobes 2.8  $\pm$  0.02 cm long, brownish black, pistillode 4.6  $\pm$  0.12 cm long; stigma rich yellow, ovary colour yellowish green.

Bunch: position of mature bunch 25<sup>o</sup> to 30<sup>o</sup> to the stem, bunch weight 6.25  $\pm$  0.75 kg, number of fingers 78.5  $\pm$  3.2, number of hands 7  $\pm$  0.25, hands loose, fingers compact.

Finger: 17.98  $\pm$  0.22 cm long and 9.98  $\pm$  0.82 cm in circumference, angular with 5 sides, slightly tapering to the tip, apex short, stout and round, finger weight 133  $\pm$  4.2 g.

Ripe fruit: colour yellow, separate easily from the hand, rind medium thick, pulp colour cream, soft, juicy, taste sweet with a good flavour, TSS 19.00  $\pm$  0.60%, total sugars 10.25  $\pm$  1.2%, reducing sugars 7.62  $\pm$  0.81%, non reducing sugars 2.50  $\pm$  0.06%, sugar acid ratio 53.95  $\pm$  1.8, keeping quality poor.

1.13 Musa (AAA Group) 'Manoranjithm'

The plant is  $250.75 \pm 3.2$  cm tall with a circumference of  $54.00 \pm 1.5$  cm at the base. It takes  $234 \pm 4$  days from planting to flowering and  $96 \pm 3.5$  days from flowering to harvest.

Pseudostem: yellowish green, heavily marked with brown to black blotches.

Leaves: petiole  $34.5 \pm 0.51$  cm long, not clasping pseudostem, margins of petiole spreading, lamina  $183.00 \pm 3.2$  cm long,  $71.00 \pm 2.1$  cm broad, base of lamina unequal, base obtuse, apex truncate, number of leaves  $33 \pm 0.85$ .

Inflorescence: with basal female and distal male flowers, female axis ageotropic, male axis positively geotropic, peduncle short and pubescent.

Bract: deciduous, shoulder <sup>high</sup>, reflex and roll back after opening, ovate, apex acute, bract colour dull purple outside, pink inside, inside colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.1 \pm 0.08$  cm long and  $2.1 \pm 0.05$  cm broad, colour creamy white, lobes 3+2, acuminate, free tepal  $2.2 \pm 0.03$  cm long,  $1.8 \pm 0.03$  cm broad, below tip corrugated; stamens 5, not fertile, staminodes 5,  $2.8 \pm 0.05$  cm long, creamy white with no anther lobes; pistil  $14.5 \pm 0.60$  cm long, stigma

rich yellow, with 3 lobes; ovary  $10.7 \pm 0.70$  cm long,  $6.8 \pm 0.08$  cm in circumference, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5 \pm 0.05$  cm long,  $4.2 \pm 0.03$  cm broad, creamy yellow, lobes 3+2, acuminate, free tepal  $2.8 \pm 0.02$  cm long,  $2.1 \pm 0.05$  cm broad, colour dull white, below tip corrugated; stamens 5, fertile, filament  $1.8 \pm 0.01$  cm long, colour creamy white, anther lobes  $2.5 \pm 0.05$  cm long, colour grey, pistillode  $4.2 \pm 0.12$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $40^{\circ} - 45^{\circ}$  to the pseudostem, bunch weight  $5.75 \pm 2.1$  kg with  $57 \pm 3.3$  fingers, hands  $7 \pm 0.61$  fingers and hands compact.

Finger:  $12.98 \pm 0.07$  cm long and  $10.25 \pm 0.36$  cm in circumference almost cylindrical, apex distinct, finger weight  $71.08 \pm 1.5$  g.

Ripe fruit : colour dull yellow, do not easily drop off from the hand, rind medium thick, pulp colour cream, soft, juicy, taste sweet with good flavour, TSS  $20.00 \pm 0.81\%$ , total sugars  $7.95 \pm 0.52\%$ , reducing sugars  $6.40 \pm 0.7\%$ , non reducing sugars  $1.48 \pm 0.50$ , sugar/acid ratio  $37.93 \pm 3.2$ , keeping quality poor.

1.14 Musa (AAA Group) 'Galanamalu'

The plant is  $274.50 \pm 2.5$  cm tall with a circumference of  $71.50 \pm 1.5$  cm at the base. It takes  $238 \pm 4.5$  days from planting to flowering and  $117 \pm 3.2$  days from flowering to harvest.

Pseudostem: yellowish green with dark purple to black blotches.

Leaves: Petiole 59.25 cm long, not clasping pseudostem, margins of petiole spreading, winged below, lamina  $221 \pm 2.5$  cm long  $54 \pm 1.5$  cm broad, base of lamina, equal, base cordate, apex truncate, number of leaves  $28 \pm 0.35$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis slightly ageotropic, basal 3 - 4 rows of male flowers persistent, peduncle short and pubescent.

Bract: deciduous, shoulder high, reflex and roll back after opening, ovate, apex acute, colour dull purple outside, light crimson inside, inside bract colour almost continuous to the base.

Female flowers: arranged in two rows, united tepal  $4.5 \pm 0.01$  cm long and  $2.8 \pm 0.02$  cm broad, creamy white, lobes 3+2, acuminate, free tepal  $3.5 \pm 0.12$  cm long,  $2.5 \pm 0.05$  cm broad, dull white, below tip corrugated; stamens not fertile,

staminodes 5,  $2.6 \pm 0.03$  cm long, creamy white, with no anther lobes; pistil  $14.9 \pm 0.12$  cm long, stigma rich yellow with 3 lobes, ovary  $11.1 \pm 0.13$  cm long,  $6.8 \pm 0.05$  cm in circumference, greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.1 \pm 0.01$  cm long,  $1.9 \pm 0.51$  cm broad, creamy white, lobes 3+2, acuminate, free tepal  $3.9 \pm 0.02$  cm long  $2.6 \pm 0.15$  cm broad, colour creamy white, below tip corrugated; stamens 5 fertile, filament  $2.5 \pm 0.05$  cm long, colour creamy white, anther lobes  $4.5 \pm 0.06$  cm long, colour grey pistillode  $5.1 \pm 0.07$  cm long, stigma colour rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $25 - 30^\circ$  to the pseudostem, bunch weight  $15.25 \pm 0.13$  kg, number of fingers,  $77 \pm 4.2$  number of hands,  $5 \pm 0.25$  hands and fingers compact.

Finger:  $11.83 \pm 0.31$  cm long and  $13.75 \pm 0.25$  cm in circumference, almost cylindrical with 3 unequal indistinct sides, slightly tapering to the apex, apex round, indistinct, finger weight  $193.50 \pm 2.5$  g.

Ripe fruits: colour greenish yellow, do not easily separate from the hand, rind medium thick, pulp colour yellowish cream, juicy, taste sweet with good flavour, TSS  $21.50 \pm 0.05\%$ , total sugars  $13.68 \pm 0.13\%$ , reducing sugars  $12.55 \pm 0.50\%$ , non reducing sugars  $1.07 \pm 0.27\%$ , sugar/acid ratio  $82.99 \pm 4.2$ , keeping quality poor.

1.15 Musa (AAA Group) 'Red banana'

The plant is  $287.00 \pm 4.5$  cm tall with a circumference of  $69.25 \pm 3.2$  cm at the base. It takes  $233 \pm 4.2$  days from planting to flowering and  $106 \pm 3.2$  days from flowering to harvest.

Pseudostem: greenish purple more with dark brown blotches.

Leaves: petiole  $46.50 \pm 1.5$  cm long, not clasping pseudostem, margins of petiole spreading, winged below lamina  $236 \pm 3.5$  cm long,  $86 \pm 2.2$  cm broad, base of lamina, equal, base cordate, apex truncate, number of leaves  $31 \pm 0.50$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis slightly ageotropic, basal 3-4 rows of male flowers persistent, peduncle short and pubescent.

Bract: deciduous, shoulder high, reflex and roll back after opening, ovate apex acute, colour dull, purple outside, light almost crimson inside, inside bract colour, continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.3 \pm 0.1$  cm long and  $3.1 \pm 0.20$  cm broad, creamy white, lobes 3+2, acuminate, free tepal  $3.6 \pm 0.21$  cm long,  $2.7 \pm 0.05$  cm broad, below tip corrugated; stamens not fertile, staminodes 5, 2.3 cm long, creamy white with no anther lobes, pistil



14.8  $\pm$  0.12 cm long, stigma rich yellow, with 3 lobes; ovary 10.7  $\pm$  0.22 cm long, 7.1  $\pm$  0.05 cm in circumference, greenish yellow with red pigmentation, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.3 cm long, 1.8  $\pm$  0.06 cm broad, creamy white, lobes 3+2, acuminate, free tepal 3.8  $\pm$  0.07 cm long 2.7  $\pm$  0.18 cm broad, colour creamy white, below tip corrugated; stamens 5, fertile, filament 2.6  $\pm$  0.04 cm long, colour creamy white, anther lobes 4.4  $\pm$  0.21 cm long colour grey, pistillode 5.6  $\pm$  0.11 cm long, stigma colour rich yellow, ovary greenish yellow with red pigmentation.

Bunch: position of mature bunch 25° - 30° to the pseudostem bunch weight 12.50  $\pm$  0.15 kg, number of fingers 77  $\pm$  3.4 number of hands 6  $\pm$  0.15, hands and fingers compact.

Finger: 12.18  $\pm$  0.04 cm long and 14.53  $\pm$  0.21 cm in circumference, almost cylindrical with 3 unequal indistinct sides, slightly tapering to the apex, apex indistinct, round, finger weight 195.60  $\pm$  3.5.

Ripe fruit: colour red, do not easily separate from the hand, rind medium thick pulp colour yellowish cream, soft, juicy, taste sweet with good flavour, TSS 21.00  $\pm$  0.50%, total sugars 13.50  $\pm$  0.18%, reducing sugars 11.50  $\pm$  0.18%, non reducing sugars 1.90  $\pm$  0.04%, sugar/acid ratio 82.99  $\pm$  48 keeping quality poor.

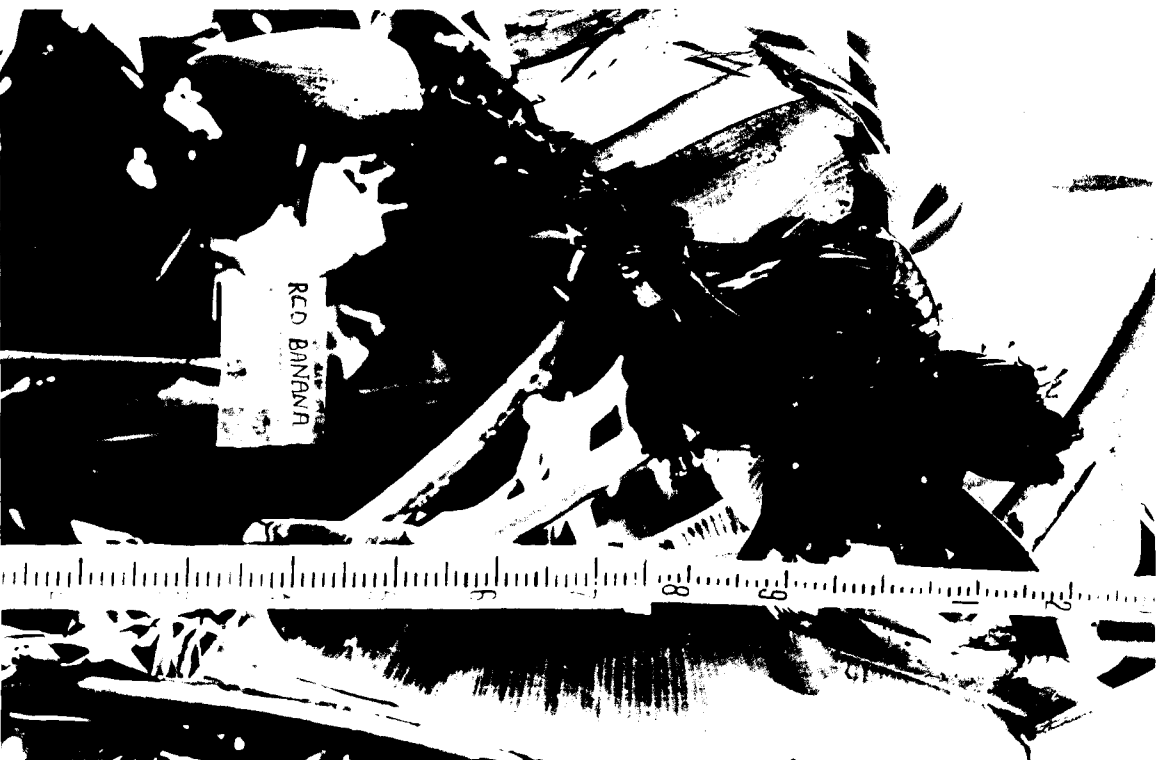


PLATE 12. Musa (AAA Group) 'Red banana'

### 1.16 Musa (AAA Group) 'Wather'

The plant is  $174 \pm 4.2$  cm tall at flowering with a circumference of  $44.5 \pm 1.2$  cm at the base. It takes  $204 \pm 3.5$  days from planting to flowering and  $92 \pm 4.2$  days from flowering to harvest.

Pseudostem: pale green, heavily marked with dark purple blotches.

Leaves: petiole  $31.00 \pm 1.8$  cm long, not clasping pseudostem, margins of petiole spreading, winged below, margins pink, lamina  $135.00 \pm 3.1$  cm long,  $57.00 \pm 2.5$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $26 \pm 0.56$ .

Inflorescence with basal female and distal male flowers, female and male axis positively geotropic, male flowers deciduous, peduncle short and pubescent.

Bract: deciduous, shoulder high, reflex and roll back after opening, ovate, apex obtuse, colour dull purple outside, light crimson inside, colour fades towards the base.

Female flowers: arranged in two rows, united tepal  $3.4 \pm 0.05$  cm long and  $1.9 \pm 0.88$  cm broad, colour creamy white, lobes 3+2, acute, free tepal  $3.1 \pm 0.08$  cm long,  $2.5 \pm 0.05$  cm broad, dull white, below tip corrugated; stamens not fertile, staminodes 5,  $2.7 \pm 0.03$  cm long colour creamy white, with no anther lobes; pistil  $14.4 \pm 0.61$  cm long, stigma

rich yellow with 3 lobes; ovary  $10.7 \pm 0.25$  cm long,  $6.00 \pm 0.13$  cm in circumference, greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 4.3 cm long,  $1.5 \pm 0.04$  cm broad, colour creamy white, lobes 3+2, acute, free tepal  $2.6 \pm 0.31$  cm long,  $1.5 \pm 0.21$  cm broad, colour dull white, below tip corrugated; stamens 5, fertile, filament  $2.2 \pm 0.12$  cm long, colour creamy white, anther lobes  $1.9 \pm 0.02$  cm long, colour grey, pistillode  $1.9 \pm 0.10$  cm long, stigma rich yellow, ovary greenish yellow.

Bunch: position of mature bunch  $30^\circ - 35^\circ$  to the stem bunch weight  $5.75 \pm 0.21$  kg, number of fingers  $57 \pm 2.8$  number of hands,  $7 \pm 0.61$  hands and fingers loose.

Finger:  $16.83 \pm 0.13$  cm long and  $10.88 \pm 0.45$  cm in circumference, almost cylindrical, apex distinct, short and stout, finger weight  $80.25 \text{ g} \pm 2.5 \text{ g}$ .

Ripe fruit: colour yellowish green, separate easily from the hand, rind medium thick, pulp colour cream, soft juicy, taste sweet, TSS  $18.00 \pm 0.56\%$ , total sugars  $5.60 \pm 0.21\%$ , reducing sugars  $4.27 \pm 0.41\%$ , non reducing sugars  $1.27 \pm 0.05\%$ , sugar/acid ratio  $17.76 \pm 0.86$ , keeping quality poor.

1.17 Musa (AAA Group) 'Karim kadali'

The plant is  $186.50 \pm 4.5$  cm tall at flowering with a circumference of  $42.00 \pm 1.8$  cm at the base. It takes  $205 \pm 3.5$  days from planting to flowering and  $85 \pm 2.9$  days from flowering to harvest.

Pseudostem: yellowish green with large dark blotches.

Leaves: petiole  $28.25 \pm 0.58$  cm long, not clasping pseudostem, margins of petiole erect with scarious wings below, lamina  $158 \pm 3.1$  cm long  $61 \pm 2.6$  cm broad, base of lamina, unequal, base obtuse, apex truncate, number of leaves  $26 \pm 0.71$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis geotropic, peduncle short and pubescent.

Bract: deciduous, shoulder low, reflex and roll back after opening, ovate, apex acute, colour dull purple outside and inside bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5 \pm 0.21$  cm long and  $3 \pm 0.10$  cm broad, creamy white, lobes 3+2, acute free tepal  $3.5 \pm 0.02$  cm long,  $3.2 \pm 0.05$  cm broad, colour creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $3 \pm 0.21$  cm long, creamy white with no anther lobes; pistil  $14 \pm 0.26$  cm long, stigma colour rich yellow,

with 3 lobes, ovary  $9.5 \pm 0.5$  cm long,  $8 \pm 0.26$  cm in circumference, yellowish green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.2 \pm 0.5$  cm long,  $3 \pm 0.06$  cm broad, colour cream, lobes 3+2, acuminate, free tepal  $3.6 \pm 0.06$  cm long  $3.9 \pm 0.01$  cm broad below tip corrugated; stamens 5, all fertile, filament  $2.3 \pm 0.04$  cm long, creamy white, anther lobes  $2.3 \pm 0.03$  cm long, brownish yellow, pistillode  $4.6 \pm 0.21$  cm long, stigma rich yellow, ovary yellowish green.

Bunch: position of mature bunch  $30^\circ - 35^\circ$  to the stem, bunch weight  $6 \pm 0.60$  kg with  $76 \pm 4.2$  fingers, hands,  $7 \pm 0.21$  fingers in a hand compact.

Finger:  $16.03 \pm 0.12$  cm long and  $9.80 \pm 0.07$  cm in circumference, almost cylindrical with 3 indistinct sides, not tapering to the tip, apex short and round finger weight  $74.79 \pm 3.6$  g.

Ripe fruit: colour yellowish green, do not easily separate from the hand, rind medium thick, pulp yellowish cream, thick, juicy, taste medium sweet, TSS  $20 \pm 0.81\%$ , total sugars  $13.87 \pm 0.50\%$ , reducing sugars  $11.50 \pm 0.40\%$ , non reducing sugars  $1.76 \pm 0.21\%$ , sugar/acid ratio  $30.49 \pm 1.12$ , keeping quality good.



PLATE 13. Musa (AAA Group) 'Karim kadali'

1.18 Musa (AAAA Group) 'Bodles Altafort'

The plant is  $240 \pm 4.5$  cm tall at flowering with a circumference of  $56.25 \pm 2.5$  cm at the base. It takes  $205 \pm 4.9$  days from planting to flowering and  $100 \pm 2.1$  days from flowering to harvest.

Pseudostem: yellowish green with dark brown blotches.

Leaves: petiole 57 cm long, not clasping pseudostem, margins of petiole spreading, winged below, margins red lamina  $211 \pm 3.8$  cm long,  $65 \pm 2.9$  cm broad, base of lamina unequal, base and apex cordate, number of leaves  $23 \pm 0.50$ .

Inflorescence: with basal female and distal male flowers, female axis pendulous, male axis ageotropic, peduncle short and pubescent.

Bract: deciduous, shoulder *high*, reflex and roll, narrowly ovate, apex acute, colour dull purple outside and inside, bract scars prominent.

Female flowers: arranged in two rows, united tepal 5.5 cm long and  $2.8 \pm 0.01$  cm broad, creamy white, lobes 3 + 2, acuminate, free tepal  $3.7 \pm 0.20$  cm long,  $3.3 \pm 0.12$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 4-5,  $2.5 \text{ cm} \pm 0.10$  cm long, creamy white, with no anther lobes; pistil  $12.4 \pm 0.95$  cm long, stigma rich yellow, ovary  $9.4 \pm 0.5$  cm long,  $7 \pm 0.75$  cm in circumference, greenish yellow, ovules arranged in two



regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.05$  cm long,  $2.8 \pm 0.04$  cm broad, creamy white, lobes 3+2, acuminate, pale yellow, free tepal  $3.5 \pm 0.03$  cm long,  $2.2 \pm 0.03$  cm broad, dull white, below tip corrugated; stamens 5, all fertile, filament  $3 \pm 0.12$  cm long, colour creamy white, anther lobes  $3.2 \pm 0.01$  cm long, brownish black; pistillode  $4.8 \pm 0.12$  cm long, stigma rich yellow, ovary yellowish green.

Bunch: position of mature bunch  $25^{\circ}$  to  $30^{\circ}$  to the stem, bunch weight  $9.25 \pm 0.23$  kg, number of fingers  $64 \pm 4.2$ , number of hands  $6 \pm 0.50$ , hands and fingers compact.

Finger:  $19.13 \pm 0.21$  cm long and  $11.95 \pm 0.05$  cm in circumference, slightly angular with 5 sides, slightly tapering to the tip, apex straight, round, finger weight  $166.18 \pm 2.5$  g.

Ripe fruit : Colour yellow, not firmly attached to the hand, rind medium thick, pulp colour cream, soft and melting, taste sweet with good flavour, TSS  $23.00 \pm 0.75\%$ , total sugars  $10.61 \pm 0.50\%$ , reducing sugars  $8.37 \pm 0.25$ , non reducing sugars  $1.19 \pm 0.05\%$ , sugar/acid ratio  $44.58 \pm 3.2$ , keeping quality poor.



PLATE 14. Musa (AAAA Group) 'Bodles Altafort'

1.19 Musa (AAB Group) 'Thiruvananthapuram'

The plant is  $210 \pm 2.8$  cm tall with a circumference of  $48.75 \pm 1.7$  cm at the base. It takes  $207 \pm 4.1$  days from planting to flowering and  $95 \pm 3.2$  days from flowering to harvest.

Pseudostem: yellowish green with black blotches near the petiole.

Leaves: petiole  $37.75 \pm 1.7$  cm long, not clasping pseudostem, margins of petiole inclosed, slightly winged below, lamina  $146 \pm 2.8$  cm long,  $75 \pm 1.7$  cm broad, base of lamina unequal, base cordate, apex obtuse, number of leaves  $24 \pm 0.26$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal till maturity, male axis positively geotropic, very long, male flowers deciduous, peduncle long and pubescent.

Bract: deciduous, shoulder low, reflex and roll back after opening, ovate, apex, acute, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.07$  cm long and  $1.8 \pm 0.02$  cm broad, colour pale yellow slightly flushed with pink, lobes 3+2, acute, colour rich yellow, free tepal  $2.3 \pm 0.02$  cm long,  $2.3 \pm 0.01$  cm broad, colour pale yellow, below tip slightly

corrugated; stamens not fertile, staminodes 5,  $2 \pm 0.03$  cm long, colour pale yellow with no anther lobes; pistil  $10.5 \pm 0.12$  cm long, stigma colour pale yellow, with 3 lobes; ovary  $8.5 \pm 0.15$  cm long,  $6.5 \pm 0.08$  cm in circumference, greenish yellow with pink flushed tip, ovules arranged in two regular rows in each loculus.

Male flowers arranged in two rows, united tepal  $5.1 \pm 0.07$  cm long,  $1.3 \pm 0.03$  cm broad, pale yellow flushed with pink, lobes 3+2, acute, rich yellow, free tepal  $2.6 \pm 0.03$  cm long,  $1.6 \pm 0.01$  cm broad, below tip corrugated, stamens 5, all fertile, filament  $2 \pm 0.02$  cm long, colour pale yellow, anther lobes  $2.8 \pm 0.03$  cm long, colour yellow flushed with pink; pistillode  $4.8 \pm 0.13$  cm long, stigma colour rich yellow, ovary greenish yellow flushed with pink at the tip.

Bunch: position of mature bunch  $45^\circ - 50^\circ$  to the stem, bunch weight  $11.25 \pm 0.14$  kg, number of fingers  $91 \pm 1.4$ , number of hands  $8 \pm 0.08$ , hands and fingers loose.

Finger:  $10.53 \pm 0.51$  cm long and  $8.65 \pm 0.31$  cm in circumference, angular with 3 - 4 unequal sides; slightly tapering to the tip, apex prominent, finger weight  $90.63 \pm 2.5$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind medium thick, pulp colour orange yellow, thick, not starchy, taste sweet, TSS  $23 \pm 0.18\%$ , total sugars  $8.59 \pm 0.21\%$ , reducing sugars  $6.78 \pm 0.18\%$ , non reducing sugars  $1.49 \pm 0.06\%$ ,  $\chi$   $23.47 \pm 0.80$ , keeping quality good.



PLATE 15. Musa (AAB Group) 'Thiruvananthapuram'

1.20 Musa (AAB Group) 'Pacha chingan'

The plant is  $208.5 \pm 4.1$  cm tall with a circumference of  $51.5 \pm 1.2$  cm at the base. It takes  $177 \pm 3.1$  days from planting to flowering and  $81 \pm 1.2$  days from flowering to harvest.

Pseudostem: yellowish green with dark blotches near the base of the petiole.

Leaves: petiole  $35 \pm 0.80$  cm long, not clasping pseudostem, margins of petiole erect, red coloured, winged below, lamina  $186 \pm 2.6$  cm long,  $68 \pm 1.8$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $21 \pm 0.65$ .

Inflorescence: with basal female and distal male flowers, female axis almost horizontal, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous.

Bract: deciduous, shoulder *low*, reflex and roll back after opening, broadly ovate, apex obtuse, colour dull purple outside, bright crimson inside, colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.6 \pm 0.05$  cm long and  $1.8 \pm 0.02$  cm broad, colour cream with light pink tinge towards the base, lobes 3+2, free tepal  $3 \pm 0.01$  cm long,  $2 \pm 0.01$  cm broad, colour creamy white, below tip corrugated; stamens not fertile, staminodes 5,

2.5 cm long, colour cream, with no anther lobes; pistil 13.3  $\pm$  0.06 cm long, stigma colour cream, with 3 lobes; ovary 9.5  $\pm$  0.08 cm long, 4  $\pm$  0.04 cm in circumference, colour green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 4.6  $\pm$  0.07 cm long, 1.2  $\pm$  0.02 cm broad, colour cream with slight pink tinge in the middle, lobes 3+2, acute, free tepal 2.3  $\pm$  0.61 cm long, 2  $\pm$  0.01 cm broad, creamy white, below tip corrugated; stamens 5, none fertile, filament 1.8  $\pm$  0.03 cm long, colour cream, anther lobes black thred like structures, pistillode 3.8  $\pm$  0.02 cm long, stigma colour pale yellow, ovary pale yellow with pink flush towards the base.

Bunch: position of mature bunch 60° to 90° to the stem, bunch weight 6.25  $\pm$  0.14 kg, number of fingers 84.5  $\pm$  2.2, number of hands 7  $\pm$  0.15, fingers in a hand loose.

Finger: 11.9  $\pm$  0.14 cm long and 10  $\pm$  0.08 cm in circumference, angular with 5 unequal, very slightly tapering to the tip, apex straight, slightly distinct, finger weight 54.75  $\pm$  2.5 g.

Ripe fruit: colour greenish yellow, loosely attached to the hand, rind thick, pulp colour cream, soft, not starchy, fit for consumption, taste sweet with good flavour, TSS 25  $\pm$  0.2%, total sugars 22.78  $\pm$  0.5%, reducing sugars 18.72  $\pm$  0.05%, non reducing sugars 3.87  $\pm$  0.07%, sugar/acid ratio, 60.76  $\pm$  1.3, keeping quality medium.

1.21. Musa (AAB Group) 'Rasthali'

The plant is  $264 \pm 2.3$  cm tall with a circumference of  $66.75 \pm 1.8$  cm at the base. It takes  $225 \pm 2.4$  days from planting to flowering and  $114 \pm 1.6$  days from flowering to harvest.

Pseudostem: light green with dark brown blotches.

Leaves: petiole  $54 \pm 0.69$  cm long, not clasping pseudostem, margins of petiole erect, slightly winged, red coloured, lamina  $187 \pm 3.4$  cm long,  $62 \pm 1.6$  cm broad, base of lamina unequal, base broadly obtuse, apex truncate, number of leaves  $\pm 33 \pm 0.45$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis ageotropic, very long, a few rows of male flowers persistent, short and pubescent.

Bract: shoulder *low*, ovate, apex, acute, reflex and roll back after opening, ovate, colour dull purple outside, reddish purple inside, inside bract colour slightly fades towards base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5 \pm 0.12$  cm long and  $2.8 \pm 0.02$  cm broad, colour cream, lobes 3+2, acuminate, free tepal  $2.5 \pm 0.03$  cm long,  $2.2 \pm 0.04$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $3 \pm 0.01$  cm long, colour cream with a slight black with no anther lobes; pistil  $15.4 \pm 0.21$  cm long,



stigma colour pale yellow, with 3 lobes; ovary  $11 \pm 0.30$  cm long,  $8.5 \pm 0.01$  cm in circumference, greenish yellow with pink flush, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.8 \pm 0.12$  cm long,  $1.8 \pm 0.08$  cm broad, colour cream with pink flush, lobes 3+2, acute, free tepal  $2.8 \pm 0.03$  cm long,  $2.3 \pm 0.05$  cm broad, below tip corrugated; stamens 5, fertile, filament  $3.2 \pm 0.01$  cm long, colour cream, anther lobes  $2.3 \pm 0.04$  cm long, brownish black, pistillode  $4.8 \pm 0.26$  cm long, stigma pale yellow, ovary greenish yellow.

Bunch: position of mature bunch  $40^{\circ} - 45^{\circ}$  to the stem, bunch weight  $12.75 \pm 0.26$  kg, number of fingers  $117 \pm 3.3$ , number of hands  $11 \pm 0.58$ , hands and fingers loose.

Finger:  $16.95 \pm 0.45$  cm long and  $12.13 \pm 0.09$  cm in circumference, almost cylindrical at maturity, tapering to the apex, apex distinct, round, finger weight  $92.92 \pm 4.2$  g.

Ripe fruit: colour yellow with tiny red spots, easily separate from the hand, rind very thin, pulp colour creamy white, soft, taste sweet, TSS  $23 \pm 0.81\%$ , total sugars  $14.68 \pm 0.68\%$ , reducing sugars  $13.50 \pm 0.56\%$ , non reducing sugars  $1.13 \pm 0.20\%$ , sugar/acid ratio  $34.18 \pm 1.2$ , keeping quality poor.



PLATE 16. Musa (AAB Group) 'Rasthali'

### 1.22 Musa (AAB Group) 'Dudhsagar'

The plant is  $251 \pm 4.5$  cm tall with a circumference of  $55 \pm 1.25$  cm at the base. It takes  $208 \pm 3.2$  days from planting to flowering and  $117 \pm 1.2$  days from flowering to harvest.

Pseudostem: yellowish green with brown to black blotches.

Leaves: petiole  $63.95 \pm 2.1$  cm long, clasping pseudostem, margins of petiole, slightly inclosed, slightly winged below, colour pink, lamina  $234 \pm 2.2$  cm long  $74 \text{ cm} \pm 1.2$ , broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $27 \pm 0.13$ .

Inflorescence: with basal female and distal male flowers, female and male axes pendulous, male flowers deciduous, peduncle medium long and pubescent.

Bract: deciduous, shoulder *low*, reflex and roll back after opening, ovate, apex acute, bract colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5.2 \pm 0.05$  cm long, and  $3.4 \pm 0.09$  cm broad, creamy white, lobes 3+2, acute, free tepal  $2.7 \pm 0.05$  cm long,  $2.2 \pm 0.03$  cm broad, below tip not corrugated, with 3 lobes; stamens not fertile, staminodes 5,  $2.3 \pm 0.01$  cm long, colour cream, with no anther lobes; pistil  $14.5 \pm 0.12$  cm long, stigma colour

pale yellow, with 3 lobes; ovary  $8.2 \pm 0.15$  cm long,  $7.5 \pm 0.08$  cm in circumference, yellowish green with a slight pink flush, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.08$  cm long,  $1.7 \pm 0.05$  cm broad, creamy white, lobes 3+2, acute, free tepal  $2.7 \pm 0.02$  cm long,  $2.5 \pm 0.03$  cm broad, below tip not corrugated; stamens 5, 2 - 4 fertile, filament  $2 \pm 0.01$  cm long, colour cream, anther lobes  $3.2 \pm 0.21$  cm long, colour brownish black, pistillode  $5.2 \pm 0.30$  cm long, stigma colour pale yellow, ovary yellowish green with a slight pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $12.75 \pm 0.16$  kg, number of fingers  $178 \pm 2.6$ , number of hands  $14 \pm 0.96$ , hands and fingers compact.

Finger:  $13.88 \pm 0.50$  cm long and  $13 \pm 0.25$  cm in circumference, angular with 3 - 5 unequal sides, not tapering to the tip, apex distinct, short, finger weight  $103.75 \pm 1.5$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind thin, pulp colour yellowish cream, not starchy, taste sweet, TSS  $21.50 \pm 0.35\%$ , total sugars  $15.15 \pm 0.21\%$ , reducing sugars  $13.00 \pm 0.15\%$ , non reducing sugars  $2.05 \pm 0.90\%$ , sugar/acid ratio  $45.51 \pm 1.2\%$ , keeping quality good.

### 1.23 Musa (AAB Group) 'Sugandhi'

The plant is  $283 \pm 2.24$  cm tall with a circumference of  $63 \pm 3.17$  cm at the base. It takes  $208 \pm 1.85$  days from planting to flowering and  $92 \pm 1.42$  days from flowering to harvest.

Pseudostem: yellowish green with brown to black blotches.

Leaves: petiole 48.25 cm long, not clasping pseudostem, margins of petiole slightly inclosed, slightly winged below, margins pink, lamina  $189 \pm 2.7$  cm long,  $85 \pm 1.8$  cm broad, base of lamina unequal, base cordate, apex broadly obtuse, number of leaves  $30 \pm 0.26$ .

Inflorescence: with basal female and distal male flowers, female and male axes positively geotropic, a few rows of male flowers persistent, peduncle medium long, pubescent.

Bract: persistent in some clones, shoulder low, reflex and roll back after opening, ovate, acute, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5.6 \pm 0.13$  cm long and  $2.5 \pm 0.05$  cm broad, colour cream flushed with pink, lobes 3+2, acute, free tepal  $3.3 \pm 0.04$  cm long,  $2.7 \pm 0.02$  cm broad, creamy white, below

tip corrugated; stamens not fertile, staminodes 5,  $2.2 \pm 0.01$  cm long, colour cream with no anther lobes; pistil  $14.2 \pm 0.05$  cm long, stigma colour cream, with 3 lobes; ovary  $8.2 \pm 0.09$  cm long,  $7.2 \pm 0.06$  cm in circumference, yellowish green with a slight pink flush, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.12$  cm long,  $1.5 \pm 0.05$  cm broad, colour cream flushed with pink, lobes 3+2, acuminate, free tepal  $2.9 \pm 0.01$  cm long,  $2.5 \pm 0.02$  cm broad, below tip corrugated; stamens 5, all fertile, filament  $2.1 \pm 0.03$  cm long, colour cream, anther lobes  $2.5 \pm 0.04$  cm long, colour brownish black, pistillode  $4.5 \pm 0.05$  cm long, stigma colour pale yellow, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ - 35^\circ$  to the stem, bunch weight  $10.25 \pm 0.15$  kg, number of fingers  $125 \pm 1.2$ , number of hands  $10 \pm 0.12$ , hands and fingers compact.

Finger:  $13.38 \pm 0.12$  cm long and  $13.50 \pm 0.26$  cm in circumference, not angular, mature fingers, plumpy, do not taper to the tip, apex prominent, round and short, finger weight  $90.75 \pm 1.3$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind thin, pulp yellowish cream, soft, not starchy, pulp taste sweet, TSS  $24 \pm 0.25\%$ , total sugars  $12.94 \pm 0.16\%$ , reducing sugars  $12.80 \pm 0.12\%$ , non reducing sugars  $1.10 \pm 0.01\%$ , sugar/acid ratio  $43.87 \pm 1.2$ , keeping quality medium.

1.24 Musa (AAB Group) 'Palayankodan'

The plant is  $228 \pm 1.2$  cm tall with a circumference of  $53.75 \pm 0.10$  cm at the base. It takes  $164 \pm 2.1$  days from planting to flowering and  $101 \pm 1.5$  days from flowering to harvest.

Pseudostem: yellowish green with brownish black blotches.

Leaves: petiole  $45 \pm 0.56$  cm long, not clasping pseudostem, margins of petiole slightly inclosed, slightly winged below, margins pink, lamina  $175 \pm 1.5$  cm long,  $96 \pm 1.7$  cm broad, base of lamina unequal, base cordate, apex obtuse, number of leaves  $25 \pm 0.71$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle medium long and pubescent.

Bract: deciduous, shoulder low, reflex and curl back after opening, ovate, apex acute, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5.4 \pm 0.12$  cm long and  $2.3 \pm 0.04$  cm broad, colour cream flushed with pink, lobes 3+2, acute, free tepal  $3.6 \pm 0.10$  cm long,  $2.7 \pm 0.04$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $2.3 \pm 0.01$  cm long, colour cream, with no anther lobes; pistil

14.8 ± 0.20 cm long, stigma colour cream, with 3 lobes; ovary 8.8 ± 0.12 cm long, 7.6 ± 0.09 cm in circumference yellowish green with a slight pink flush, ovules arranged in 2 regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.5 ± 0.13 cm long, 1.7 ± 0.07 cm broad, colour cream flushed with pink, lobes 3+2, acuminate, free tepal 3 ± 0.03 cm long, 2.6 ± 0.02 cm broad, below tip corrugated; stamens 5, all fertile, filament 2.3 ± 0.01 cm long, colour cream, anther lobes 2.7 ± 0.05 cm long, brownish black, pistillode 4.6 ± 0.07 cm long, stigma pale yellow, ovary yellowish green with pink flush at the tip.

Bunch: position of mature bunch 35° - 40° to the stem, bunch weight 13.25 ± 0.35 kg, number of fingers 189 ± 2.1, number of hands 11 ± 0.11, hands and fingers compact.

Finger: 11.60 cm long and 10.63 cm in circumference, slightly angular with 4 - 5 indistinct sides, tapering to the tip, apex prominent, short, finger weight 74.25 ± 0.56 g.

Ripe fruit: colour yellow, firmly attached to the hand, rind thin, pulp colour yellowish cream, taste sweet, TSS 21.50 ± 0.25%, total sugars 16.85 ± 0.21%, reducing sugars 13.33 ± 0.09%, non reducing sugars 3.34 ± 0.10%, sugar/acid ratio 44.93 ± 1.2, keeping quality good.



### 1.25 Musa (AAB Group) 'China'

The plant is  $233.5 \pm 2.8$  cm tall with a circumference of  $54.5 \pm 1.6$  cm at the base. It takes  $22.9 \pm 3.1$  days from planting to flowering and  $137 \pm 1.4$  days from flowering to harvest.

Pseudostem: pale green with light black blotches near the base of petiole.

Leaves: petiole  $41.75 \pm 0.78$  cm long, not clasping pseudostem, margins of petiole inclosed, slightly winged below, lamina  $158 \pm 2.6$  cm long  $64 \pm 1.6$  cm broad, base of lamina unequal, base cordate, apex obtuse, number of leaves  $33 \pm 0.41$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, short, male flowers deciduous, peduncle medium long and pubescent.

Bract: deciduous, shoulder low, reflex and roll back after opening, ovate, apex obtuse, colour brownish purple outside, yellowish purple inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.0 \pm 0.06$  cm long and  $1.6 \pm 0.03$  cm broad, colour pale yellow flushed with pink, lobes 3+2, acute, colour rich yellow, free tepal  $2.1 \pm 0.02$  cm long,  $2.0 \pm 0.01$  cm broad, colour pale yellow, below tip corrugated; stamens not fertile,

staminodes 5,  $1.8 \pm 0.02$  cm long, colour pale yellow, with no anther lobes; pistil  $10.6 \pm 0.05$  cm long, stigma colour pale yellow, with 3 lobes, ovary  $8.6 \pm 0.02$  cm long,  $6.6 \pm 0.05$  cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.0 \pm 0.05$  cm long,  $1.2 \pm 0.02$  cm broad, pale yellow flushed with pink, acute, lobes 3+2, rich yellow, free tepal  $2.5 \pm 0.02$  cm long  $1.7 \pm 0.03$  cm broad below tip corrugated; stamens 5, all fertile, filament  $2.1 \pm 0.02$  cm long, colour pale yellow, anther lobes  $2.6 \pm 0.01$  cm long, colour yellow, flushed with pink, pistillode  $4.6 \pm 0.12$  cm long, stigma colour rich yellow, ovary greenish yellow flushed with pink.

Bunch: position of mature bunch  $45^{\circ}$  -  $50^{\circ}$  to the stem, bunch weight  $7.25 \pm 0.13$  kg, number of finger  $139 \pm 1.8$ , number of hands  $10 \pm 0.51$ , hands and fingers compact.

Finger:  $10.38 \pm 0.15$  cm long and  $9.25 \pm 0.11$  cm in circumference, slightly angular with 5 indistinct sides, apex distinct, short, finger weight  $49.25 \pm 3.5$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind thin, pulp creamy white, thick, not starchy, fit for consumption, TSS  $2.2 \pm 0.56\%$ , total sugars  $11.53 \pm 0.21\%$ , reducing sugars  $8.55 \pm 0.76\%$ , non reducing sugars  $2.35 \pm 0.35\%$ , sugar acid ratio  $30.20 \pm 1.02$ , keeping quality good.

1.26 Musa (AAB Group) 'Mannan'

The plant is  $212.50 \pm 3.2$  cm tall with a circumference of  $52.5 \pm 2.5$  cm at the base. It takes  $172 \pm 4.1$  days from planting to flowering and  $86 \pm 3.0$  days from flowering to harvest.

Pseudostem: light green with brownish to black blotches.

Leaves: petiole  $19.5 \pm 0.85$  cm long, not clasping pseudostem, margins of petiole erect, with wings below, lamina  $171 \pm 3.1$  cm long  $67 \pm 1.8$  cm broad, base of lamina, unequal, base cordate, apex truncate; number of leaves  $20 \pm 0.79$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous; peduncle medium long, glabrous.

Bract: deciduous, shoulder low, reflex and roll back after opening, broadly ovate, apex obtuse, colour dark purple outside and light crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.6 \pm 0.10$  cm long and  $2.2 \pm 0.05$  cm broad, colour pale yellow with pink flush towards the base, lobes 3+2, acute, free tepal  $3 \pm 0.02$  cm long,  $2.5 \pm 0.01$  cm broad, colour creamy white, below tip corrugated; no fertile stamens, staminodes 5,  $2.6 \pm 0.02$  cm long, colour creamy white, with no anther

lobes; pistil  $12.8 \pm 0.3$  cm long, stigma colour yellow, with 3 lobes, ovary  $9.2 \pm 0.12$  cm long,  $7.5 \pm 0.20$  cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers arranged in two rows, united tepal  $4.6 \pm 0.30$  cm long,  $2 \pm 0.04$  cm broad, colour cream with pink flush towards the base, lobes 3+2, acute, free tepal  $2.5 \pm 0.01$  cm long  $2 \pm 0.02$  cm broad, colour cream, below tip corrugated; stamens 5, none fertile, filament  $1.2 \pm 0.01$  cm long, colour cream, anther lobes black thred like structures; pistillode  $4.5 \pm 0.12$  cm long, stigma colour pale yellow, ovary pale yellow with pink band towards the base.

Bunch: position of mature bunch  $50^\circ - 55^\circ$  to the stem bunch weight  $6.25 \pm 0.23$  kg, number of finger  $73.5 \pm 2.2$ , number of hands  $8 \pm 0.12$ , fingers in a hand loosely arranged.

Finger:  $11.38 \pm 0.51$  cm long and  $8.75 \pm 0.42$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex indistinct, finger weight  $58.78 \pm 1.2$  g.

Ripe fruit: colour greenish yellow, loosely attached to the hand, separate easily, rind thick, pulp colour cream, thick, not starchy, fit for consumption, TSS  $21.50 \pm 0.15\%$ , total sugars  $17.67 \pm 0.12\%$ , reducing sugars  $16.59 \pm 0.20\%$ , non reducing sugars  $1.03 \pm 0.04\%$ , sugar/acid ratio  $39.10 \pm 2.0$ , keeping quality medium.

1.27 Musa (AAB Group) 'Malakali'

The plant is  $214 \pm 3.6$  cm tall with a circumference of  $53 \pm 1.4$  cm at the base. It takes  $163 \pm 3.5$  days from planting to flowering and  $83 \pm 2.6$  days from flowering to harvest.

Pseudostem: light green with light brown to black blotches towards the base of the petiole.

Leaves: petiole  $34 \pm 1.01$  cm long, slightly clasping pseudostem, margins of petiole slightly inclosed, lamina  $165 \pm 322$  cm long,  $65 \pm 1.8$  cm broad, base of lamina, unequal, base and apex truncate; number of leaves  $24 \pm 0.68$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle medium long, glabrous.

Bract: deciduous, shoulder *low*, reflex and roll back after opening, ovate, apex acute, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.8 \pm 0.04$  cm long and  $2.5 \pm 0.01$  cm broad, pale yellow with pink flush towards the base lobes 3+2, pale yellow, acute free tepal  $3.8 \pm 0.03$  cm long,  $3.4 \pm 0.06$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes

5,  $2.5 \pm 0.02$  cm long, pale yellow with no anther lobes; pistil  $13.6 \pm 0.12$  cm long, stigma colour cream, with 3 lobes; ovary  $8.9 \pm 0.12$  cm long,  $7.2 \pm 0.08$  cm in circumference, colour greenish yellow with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.2 \pm 0.06$  cm long,  $4.1 \pm 0.03$  cm broad, yellowish pink outside, light pink inside, lobes 3+2, acute; free tepal  $3 \pm 0.01$  cm long  $2.5 \pm 0.04$  cm broad, colour cream, below tip corrugated; stamens 5, not fertile, filament  $2.8 \pm 0.02$  cm long, cream with pink flush, anther lobes brownish black with no pollen grains, black thread like in some flowers; pistillode  $4.6 \pm 0.03$  cm long, stigma pale yellow, ovary greenish with light pink flush towards the base.

Bunch: position of mature bunch  $45^\circ$  to  $50^\circ$  to the stem, bunch weight  $9 \text{ kg} \pm 0.23 \text{ kg}$ , number of fingers  $83 \pm 4.2$ , number of hands  $6 \pm 0.12$ , fingers loosely arranged.

Finger:  $15.25 \pm 0.23$  cm long and  $11.44 \pm 0.13$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex indistinct, finger weight  $99.25 \pm 3.6$  g.

Ripe fruit: colour dull greenish yellow, loosely attached to the hand, separate easily rind thick, pulp colour cream, thick, not starchy fit for consumption, taste sweet, TSS  $21 \pm 0.68\%$ , total sugars  $16.39 \pm 0.05\%$  reducing sugars  $13.35 \pm 0.16\%$ , non reducing sugars  $2.90 \pm 0.18$ , sugar acid ratio  $35.64 \pm 1.2$ , keeping quality *medium*.



PLATE 17. Musa (AAB Group) 'Malakali'



1.28 Musa (AAB Group) 'Pacha nadan'

The plant is  $202.50 \pm 4.5$  cm tall at flowering with a circumference of  $56 \pm 1.5$  cm at the base. It takes  $186 \pm 4.8$  days from planting to flowering and  $76 \pm 3.3$  days from flowering to harvest.

Pseudostem: light green with light brown blotches near the base of the petiole only.

Leaves: petiole  $32.75 \pm 0.89$  cm long, margins slightly spreading, not clasping pseudostem, margins of petiole light pink in colour, lamina  $149 \pm 2.9$  cm long  $64 \pm 1.8$  cm broad, base of lamina unequal, base truncate, apex cordate, number of leaves  $19 \pm 0.28$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis positively geotropic, male flowers deciduous, peduncle medium long, glabrous.

Bract: deciduous, shoulder high, ovate, apex obtuse, colour dark purple outside, light crimson inside, inside bract colour continuous to the base, reflex and roll back after opening, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.5 \pm 0.04$  cm long and  $2.3 \pm 0.01$  cm broad, colour cream with light pink flush, lobes 3+2, acute, free tepal  $3.5 \pm 0.01$  cm long,  $3.2 \pm 0.01$  cm broad, creamy white below tip corrugated stamens not fertile, staminodes 5,  $3.6 \pm 0.05$  cm long, cream with light black colour at the tip, with no anther



lobes; pistil  $13.6 \pm 0.12$  cm long, stigma colour cream, with 3 lobes; ovary  $10 \pm 0.12$  cm long,  $7.2 \pm 0.3$  cm in circumference, light green with pink flush at the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.8 \pm 0.05$  cm long,  $2 \pm 0.02$  cm broad, cream with pink flush, lobes 3+2, acute, free tepal  $2.3 \pm 0.02$  cm long,  $2 \pm 0.01$  cm broad, colour cream, below tip corrugated; stamens 5, none fertile, filament,  $2.3 \pm 0.02$  cm long, colour cream, anther lobes  $2.2 \pm 0.01$  cm long, yellowish brown with no pollen grains, pistillode  $4.5 \pm 0.13$  cm long, stigma light yellow, ovary colour greenish yellow.

Bunch: position of mature bunch  $55^\circ$  to  $60^\circ$  to the stem, bunch weight  $5.75 \pm 0.25$  kg, number of fingers  $51 \pm 3.8$ , number of hands  $6.5 \pm 0.18$ , fingers in a hand loose.

Finger:  $11.23 \pm 0.25$  cm long and  $11.83 \pm 0.23$  cm in circumference, angular with 5 unequal sides, slightly tapering to apex, apex indistinct, finger weight  $68 \pm 3.3$  g.

Ripe fruit: dull greenish yellow, separate easily from the hand, rind thick, pulp colour cream, thick, not starchy, fit for consumption, pulp taste sweet, TSS  $24.00 \pm 0.88\%$ , total sugars  $17.15 \pm 0.25\%$ , reducing sugars  $14.20 \pm 0.12\%$ , non reducing sugars  $1.81 \pm 0.08\%$ , sugar/acid ratio  $41.43 \pm 1.3$ , keeping quality medium.



PLATE 18. Musa (AAB Group) 'Pacha nadan'

1.29 Musa (AAB Group) 'Nendra padaththi'

The plant is  $222.5 \pm 3.6$  cm tall with a circumference of  $55.75 \pm 1.6$  cm at the base. It takes  $181 \pm 3.5$  days from planting to flowering and  $83 \pm 2.8$  days from flowering to harvest.

Pseudostem: light green with brown to black blotches near the base of petiole.

Leaves: petiole  $44.5 \pm 1.2$  cm long, not clasping pseudostem, margins of petiole slightly spreading, light pink in colour, lamina  $188 \pm 3.2$  cm long  $69 \pm 1.2$  cm broad, base of lamina, unequal, base truncate, apex cordate, number of leaves  $19 \pm 0.26$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal till maturity, male axis pendulous, bracts and male flowers persistent for a few days in some clones.

Bract: persistent in some clones, shoulder *low*, do not reflex and roll back after opening, ovate, apex obtuse, outside colour brownish purple, inside colour light crimson, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.4 \pm 0.03$  cm long and  $2.3 \pm 0.02$  cm broad, colour cream with light pink flush, lobes 3+2, acute, free tepal  $3.5 \pm 0.02$  cm

long,  $3.2 \pm 0.01$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $3.4 \pm 0.03$  cm long, colour cream, with no anther lobes; pistil  $13.5 \pm 0.13$  cm long, stigma colour pale yellow, with 3 lobes; ovary  $9.9 \pm 0.13$  cm long  $7 \pm 0.09$  cm in circumference, colour light green with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.8 \pm 0.08$  cm long,  $2.3 \pm 0.02$  cm broad, colour cream with pink flush, lobes 3+2, acute, free tepal  $2.2 \pm 0.01$  cm long,  $2.1 \pm 0.01$  cm broad, colour cream, below tip corrugated; stamens 5, none fertile, filament 2.3 cm long, colour cream, anther lobes  $2.1 \pm 0.01$  cm long, colour yellowish brown; pistillode  $4.6 \pm 0.09$  cm long, stigma pale yellow.

Bunch: Position of mature bunch  $55^\circ$  to  $60^\circ$  to the stem, bunch weight  $3.75 \pm 0.2$  kg, number of fingers  $4.9 \pm 3.2$ , number of hands  $4 \pm 0.18$ , fingers loosely arranged.

Finger:  $11.25 \pm 0.3$  cm long and 12.08 cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, straight, apex indistinct, finger weight  $64.64 \pm 2.5g$ .

Ripe fruit: colour dull greenish yellow, separate easily from the hand rind thick, pulp colour cream, thick, not starchy, fit for consumption, taste sweet, TSS  $2.4 \pm 1.3\%$ , total sugars  $16.35 \pm 0.41\%$ , reducing sugars  $14.86 \pm 0.08\%$  non reducing sugars  $1.43 \pm 0.10\%$ , sugar/acid ratio  $39.91 \pm 2.1$ , keeping quality medium.



PLATE 19. Musa (AAB Group) 'Nendra padaththi'

1.30 Musa (AAB Group) 'Chara padaththi'

The plant is  $212.5 \pm 3.8$  cm tall with a circumference of  $51.25 \pm 0.75$  cm at the base. It takes  $168 \pm 2.1$  days from planting to flowering and  $74 \pm 1.3$  days from flowering to harvest.

Pseudostem: light green with brown to black blotches towards the base of the petiole.

Leaves: petiole  $51 \pm 1.02$  cm long, slightly clasping pseudostem, margins of petiole slightly inclosed, slight pink in colour, lamina  $184 \pm 2.5$  cm long,  $67 \pm 1.8$  cm broad, base of lamina, unequal base and apex truncate, number of leaves  $27 \pm 0.81$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively ageotropic, male flowers and bracts persistent, peduncle medium long and glabrous.

Bract: persistent, *low*, do not reflex and roll back after opening, ovate, apex acute, colour brownish purple outside, light crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.6 \pm 0.05$  cm long and  $2.3 \pm 0.02$  cm broad, pale yellow with slight pink flush, lobes 3+2, obtuse, free tepal  $3.5 \pm 0.02$  cm long,  $3.2 \pm 0.01$  cm broad, cream with light pink tinge below tip corrugated; no fertile stamens, staminodes 5,

2  $\pm$  0.01 cm long, very small with anther lobes; pistil 13.3  $\pm$  0.12 cm, <sup>stigma</sup> pale yellow, with 3 lobes; ovary 8.8  $\pm$  0.12 cm long, 7.5  $\pm$  0.14 cm in circumference, colour greenish yellow, ovules arranged in two regular rows.

Male flowers: arranged in two rows, united tepal 5  $\pm$  0.10 cm long, 4  $\pm$  0.08 cm broad, yellowish pink outside, light pink inside, lobes 3+2, acute, free tepal 2.8  $\pm$  0.01 cm long 2.3  $\pm$  0.01 cm broad, cream with pink flush at the tip, below tip corrugated; stamens 5, none fertile, filament 2.5 cm long cream in colour with pink flush, anther lobes black and thread like except in one or two stamens per flower; pistillode 4.2  $\pm$  0.04 cm long, stigma colour pale yellow, ovary greenish with light pink band towards the base.

Bunch: position of mature bunch 45° to 50° to the stem, bunch weight 7.5  $\pm$  0.12 kg number of fingers 89  $\pm$  3.4, number of hands 7  $\pm$  0.12, fingers in a hand loosely arranged.

Finger: 11.04  $\pm$  0.05 cm long and 10.73  $\pm$  0.06 cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex indistinct, finger weight 86.25  $\pm$  3.3 g.

Ripe fruit: colour dull greenish yellow, loosely attached to the hand, separate easily rind thick, pulp colour, cream, thick fit for consumption, taste sweet, TSS 21  $\pm$  0.56%, total sugars 15.43  $\pm$  0.02%, reducing sugars 13.80  $\pm$  0.05% non reducing sugars 1.55  $\pm$  0.08%, sugar/acid ratio 35.51  $\pm$  3.5, keeping quality medium.



PLATE 20. Musa (AAB Group) 'Charapadaththi'



### 1.31 Musa (AAB Group) 'Kullan'

The plant is  $159 \pm 2.8$  cm tall with a circumference of  $53.75 \pm 0.1$  cm at the base. It takes  $173 \pm 2.5$  days from planting to flowering and  $95 \pm 2.1$  days from flowering to harvest.

Pseudostem: light green with brown to black blotches towards the base of the petiole.

Leaves: petiole  $25.25 \pm 0.81$  cm long, slightly clasping pseudostem, margins of petiole slightly inclosed, lamina  $144 \pm 1.5$  cm long,  $66 \pm 1.6$  cm broad, base of lamina unequal, base and apex truncate; number of leaves  $26 \pm 0.84$ .

Inflorescence: with basal female and distal male flowers, female axis semi pendulous, male axis positively geotropic, male flowers and bracts persistent, peduncle medium long and glabrous.

Bract: persistent, shoulder low, do not roll back after opening, ovate, apex acute, colour brownish purple outside, light crimson inside, inside bract colour continuous to the base.

Female flowers: arranged in two rows, united tepal  $3.6 \pm 0.05$  cm long and  $1.3 \pm 0.03$  cm broad, pale yellow with pink flush, lobes 3+2, obtuse, free tepal  $2.5 \pm 0.02$  cm long,  $2.2 \pm 0.01$  cm broad, cream with light pink tinge, below tip corrugated; stamens not fertile, staminodes 5,

2 ± 0.02 cm long, with no anther lobes; pistil 9.3 ± 0.13 cm long, stigma pale yellow, with 3 lobes; ovary 6.8 ± 0.22 cm long, 5.5 ± 0.24 cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 3.1 ± 0.10 cm long, 2.1 ± 0.08 cm broad, yellowish pink outside, light pink inside, lobes 3+2, acute, free tepal 1.8 ± 0.01 cm long, 1.3 ± 0.01 cm broad, cream with pink flush, below tip corrugated; stamens 5, not fertile, filament 1.5 ± 0.02 cm long, cream, anther lobes 2.1 ± 0.05 cm long, black thread like structures except pistillode<sup>1-2</sup> 33 ± 0.04 cm long, stigma colour pale yellow, ovary greenish yellow with pink flush.

Bunch: position of mature bunch 45°-50° to the stem, bunch weight 3.75 ± 0.15 kg, number of fingers 72 ± 1.78 fingers, number of hands 7 ± 0.58, hands and fingers loose.

Finger: 9.83 ± 0.15 cm long and 9.0 ± 0.08 cm in circumference, angular with 5 unequal sides, tapering to the tip, apex indistinct, finger weight 45.50 ± 1.8.

Ripe fruit: colour dull yellow, easily separate from the hand, rind thick, pulp creamy white, not starchy, fit for consumption, taste sweet, TSS 23 ± 1.5%, total sugars 12.75 ± 0.50%, reducing sugars 10.73 ± 0.21%, non reducing sugars 1.93 ± 0.06%, sugar acid ratio 42.75 ± 1.8, keeping quality medium.



PLATE 21. Musa (AAB Group) 'Kullan'

1.32 Musa (AAB Group) 'Chinali'

The plant is  $241 \pm 2.5$  cm tall with a circumference of 63.75 cm at the base. It takes  $232 \pm 1.8$  days from planting to flowering and  $94 \pm 1.2$  days from flowering to harvest.

Pseudostem: yellowish green with light black blotches.

Leaves: petiole 58.75 cm long, not clasping pseudostem, margins of petiole inclosed, slightly winged below, lamina  $215 \pm 3.1$  cm long,  $68 \pm 1.6$  cm broad, base of lamina unequal, base broadly obtuse, apex truncate, number of leaves  $25 \pm 0.23$ .

Inflorescence: with basal female and distal male flowers, female and male axis positively geotropic, male flowers and bracts persistent, peduncle long and pubescent.

Bract: persistent, shoulder low, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $5.1 \pm 0.03$  cm long and  $2.0 \pm 0.03$  cm broad, colour pale yellow flushed with pink, lobes 3+2, acute, colour orange yellow, free tepal  $2.5 \pm 0.10$  cm long,  $2.0 \pm 0.05$  cm broad, colour pale yellow, below tip corrugated; stamens not fertile, staminodes 5,  $2.0 \pm 0.13$  cm long, colour pale

yellow, with no anther lobes; pistil  $11.2 \pm 0.05$  cm long, stigma colour rich yellow, with 3 lobes; ovary  $9.1 \pm 0.08$  cm long,  $7.1 \pm 0.07$  cm in circumference, colour yellowish green flushed with pink at the tip, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.3 \pm 0.05$  cm long,  $2.1 \pm 0.03$  cm broad, colour pale yellow flushed with pink, lobes 3+2, acute, colour orange yellow, free tepal  $3.2 \pm 0.01$  cm long,  $1.8 \pm 0.01$  cm broad, below tip corrugated, stamens 5, all fertile, filament  $2.3 \pm 0.03$  cm long, colour pale yellow, anther lobes  $2.9 \pm 0.02$  cm long, colour yellow, pistillode  $4.8 \pm 0.07$  cm long, flushed with pink, stigma colour rich yellow, ovary yellowish green flushed with pink.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $8 \pm 0.12$  kg, number of fingers  $85 \pm 1.5$ , number of hands  $9 \pm 0.12$ , hands and fingers loose.

Finger:  $10.38 \pm 0.15$  cm long and  $9.25 \pm 0.08$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex distinct, very short, finger weight  $107.23 \pm 2.5$  g.

Ripe fruit: colour dull yellow, firmly attached to hand, rind thick, pulp colour orange yellow, soft, taste sweet, TSS  $23 \pm 0.89\%$ , total sugars  $8.56 \pm 0.13\%$ , reducing sugars  $6.45 \pm 0.10\%$ , non reducing sugars  $2.01 \pm 0.07\%$ , sugar/acid ratio  $27.67 \pm 0.98$  keeping quality good.

### 1.33 Musa (AAB Group) 'Nendran'

The plant is  $283.5 \pm 2.5$  cm tall with a circumference of  $54.85 \pm 1.2$  cm at the base. It takes  $280 \pm 3.6$  days from planting to flowering and  $95 \pm 2.4$  days from flowering to harvest.

Pseudostem: yellowish green with reddish tinge and with dark brown blotches towards the bases of petioles.

Leaves: are leathery, polished, petiole  $54.25 \pm 1.5$  cm long, not clasping pseudostem, margins of petiole inclosed, red coloured, slightly winged below, lamina  $150 \pm 2.5$  cm long,  $57 \pm 1.5$  cm broad, base of lamina unequal, base broadly obtuse, apex truncate, number of leaves  $27 \pm 0.26$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis, positively geotropic, male flowers persistent, peduncle medium long, glabrous.

Bract: persistent, shoulder low, slightly curl after opening, ovate, obtuse, brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5.2 \pm 0.04$  cm long and  $3.5 \pm 0.02$  cm broad, colour cream with pink blotches towards the base, lobes 3+2, acute, free

tepal  $3.8 \pm 0.01$  cm long,  $3.2 \pm 0.02$  cm broad, below tip slightly corrugated; colour creamy white, stamens not fertile, staminodes 5,  $2.3 \pm 0.01$  cm long, colour cream, with no anther lobes; pistil  $16.5 \pm 0.13$  cm long, stigma creamy white, with 6 lobes; ovary  $14.1 \pm 0.09$  cm long,  $10.5 \pm 0.04$  cm in circumference, yellowish green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.5 \pm 0.04$  cm long,  $3.2 \pm 0.03$  cm broad, colour creamy white, slightly flushed with pink, lobes 3+2, acute, free tepal  $3.1 \pm 0.02$  cm long,  $2.6 \pm 0.03$  cm broad, below tip corrugated, stamens 5, all fertile, filament  $2.6 \pm 0.04$  cm long, creamy white, anther lobes  $3.3 \pm 0.03$  cm long; pistillode  $5.2 \pm 0.1$  cm long, stigma pale yellow, ovary yellowish green.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $13.5 \pm 0.35$  kg, number of fingers  $75 \pm 2.4$ , number of hands  $6 \pm 0.13$ , hands and fingers loose.

Finger:  $24.32 \pm 0.85$  cm long and  $13.31 \pm 0.41$  cm in circumference, angular with 5 prominent ridges, slightly tapering to the tip, apex distinct, stout, finger weight  $173.23 \pm 3.2$  g.

Ripe fruit: yellow in colour, firmly attached to the hand, rind thick, pulp yellowish orange, thick, taste sweet, TSS  $29.30 \pm 0.45\%$ , total sugars  $15.94 \pm 0.75\%$ , reducing sugars  $13.22 \pm 0.13\%$ , non reducing sugars  $1.27 \pm 0.08\%$ , sugar/acid ratio  $55.34 \pm 2.2$ , keeping quality good.



PLATE 22. Musa (AAB Group) 'Mendran'



1.34 Musa (AB Group) 'Krishna vazhai'

The plant is  $237 \pm 3.6$  cm tall, with a circumference of  $58 \pm 2.1$  cm at the base. It takes  $171 \pm 3.2$  days from planting to flowering and  $71 \pm 1.6$  days from flowering to harvest.

Pseudostem: light green with large black blotches throughout.

Leaves: petiole  $34.25 \pm 0.25$  cm long, not clasping pseudostem, margins of petiole erect, red in colour, lamina  $190 \pm 1.2$  cm long,  $61 \pm 1.5$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $22 \pm 0.52$ .

Inflorescence: with basal female and distal male flowers, female axis almost horizontal, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous,

Bract: deciduous, shoulder low, reflex and roll back after ripening, ovate, apex obtuse, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4 \pm 0.02$  cm long and  $2 \pm 0.01$  cm broad, colour cream, pink band at the base, lobes 3+2, acuminate, free tepal  $2.9 \pm 0.01$  cm long,  $2.5 \pm 0.02$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $2.3 \pm 0.12$  cm long, colour cream, with no anther lobes; pistil

13.3  $\pm$  0.13 cm long, stigma pale yellow, with 3 lobes; ovary 9.3  $\pm$  0.08 cm long, <sup>18  $\pm$  0.05 cm</sup> in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 4.5  $\pm$  0.03 cm long, 2.2  $\pm$  0.02 broad, colour cream with pink flush, lobes 3+2, acuminate, free tepal 2.3  $\pm$  0.04 cm long, 2  $\pm$  0.02 cm broad, colour creamy white, below tip corrugated; stamens 5, none fertile, filament 2  $\pm$  0.05 cm long, colour cream, anther lobes 2.3  $\pm$  0.02 cm long, colour brownish black, pistillode 4.8  $\pm$  0.10 cm long, stigma colour cream, ovary greenish yellow with pink flush.

Bunch: position of mature bunch 60 - 70° to the stem, bunch weight 5.25  $\pm$  0.21 kg, number of fingers 78  $\pm$  3.1, number of hands 6  $\pm$  0.10 hands and fingers loose.

Finger: 13.75  $\pm$  0.52 cm long and 10.88  $\pm$  0.46 in circumference, angular with 5 unequal sides, tapering to the tip, apex distinct, short, finger weight 58  $\pm$  1.4 g.

Ripe fruit: colour dull greenish yellow, firmly attached to the hand, rind thick, pulp colour creamy white, thick, not starchy, taste sweet, TSS 24.03  $\pm$  0.25%, total sugars 16.11  $\pm$  0.12%, reducing sugars 15  $\pm$  0.18%, non reducing sugars 1.05  $\pm$  0.05%, sugar/acid ratio 31.65  $\pm$  1.7, keeping quality good.



PLATE 23. Musa (AB Group) 'Krishna vazhai'

### 1.35 Musa (AB Group) 'Vannan'

The plant is  $227 \pm 1.5$  cm tall with a circumference of 52.50 cm at the base. It takes  $174 \pm 2.2$  days from planting to flowering and  $70 \pm 1.7$  days from flowering to harvest.

Pseudostem: light green with dark brown to black blotches.

Leaves: petiole  $32.75 \pm 0.65$  cm long, not clasping pseudostem, margins of petiole erect, red in colour, lamina  $183 \pm 1.5$  cm long,  $64 \pm 2.0$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $18 \pm 0.61$ .

Inflorescence: with basal female and distal male flowers, female axis almost horizontal, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous.

Bract: deciduous, shoulder low, reflex and roll back after opening, ovate, apex obtuse, colour brownish purple outside, light crimson inside, inside colour continuous in the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.04$  cm long and  $2 \pm 0.02$  cm broad, colour cream, pink band at the base, lobes 3+2, acuminate, free tepal  $2.8 \pm 0.02$  cm long,  $2.2 \pm 0.01$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $2.3 \pm$

0.10 cm long, colour cream, with no anther lobes; pistil 12.5  $\pm$  0.21 cm long, stigma pale yellow with 3 lobes; ovary 8.6  $\pm$  0.12 cm long, 6.3  $\pm$  0.09 cm in circumference, colour greenish yellow, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 4.7  $\pm$  long, ~~3.62002~~cm broad, colour cream with pink flush, lobes 3+2, free tepal 1.8  $\pm$  0.02 cm long, 1.6  $\pm$  0.01 cm broad, colour creamy white, below tip corrugated; stamens 5, none fertile, filament 2.5  $\pm$  0.10 cm long, colour cream, anther lobes 2  $\pm$  0.02 cm long, colour brownish black; pistillode 4.5  $\pm$  0.22 cm long, stigma colour cream, ovary greenish yellow with pink flush.

Bunch: position of mature bunch 60° - 70° to the stem, bunch weight 3.75  $\pm$  0.21 kg, number of fingers 81  $\pm$  3.2, number of hands, 6  $\pm$  0.13, hands and fingers loose.

Finger: 10.48  $\pm$  0.32 cm long and 10.25  $\pm$  0.25 cm in circumference, angular with 5 unequal sides, tapering to the tip, apex distinct, short, finger weight 45.5  $\pm$  2.5 g.

Ripe fruit: Colour dull greenish yellow, firmly attached to the hand, rind thick, pulp colour creamy white, thick, not starchy, taste sweet with a good flavour, TSS 21.50  $\pm$  0.25%, total sugars 16.91  $\pm$  0.16%, reducing sugars 14.51  $\pm$  0.55%, non reducing sugars 2.28  $\pm$  0.05%, sugar/acid ratio 37.15  $\pm$  1.5, keeping quality good.

1.36 Musa (AB Group) 'Virupakshi'

The plant is  $251 \pm 2.8$  cm tall with a circumference of  $54 \pm 0.79$  cm at the base. It takes  $174 \pm 2.5$  days from planting to flowering and  $70 \pm 1.5$  days from flowering to harvest.

Pseudostem: light green with dark brown to black blotches.

Leaves: slightly yellowish green, petiole  $53.75 \pm 0.85$  cm long, not clasping pseudostem, margins of petiole red in colour, not touching, lamina  $181 \pm 2.5$  cm long,  $67 \pm 1.8$  cm broad, base of lamina unequal, cordate, apex truncate, number of leaves  $19 \pm 0.52$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal till maturity, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous.

Bract: deciduous, shoulder low, reflex and roll back after opening, ovate, apex obtuse, colour brownish purple outside, light crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4 \pm 0.03$  cm long and  $2 \pm 0.01$  cm broad, cream with pink flush, lobes 3+2, acute, free tepal  $2.6 \pm 0.02$  cm long,  $2.5 \pm 0.01$  cm broad, colour cream, below tip corrugated; stamens not fertile, staminodes 5,  $2.1 \pm 0.20$  cm long, colour cream with no anther lobes; pistil  $12.3 \pm 0.62$  cm

long, stigma, colour cream, with 3 lobes; ovary  $8.5 \pm 0.15$  cm long,  $6.2 \pm 0.20$  cm in circumference, greenish yellow with pink flush at the tip, ovules arranged in 2 regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.6 \pm 0.2$  cm long,  $1.9 \pm 0.05$  cm broad, colour pale yellow, lobes 3 + 2, acute, free tepal  $2 \pm 0.05$  cm long,  $1.7 \pm 0.02$  cm broad, below tip corrugated; stamens 5, none fertile, filament  $2.5 \pm 0.12$  cm long, colour cream, anther lobes  $2 \pm 0.11$  cm long, colour brownish black, pistillode  $4.6 \pm 0.26$  cm long, stigma colour pale yellow, ovary greenish yellow with pink band.

Bunch: position of mature bunch  $60 - 70^\circ$  to the stem, bunch weight  $4 \pm 0.13$  kg, number of fingers  $63 \pm 2.6$ , number of hands  $5 \pm 0.21$ , hands and fingers loose.

Finger:  $9.88 \pm 0.26$  cm long and  $9.5 \pm 0.56$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex distinct, short, finger weight  $42.58 \pm 0.72$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp creamy white, thick, not starchy, taste sweet with good flavour, TSS  $22.50 \pm 0.78\%$ , total sugars  $19.12 \pm 0.65\%$ , reducing sugars  $17.85 \pm 0.52\%$ , non reducing sugars  $1.54 \pm 0.25\%$ , sugar/acid ratio  $55.43 \pm 1.2$ , keeping quality good.



PLATE 24. Musa (AB Group) 'Virupakshi'



### 1.37 Musa (AB Group) 'Sirumalai'

The plant is  $229 \pm 2.5$  cm tall at flowering with a circumference of  $52.50 \pm 1.6$  cm at the base. It takes  $170 \pm 1.3$  days from planting to flowering and  $71 \pm 1.2$  days from flowering to harvest.

Pseudostem: light green with dark brown to black blotches.

Leaves: petiole  $33.00 \pm 0.85$  cm long, not clasping pseudostem, margins of petiole erect, pink in colour, lamina  $167 \pm 3.5$  cm long,  $63 \pm 2.1$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $21 \pm 0.38$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal till maturity, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous.

Bract: deciduous, shoulder low, reflex and roll back after opening, ovate, apex obtuse, colour brownish purple outside, light crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.04$  cm long and  $2.2 \pm 0.02$  cm broad, colour cream with pink flush, lobes 3+2, acute, free tepal  $2.8 \pm 0.03$  cm long,  $2.6 \pm 0.03$  cm broad, colour creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $2.3 \pm$

0.20 cm long, with no anther lobes; pistil  $12.5 \pm 0.52$  cm long, stigma colour cream with 3 lobes; ovary  $8.7 \pm 0.16$  cm long,  $6.4 \pm 0.20$  cm in circumference, greenish yellow with pink flush, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.8 \pm 0.12$  cm long,  $2.1 \pm 0.04$  cm broad, colour pale yellow flushed with pink, lobes 3+2, acute, free tepal 2.2 long  $1.8 \pm 0.03$  cm broad, below tip corrugated; stamens 5, none fertile, filament  $2.7 \pm 0.22$  cm long, colour cream, anther lobes  $2 \pm 0.91$  cm long, colour brownish black, pistillode  $4.7 \pm 0.21$  cm long, stigma colour pale yellow, ovary greenish yellow with pink flush.

Bunch: position of mature bunch  $60^\circ - 70^\circ$  to the stem, bunch weight  $4 \pm 0.15$  kg, number of fingers  $74 \pm 1.7$ , number of hands  $6 \pm 0.12$ , hands and fingers loose.

Finger:  $10.88 \pm 0.11$  cm long and  $9.75 \pm 0.06$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex distinct, short, finger weight  $54.38 \pm 1.01$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp colour creamy white, thick, not starchy, ~~sweet~~ sweet with good flavour, TSS  $21 \pm 0.18\%$ , total sugars  $19.25 \pm 0.21\%$ , reducing sugars  $18.31 \pm 0.09\%$ , non reducing sugars  $1.19 \pm 0.05\%$ , sugar/acid ratio  $46.40 \pm 1.8$ , keeping quality good.



PLATE 25. Misa (AB Group) 'Sitrimalat'

### 1.38 Musa (AB Group) 'Agniswar'

The plant is  $233 \pm 4.5$  cm tall at flowering with a circumference of  $44.5 \pm 1.5$  cm at the base. It takes  $177 \pm 4.5$  days from planting to flowering and  $108 \pm 2.8$  days from flowering to harvest.

Pseudostem: is light green with slight brown to black blotches.

Leaves: petiole  $37.25 \pm 0.75$  cm long, slightly clasping pseudostem, margins of petiole erect, red coloured, with wings below, lamina  $163 \pm 3.8$  cm long,  $63 \pm 1.5$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $30 \pm 0.78$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous.

Bract: deciduous, shoulder high, outside colour, dark purple, glaucous, inside colour bright crimson, inside colour continuous, broadly ovate, do not roll back after opening, apex obtuse, bract scars scarcely prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.05$  cm long and  $2.0 \pm 0.02$  cm broad, cream with pink flush, lobes 3+2, acute, free tepal  $3.2 \pm 0.04$  cm long,  $2.3 \pm 0.02$  cm broad, colour cream, below tip corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.02$  cm long, colour cream,



PLATE 25. Musa (AB Group) 'Sirumalai'

1.38 Musa (AB Group) 'Agniswar'

The plant is  $233 \pm 4.5$  cm tall at flowering with a circumference of  $44.5 \pm 1.5$  cm at the base. It takes  $177 \pm 4.5$  days from planting to flowering and  $108 \pm 2.8$  days from flowering to harvest.

Pseudostem: is light green with slight brown to black blotches.

Leaves: petiole  $37.25 \pm 0.75$  cm long, slightly clasping pseudostem, margins of petiole erect, red coloured, with wings below, lamina  $163 \pm 3.8$  cm long,  $63 \pm 1.5$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $30 \pm 0.78$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis positively geotropic, male flowers deciduous, peduncle medium long and glabrous.

Bract: deciduous, shoulder high, outside colour, dark purple, glaucous, inside colour bright crimson, inside colour continuous, broadly ovate, do not roll back after opening, apex obtuse, bract scars scarcely prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.05$  cm long and  $2.0 \pm 0.02$  cm broad, cream with pink flush, lobes 3+2, acute, free tepal  $3.2 \pm 0.04$  cm long,  $2.3 \pm 0.02$  cm broad, colour cream, below tip corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.02$  cm long, colour cream,

with no anther lobes; pistil  $14.2 \pm 0.15$  cm long, stigma cream coloured,  $2.2 \pm 0.01$  cm in circumference, with 3 lobes; ovary  $10.3 \pm 0.40$  cm long,  $6.3 \pm 0.03$  cm in circumference, colour light green, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.8 \pm 0.22$  cm long,  $1.6 \pm 0.04$  cm broad, cream coloured with pink flush, lobes 3+2, acute, free tepal  $2.3 \pm 0.01$  cm long,  $1.8 \pm 0.02$  cm broad, below tip corrugated; stamens 5, none fertile, filament  $1.5 \pm 0.01$  cm long, colour cream, anther lobes withered black thread like structure; pistillode  $4.2 \pm 0.12$  cm long, stigma colour yellow, ovary greenish with intense pink band at the base.

Bunch: position of mature bunch  $75 - 80^\circ$  to the stem, bunch weight  $5 \pm 0.15$  kg, number of fingers  $74 \pm 3.0$ , hands  $7 \pm 0.07$ , fingers in a hand arranged loosely.

Finger:  $9.13 \pm 0.12$  cm long and  $7.18 \pm 0.05$  cm in circumference, angular with 5 unequal sides, slightly tapering to tip, apex straight, finger weight  $54.64 \pm 2.7$  g.

Ripe fruit: dull greenish yellow, loosely attached to the hand, rind thick, pulp cream coloured, slightly starchy, fit for consumption, thick, taste sweet, TSS  $23.50 \pm 0.25\%$ , total sugars  $17.18 \pm 1.0\%$ , reducing sugars  $15.35 \pm 0.58\%$ , non reducing sugars  $1.57 \pm 0.18\%$ , sugar/acid ratio  $38.58 \pm 1.2$ , keeping quality medium.



PLATE 26. Musa (AB Group) 'Agniswar'



1.39 Musa (AB Group) 'Adakka kunnan'

The plant is  $246 \pm 3.6$  cm tall with a circumference of  $62.25 \pm 1.3$  cm at the base. It takes  $233 \pm 3.3$  days from planting to flowering and  $115 \pm 2.1$  days from flowering to harvest.

Pseudostem: yellowish green with light black blotches near the base of petiole.

Leaves: petiole  $67.5 \pm 0.53$  cm long, clasping pseudostem, margins of petiole red coloured, inclosed, lamina  $189 \pm 1.2$  cm long,  $68 \pm 1.3$  cm broad, base of lamina unequal, base and apex cordate, number of leaves  $31 \pm 0.25$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal, male axis positively geotropic, male flowers deciduous, penduncle medium long, glabrous.

Bract: deciduous, shoulder *low*, broadly ovate, apex obtuse, roll back after opening, colour dull purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $3.1 \pm 0.02$  cm long and  $1.2 \pm 0.02$  cm broad, cream with light pink colour throughout, lobes 3+2, acuminate, free tepal  $2.6 \pm 0.03$  cm long,  $1.6 \pm 0.01$  cm, broad below tip corrugated; stamens not fertile, staminodes 5,  $2.0 \pm 0.01$  cm long, colour creamy yellow with no anther lobes; pistil  $8.5 \pm 0.07$  cm long,

stigma colour cream, with 4 lobes; ovary  $5.5 \pm 0.05$  cm long,  $4.2 \pm 0.04$  cm in circumference, greenish yellow with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $3.2 \pm 0.20$  cm long,  $1.2 \pm 0.03$  cm broad, light pink with cream streaks, lobes 3+2, acuminate, free tepal  $2.2 \pm 0.02$  cm long,  $1.3 \pm 0.01$  cm broad, below tip corrugated; stamens 5, none fertile, filament  $1.8 \pm 0.20$  cm long, colour brownish cream, anther lobes  $2.0 \pm 0.03$  cm long, pistillode  $5.2 \pm 0.03$  cm long, stigma colour pale yellow, ovary greenish yellow with pink streaks towards the base.

Bunch: position of mature bunch  $50^{\circ} - 55^{\circ}$  to the stem, bunch weight  $5.5 \pm 0.12$  kg, number of fingers  $1.26 \pm 2.6$ , number of hands  $10 \pm 0.01$  fingers in a hand very compact.

Finger:  $19.68 \pm 0.25$  cm long and  $8.75 \pm 0.20$  cm in circumference, mature fingers plumpy, apex distinct, straight, finger weight  $48.45 \pm 2.3$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind very thin, pulp colour white, thick, slightly starchy, fit for consumption, taste sweet, TSS  $26 \pm 0.14\%$ , total sugars  $13.25 \pm 0.12\%$ , reducing sugars  $12.78 \pm 0.41\%$  non reducing sugars  $0.95 \pm 0.09\%$ , sugar/acid ratio  $49.08 \pm 3.6$ , keeping quality good.



PLATE 27. Musa (AB Group) 'Adakka kuman'

1.40 Musa (AB Group) 'Valiya kunnan'

The plant is  $234.5 \pm 3.2$  cm tall with a circumference of  $59.5 \pm 1.5$  cm at the base. It takes  $234 \pm 2.4$  days from planting to flowering and  $100 \pm 1.8$  days from flowering to harvest.

Pseudostem: yellowish green with light pink colour and black blotches near the base of petiole.

Leaves: petiole  $59.5 \pm 0.43$  cm long, clasping pseudostem, margins of petiole red coloured, inclosed, lamina  $204 \pm 3.0$  cm long,  $70 \pm 2.1$  cm broad, base of lamina unequal, base and apex obtuse, number of leaves  $30 \pm 0.27$ .

Inflorescence: with basal female and distal male flowers, female axis horizontal till maturity, male axis positively geotropic, male flowers deciduous, peduncle medium long, glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex obtuse, reflex and roll back after opening, colour dull purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5.1 \pm 0.06$  cm long and  $1.9 \pm 0.03$  cm broad, cream with light pink colour throughout, lobes 3+2, acuminate, free tepal  $3.6 \pm 0.04$  cm long,  $2.6 \pm 0.05$  cm broad, below tip corrugated; stamens not fertile, staminodes 5,  $3.1 \pm 0.10$  cm long, colour creamy yellow, with no anther lobes; pistil

12.5  $\pm$  0.12 cm long, stigma colour cream, with lobes; ovary 7.5  $\pm$  0.05 cm long, 5.4  $\pm$  0.01 cm in circumference, greenish yellow with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.2  $\pm$  0.10 cm long, 1.4  $\pm$  0.04 cm broad, light pink with cream streaks, lobes 3+2, acuminate, free tepal 3.5  $\pm$  0.02 cm long, 2.3  $\pm$  0.01 cm broad, creamy white, below tip corrugated; stamens 5, none fertile, filament 2.2  $\pm$  0.10 cm long, colour yellowish cream, anther lobes 2.3  $\pm$  0.12 cm long, yellowish brown, pistillode 6.5  $\pm$  0.20 cm long, stigma colour pale yellow, ovary greenish yellow with pink streaks towards the base.

Bunch: position of mature bunch 55° - 55° to the stem, bunch weight 10.25  $\pm$  0.14 kg, number of fingers 160  $\pm$  3.4, number of hands 12  $\pm$  0.15 hands and fingers compact.

Finger: 14.25  $\pm$  0.28 cm long and 10.18  $\pm$  0.21 cm in circumference, angular with 3-4 indistinct sides, apex distinct, straight, finger weight 77.79  $\pm$  1.72.

Ripe fruit: colour yellow, firmly attached to the hand, rind very thin, pulp colour white, not starchy, taste sweet, TSS 26  $\pm$  0.15%, total sugars 14.58  $\pm$  0.32%, reducing sugars 12.90  $\pm$  0.35%, non reducing sugars 1.60  $\pm$  0.40%, sugar/acid ratio 51.16  $\pm$  1.2, keeping quality good.

## 1.41 Musa (AB Group) 'Thaen kunnan'

The plant is  $245 \pm 3.2$  cm tall with a circumference of  $51.50 \pm 1.5$  cm at the base. It takes  $223 \pm 3.5$  days from planting to flowering and  $124 \pm 1.8$  days from flowering to harvest.

Pseudostem: yellowish green with pink colour near the base of petioles.

Leaves: petiole  $39.25 \pm 0.65$  cm long, clasping pseudostem, margins of petiole inclosed, slightly winged below, lamina  $195 \pm 2.1$  cm long,  $52 \pm 2.0$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $36 \pm 0.26$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex acute, reflex and roll back after opening, colour outside dull purple, inside light crimson, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5.1 \pm 0.04$  cm long and  $1.7 \pm 0.03$  cm broad, cream with light pink colour throughout, lobes 3+2, acuminate, free tepal  $3.1 \pm 0.02$  cm long,  $2.2 \pm 0.02$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $5 \pm 0.14$  cm long, colour creamy yellow, with no anther lobes;

pistil  $13 \pm 0.25$  cm long, stigma colour cream, with 3 lobes; ovary  $7.9 \pm 0.18$  cm long,  $5.2 \pm 0.04$  cm in circumference, greenish yellow with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.10$  cm long,  $1.6 \pm 0.07$  cm broad, light pink with cream streaks, lobes 3+2, acuminate, free tepal  $3.5 \pm 0.02$  cm long,  $2.1 \pm 0.02$  cm broad, creamy white, below tip corrugated; stamens 5, none fertile, filament  $2.5 \pm 0.10$  cm long, colour yellowish cream, pistillode  $6.5 \pm 0.21$  cm long, stigma colour pale yellow, ovary greenish yellow with pink streaks towards the base.

Bunch: position of mature bunch  $40^\circ - 45^\circ$  to the stem, bunch weight  $7.25 \pm 0.15$  kg, number of fingers  $109 \pm 2.4$ , number of hands  $30 \pm 0.10$ , hands and fingers loose.

Finger:  $19.68 \pm 0.21$  cm long and  $8.23 \pm 0.10$  cm in circumference, angular with 3 - 4 sides, tapering to the tip, apex distinct, long, finger weight  $51.25 \pm 1.2$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind thin, pulp colour white, thick, taste sweet, TSS  $29 \pm 1.2\%$ , total sugars  $17.65 \pm 1.5\%$ , reducing sugars  $14.50 \pm 0.58\%$ , non reducing sugars  $3.04 \pm 0.21\%$ , sugar/acid ratio  $58.04 \pm 2.2$ , keeping quality good.



PLATE 28. Musa (AB Group) 'Thaen kurman'



1.42 Musa (AB Group) 'Padali moongil'

The plant is  $232.5 \pm 2.24$  cm tall with a circumference of  $46.25 \pm 2.18$  cm at the base. It takes  $228 \pm 2.27$  days from planting to flowering and  $115 \pm 2.5$  days from flowering to harvest.

Pseudostem: yellowish green with light pink colour and black blotches near the base of petiole.

Leaves: petiole  $60.75 \pm 0.43$  cm long, clasping pseudostem, margins of petiole red coloured, inclosed lamina  $176 \pm 3.0$  cm long,  $46 \pm 0.96$  cm broad, base of lamina unequal, base and apex obtuse, number of leaves  $28 \pm 0.25$ .

Inflorescence: male axis absent, female axis horizontal; peduncle medium long, glabrous.

Bract: female flowers deciduous, shoulder low, broadly ovate, apex obtuse, roll back after opening, colour dull purple outside, bright crimson inside, inside bract colour continuous to the base, bract sears prominent.

Female flowers: arranged in two rows, united tepal  $6.2 \pm 0.05$  cm long and  $2.3 \pm 0.02$  cm broad, cream with light pink colour throughout, lobes 3+2, acuminate, free tepal  $4.1 \pm 0.03$  cm long,  $3.2 \pm 0.02$  cm broad, below tip corrugated; stamens not fertile, staminodes 5,  $4.2 \pm 0.10$  cm long, colour creamy yellow, with no anther lobes; pistil  $14.5 \pm 0.21$  cm long, stigma colour cream, with 4 lobes;

ovary  $8.5 \pm 0.06$  cm long,  $6.1 \pm 0.04$  cm in circumference, greenish yellow with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Bunch: position of mature bunch  $90^\circ$  to the stem, bunch weight  $2.5 \pm 0.10$  kg, number of fingers  $20 \pm 0.20$ , number of hands  $4 \pm 0.10$ , hands and fingers loose.

Finger:  $15.88 \pm 0.45$  cm long and  $11.88 \pm 0.28$  cm in circumference, angular with 3-4 indistinct sides, apex distinct, straight, finger weight  $96.5 \pm 2.12$  g.

Ripe fruit: colour yellow, firmly attached to the hand, rind very thin, pulp colour white, not starchy, taste sweet, TSS  $28 \pm 0.16\%$ , total sugars  $16.72 \pm 0.31\%$ , reducing sugars  $13.70 \pm 0.40\%$ , non reducing sugars  $2.87 \pm 0.81\%$ , sugar/acid ratio  $7.64 \pm 2.0$ , keeping quality good.

In cultivar 'Padali moongil' taxonomic scoring for characters of male flowers could not be done because of the absence of male axis. The cultivar has 22 chromosomes ( $2n=22$ ) and has similar morphological characters of 'Valiya kunnan'.



PLATE 29. Musa (AB Group) 'Padali moongil'

### 1.43 Musa (AB Group) 'Neypoovan'

The plant is  $280.5 \pm 3.34$  cm tall with a circumference of  $55.5 \pm 3.17$  cm at the base. It takes  $186 \pm 1.27$  days from planting to flowering and  $110 \pm 1.15$  days from flowering to harvest.

Pseudostem: yellowish green with light pink colour and black blotches near the base of petioles.

Leaves: thick, glaucous below, petiole  $56.75 \pm 0.53$  cm long, clasping pseudostem, margins of petiole red coloured, inclosed, lamina  $163 \pm 2.5$  cm long,  $5.5 \pm 1.1$  cm broad, base of lamina unequal, base and apex obtuse, number of leaves  $27 \pm 0.30$ .

Inflorescence: female axis horizontal when immature, male axis positively geotropic, with basal female and distal male flowers, male flowers deciduous, peduncle medium long, glabrous.

Bract: deciduous, shoulder *low*, broadly ovate, apex obtuse, reflex and roll back after opening, colour dull purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars prominent.

Female flowers: arranged in two rows, united tepal  $5 \pm 0.05$  cm long and  $1.8 \pm 0.04$  cm broad, cream with light pink colour throughout, lobes 3+2, acuminate, free tepal  $3.5 \pm 0.03$  cm long,  $2.2 \pm 0.01$  cm broad, creamy white, below tip corrugated; stamens not fertile, staminodes 3-5,

3.0 cm long, colour creamy yellow with no anther lobes; pistil  $12.8 \pm 0.21$  cm long, stigma colour cream, with 4 lobes; ovary  $7.8 \pm 0.15$  cm long,  $5.3 \pm 0.02$  cm in circumference, greenish yellow with pink flush towards the base, ovules arranged in two regular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.3 \pm 0.10$  cm long,  $1.4 \pm 0.05$  cm broad, light pink with creamy streaks, lobes 3+2, acuminate, free tepal  $3.3 \pm 0.03$  cm long,  $2.1 \pm 0.02$  cm broad, creamy white, below tip corrugated; stamens 5, none fertile, filament  $2.3 \pm 0.10$  cm long, colour yellowish cream, anther lobes  $2.5 \pm 0.12$  cm long, yellowish brown, pistillode  $6.2 \pm 0.21$  cm long, stigma colour pale yellow, ovary greenish yellow with pink streaks towards the base.

Bunch: position of mature bunch  $50^{\circ}$  -  $55^{\circ}$  to the stem, bunch weight  $10 \pm 0.15$  kg, number of fingers  $188 \pm 4.0$ , number of hands  $12 \pm 0.10$ , hands compact, spirally arranged, fingers in a hand compact.

Finger:  $11.13 \pm 0.28$  cm long and  $8.65 \pm 0.21$  cm in circumference with 3-4 sides, ridges indistinct, tapering to the tip, apex distinct, straight, finger weight  $62.63 \pm 1.62$ g.

Ripe fruit: colour yellow, firmly attached to the hand, rind very thin, pulp colour white, thick, not starchy, taste sweet with good flavour, TSS  $28.50 \pm 0.25\%$ , total sugars  $15.65 \pm 0.42\%$ , reducing sugars  $13.95 \pm 0.42\%$ , non reducing sugars  $1.62 \pm 0.50\%$ , sugar/acid ratio  $59.25 \pm 2.67$ , keeping quality good.

1.44 Musa (AB Group) 'Kostha bontha'

The plant is  $315.50 \pm 3.5$  cm tall with a circumference of  $69.50 \pm 1.8$  cm at the base. It takes  $233 \pm 3.1$  days from planting to flowering and  $108 \pm 2.0$  days from flowering to harvest.

Pseudostem: light green with pink colour near the base of petiole.

Leaves: petiole  $54.25 \pm 1.0$  cm long, clasping pseudostem, margins of petiole inclosed, slightly winged below, lamina  $230 \pm 7.5$  cm long,  $44 \pm 0.78$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $36 \pm 0.26$ .

Inflorescence: with basal female and distal male flowers, female axis almost horizontal, male axis positively geotropic, male flowers deciduous, peduncle short and hairy.

Bract: deciduous, shoulder low, do not roll back after opening, broadly ovate, apex obtuse, colour brownish purple outside, bright crimson inside, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.5 \pm 0.05$  cm long and  $1.4 \pm 0.02$  cm broad, colour cream flushed with pink, lobes 3+2, acute, free tepal  $3.6 \pm 0.04$  cm long,  $1.7 \pm 0.03$  cm broad, colour light pink, below tip not corrugated; stamens not fertile, staminodes 5,

2.3  $\pm$  0.01 cm long, colour creamy white, with no anther lobes; pistil 12.1  $\pm$  0.63 cm long, stigma colour cream, with 3 lobes; ovary 9.8  $\pm$  0.15 cm long, 8.2  $\pm$  0.08 cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.3  $\pm$  0.04 cm long, 1.5  $\pm$  0.01 cm broad, colour cream flushed with pink, lobes 3+2, free tepal 3.7  $\pm$  0.03 cm long, 2.7  $\pm$  0.02 cm broad, colour light pink, below tip slightly corrugated, stamens 5, none fertile, filament 2.6  $\pm$  0.02 cm long, colour creamy white, anther lobes 3.1  $\pm$  0.01 cm long, colour cream, pistillode 4.6  $\pm$  0.07 cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch 70°- 80° to the stem, bunch weight 12.75  $\pm$  0.25 kg, number of fingers 172  $\pm$  3.4, number of hands 12  $\pm$  0.12, hands loose, fingers compact.

Finger: 12.63  $\pm$  0.10 cm long and 11.33  $\pm$  0.15 cm in circumference, slightly angular with 3 - 4 unequal sides, apex prominent, long, finger weight 68.42  $\pm$  1.3 g, finger with ashy coating.

Ripe fruit: colour dull yellow, rind thick, pulp colour white, thick, starchy, not fit for consumption, TSS 27  $\pm$  0.30%, total sugars 17.54  $\pm$  0.25%, reducing sugars 15  $\pm$  0.18%, non reducing sugars 2.42  $\pm$  0.05%, sugar/acid ratio 49.17  $\pm$  1.7, keeping quality good.



PLATE 30. Musa (AB Group) 'Kostha bontha'



1.45 Musa (AB Group) 'Venneettu mannan'

The plant is  $362.00 \pm 3.1$  cm tall with a circumference of  $77.50 \pm 1.4$  cm at the base. It takes  $246 \pm 2.6$  days from planting to flowering and  $105 \pm 1.5$  days from flowering to harvest.

Pseudostem: light green with pink colour near the base of petiole.

Leaves: petiole  $66.75 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, slightly winged below, lamina  $200 \pm 1.8$  cm long,  $69 \pm 1.5$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $31.00 \pm 0.36$ .

Inflorescence: with basal female and distal male flowers, female axis almost horizontal, male axis positively geotropic, male flowers deciduous, peduncle short and hairy.

Bract: deciduous, shoulder low, do not roll back after opening, broadly ovate, apex obtuse, colour brownish purple outside, bright crimson inside, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.7 \pm 0.04$  cm long and  $1.6 \pm 0.01$  cm broad, colour cream flushed with pink, lobes 3+2, acute, free tepal  $3.5 \pm 0.03$  cm long,  $1.5 \pm 0.02$  cm broad, colour light pink, below tip not corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.02$  cm

long, colour creamy white, with no anther lobes; pistil 12.8  $\pm$  0.12 cm long, stigma colour cream, with 3 lobes; ovary 10.2  $\pm$  0.15 cm long, 8.3  $\pm$  0.08 cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.2  $\pm$  0.03 cm long, 1.6  $\pm$  0.02 cm broad, colour cream flushed with pink, lobes 3+2, free tepal 3.8  $\pm$  0.02 cm long, 2.9  $\pm$  0.03 cm broad, colour light pink, below tip slightly corrugated, stamens 5, none fertile, filament 2.7  $\pm$  0.01 cm long, colour cream, pistillode 4.7  $\pm$  0.06 cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch 70° - 80° to the stem, bunch weight 15.25  $\pm$  0.26 kg, number of fingers 209  $\pm$  3.2, number of hands 13  $\pm$  0.16, hands loose, fingers compact.

Finger: 13.63  $\pm$  0.13 cm long and 9.48  $\pm$  0.06 cm in circumference, slightly angular with 3 - 4 unequal sides, apex prominent, long, finger weight 78.00  $\pm$  1.5 g, fingers with ashy coating.

Ripe fruit: colour dull yellow, rind thick, pulp colour white, thick, starchy, not fit for consumption, TSS 24  $\pm$  0.32%, total sugars 16.85  $\pm$  0.18%, reducing sugars 14.86  $\pm$  0.51%, non reducing sugars 1.32  $\pm$  0.07%, sugar/acid ratio 46.81  $\pm$  1.6, keeping quality medium.



PLATE 32. Musa (AB Group) 'Venmeettu mannan'

1.46 Musa ABB (Group) 'Karpooravally'

The plant is  $286 \pm 4.5$  cm tall with a circumference of  $63 \pm 2.5$  cm at the base. It takes  $225 \pm 3.0$  days from planting to flowering and  $117 \pm 1.6$  days from flowering to harvest.

Pseudostem: light green with pink colour on the bases of petioles.

Leaves: petiole  $59.75 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, lamina  $196 \pm 2.2$  cm long,  $58 \pm 1.8$  cm broad, base of lamina unequal, base and apex truncate, number of leaves  $30 \pm 0.75$ .

Inflorescence: with basal female and distal male flowers, female and male axes positively geotropic, male flowers deciduous; peduncle long and glabrous.

Bract: deciduous, shoulder <sup>low</sup>, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $5.2 \pm 0.2$  cm long and  $2.2 \pm 0.05$  cm broad, pale yellow with pink flush, lobes 3+2, rich yellow; free tepal  $3.3 \pm 0.02$  cm long,  $2.7 \pm 0.01$  cm broad, colour cream, below tip slightly corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.04$  cm, colour pale yellow, with no anther lobes; pistil  $15.7 \pm$

0.07 cm long, stigma colour cream, with 3 lobes; ovary  $11 \pm 0.08$  cm long,  $7.3 \pm 0.05$  cm in circumference, colour green with pink flush towards the base, ovules arranged in four irregular rows.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.21$  cm long,  $2.3 \pm 0.10$  cm broad, pale yellow with pink flush, lobes 3+2, rich yellow, acute; free tepal  $3.2 \pm 0.01$  cm long,  $2.5 \pm 0.02$  cm broad, colour cream, below tip corrugated, stamens 5, all fertile, filament  $2.4 \pm 0.02$  cm long, pale yellow, anther lobes  $3.6 \pm 0.03$  cm long, colour pinkish yellow, pistillode  $5.6 \pm 0.01$  cm long, stigma colour cream, ovary yellowish green with pink flush towards the base.

Bunch: position of mature bunch  $25^{\circ}$  -  $30^{\circ}$  to the stem, bunch weight  $11.5 \pm 0.21$  kg, number of fingers  $170 \pm 25$ , number of hands  $11 \pm 0.60$ , fingers in a hand compact.

Finger:  $13.13 \pm 0.56$  cm long and  $11.70 \pm 0.45$  cm in circumference, angular with 5 sides, not tapering to the tip, apex very distinct, finger weight  $57.29 \pm 3.2$  g, contains a few black seeds, fingers with ashy coating.

Ripe fruit: Colour yellow, firmly attached to the hand, rind thin, pulp colour cream, soft, not starchy, fit for consumption, TSS  $24.5 \pm 0.78\%$ , total sugars  $18.4 \pm 0.15\%$ , reducing sugars  $16.3 \pm 0.21\%$ , non reducing sugars  $2.05 \pm 0.05\%$ , sugar/acid ratio  $63.91 \pm 2.1$ , keeping quality good.



PLATE 52. Musa (ABB Group) 'Karpooravally'

1. Musa (ABB Group) 'Chirapunchi'

The plant is  $327 \pm 4.2$  cm tall with a circumference of  $85.25 \pm 2.0$  cm at the base. It takes  $233 \pm 3.5$  days from planting to flowering and  $116 \pm 2.9$  days from flowering to harvest.

Pseudostem: light green with pink tinge.

Leaves: petiole  $59.75 \pm 0.95$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $227 \pm 2.6$  cm long,  $67 \pm 1.6$  cm broad, base of lamina unequal, base cordate and apex truncate, number of leaves  $38 \pm 0.65$ .

Inflorescence: with basal female and distal male flowers, female axis and male axis positively geotropic, male flowers deciduous; peduncle long and glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $5.6 \pm 0.07$  cm long and  $3 \pm 0.05$  cm broad, pale yellow with pink flush, lobes 3+2, rich yellow, acuminate, free tepal  $3.2 \pm 0.03$  cm long,  $2.9 \pm 0.03$  cm broad, colour cream, below tip very slightly corrugated; stamens not fertile, staminodes 5,  $2.7 \pm 0.01$  cm long, pale yellow with no anther lobes; pistil  $15.8 \pm 0.07$  cm long, stigma colour cream with 3 lobes,

ovary  $11.1 \pm 0.04$  cm long,  $7.6 \pm 0.02$  cm in circumference, colour green with pink flush towards the base, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.7 \pm 0.20$  cm long,  $2.5 \pm 0.02$  cm broad, pale yellow with pink flush, lobes 3+2, rich yellow, acuminate; free tepal  $3.6 \pm 0.02$  cm long,  $2.8 \pm 0.01$  cm broad, below tip slightly corrugated; stamens 5, all fertile, filament  $2.9 \pm 0.03$  cm long, pale yellow, anther lobes  $3.9 \pm 0.02$  cm long, colour pinkish yellow, pistillode  $5.8 \pm 0.02$  cm long, stigma colour cream, ovary yellowish green with pink flush towards the base.

Bunch: position of mature bunch  $25^{\circ} - 30^{\circ}$  to the stem, bunch weight  $14.25 \pm 0.15$  kg, number of fingers  $190.5 \pm 3.2$ , number of hands  $12 \pm 0.10$ , hands and fingers compact.

Finger:  $14 \pm 0.12$  cm long and  $9.25 \pm 0.10$  cm in circumference, with 5 unequal sides, tapering to the tip, apex prominent, finger weight  $63 \pm 1.3$  g.

Ripe fruit: colour dull yellow, do not separate easily from the hand, rind medium thick, pulp colour cream, soft, slightly starchy, fit for consumption, pulp medium soft, TSS  $23 \pm 1.3\%$ , total sugars  $18.13 \pm 0.14\%$ , reducing sugars  $15.59 \pm 0.18\%$ , non reducing sugars  $2.44 \pm 0.05\%$ , sugar/acid ratio  $75.52 \pm 1.3$ , keeping quality good.



1.7 Musa (ABB Group) 'Pey kunnan'

The plant is  $307 \pm 2.3$  cm tall and with a circumference of  $69.50 \pm 1.3$  cm at the base. It takes  $213 \pm 2.8$  days from planting to flowering and  $114 \pm 1.9$  days from flowering to harvest.

Pseudostem: light green with pink tinge.

Leaves: petiole  $45 \pm 0.78$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $212 \pm 2.2$  cm long,  $58 \pm 0.58$  cm broad, base of lamina unequal, base cordate and apex truncate, number of leaves  $34 \pm 0.79$ .

Inflorescence: with basal female and distal male flowers, female axis and male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $5.1 \pm 0.21$  cm long and  $2 \pm 0.04$  cm broad, pale yellow with pink flush, lobes 3+2, rich yellow, acuminate, free tepal  $3.2 \pm 0.02$  cm long,  $2.8 \pm 0.02$  cm broad, colour cream, below tip very slightly corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.01$  cm long, pale yellow, with no anther lobes; pistil  $15.6 \pm 0.03$  cm long, stigma colour

cream, with 3 lobes; ovary  $11.1 \pm 0.03$  long,  $7.3 \pm 0.01$  cm in circumference, colour green with pink flush towards the base, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.5 \pm 0.20$  cm long,  $2.3 \pm 0.01$  cm broad, pale yellow with pink flush, lobes 3+2, rich yellow, acuminate, free tepal  $3.2 \pm 0.01$  cm long,  $2.8 \pm 0.02$  cm broad, creamy white, below tip slightly corrugated; stamens 5, all fertile, filament  $2.5 \pm 0.03$  cm long, colour pale yellow, anther lobes  $3.7 \pm 0.02$  cm long, pinkish yellow; pistillode  $5.7 \pm 0.93$  cm long, stigma colour cream, ovary yellowish green with pink flush towards the base.

Bunch: position of mature bunch  $25^{\circ} - 30^{\circ}$  to the stem, bunch weight  $10.50 \pm 0.13$  kg, number of fingers  $171 \pm 3.5$ , number of hands  $11 \pm 0.68$ , fingers compact.

Finger:  $12.63 \pm 0.14$  cm long and  $9.75 \pm 0.12$  cm in circumference, angular with 5 sides, slightly tapering to the tip, apex prominent, finger weight  $63.15 \pm 1.2$  g with ashy coating, contains a number of black seeds.

Ripe fruit: colour yellow, do not separate easily from the hand, rind medium thick, pulp colour cream, soft, fit for consumption but for the seeds taste sweet, TSS  $25 \pm 0.04\%$ , total sugars  $16.75 \pm 0.42\%$ , reducing sugars  $15.09 \pm 0.45\%$ , non reducing sugars  $1.29 \pm 0.50\%$ , sugar acid ratio  $79.76 \pm 2.1$ , keeping quality good.



PLATE 33. Musa (ABB Group) 'Pey kuman'

1.49 Musa (ABB Group) 'Walha'

The plant is  $264 \pm 1.2$  cm tall with a circumference of  $69 \pm 1.6$  cm at the base. It takes  $181 \pm 4.1$  days from planting to flowering and  $100 \pm 2.1$  days from flowering to harvest.

Pseudostem: yellowish green with very light brown blotches near the petioles.

Leaves: petiole  $57.5 \pm 0.83$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $193 \pm 2.2$  cm long,  $60 \pm 2.5$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $32 \pm 0.23$ .

Inflorescence: with basal female middle male and distal female flowers, positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, ovate, apex obtuse, slightly roll back after opening, colour outside brownish purple, inside bright crimson, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.8 \pm 0.03$  cm long and  $2.1 \pm 0.02$  cm broad, colour creamy yellow flushed with pink, lobes 3+2, acute, free tepal  $3.4 \pm 0.03$  cm long,  $3.2 \pm 0.05$  cm broad, colour pale pink, below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.3 \pm 0.10$  cm long, creamy white with no anther lobes;

pistil  $10.5 \pm 0.23$  cm long, stigma colour cream with 6 lobes; ovary  $7.8 \pm 0.12$  cm long,  $8.0 \pm 0.08$  cm in circumference, greenish yellow with pink flush, ovules arranged in 4 irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $3.8 \pm 0.10$  cm long,  $2.4 \pm 0.09$  cm broad, creamy yellow flushed with pink, lobes 3+2, acuminate, free tepal  $3.0 \pm 0.10$  cm long,  $2.8 \pm 0.08$  cm broad, below tip rarely corrugated; stamens one or two well developed, not fertile, filament  $2.1 \pm 0.12$  cm long, creamy white, anther lobes  $2.6 \pm 0.09$  cm long, colour yellow, pistillode  $3.4 \pm 0.07$  cm long, stigma colour cream, ovary green with pink flush.

Bunch: position of mature bunch <sup>30'</sup> to the stem, bunch weight  $14.75 \pm 0.16$  kg, number of fingers  $203 \pm 5.0$ , number of hands  $17 \pm 0.37$ , hands and fingers very compact.

Finger:  $17.03 \pm 0.60$  cm long and  $9.93 \pm 0.21$  cm in circumference, mature fingers almost cylindrical, tapering to the tip, apex prominent, short, warty, finger weight  $80.63 \pm 2.1$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp creamy white, soft, starchy, not fit for consumption, TSS  $25 \pm 0.21\%$ , total sugars  $6.94 \pm 0.14\%$ , reducing sugars  $5.66 \pm 0.09\%$ , non reducing sugars  $1.22 \pm 0.04\%$ , sugar/acid ratio,  $35.57 \pm 1.8$ , keeping quality medium.



PLATE 34. Musa (ABB Group) 'Walha'

1.50 Musa (ABB Group) 'Ashy batheesa'

The plant is  $301 \pm 3.2$  cm tall with a circumference of  $62 \pm 1.2$  cm at the base. It takes  $188 \pm 3.6$  days from planting to flowering and  $101 \pm 1.2$  days from flowering to harvest.

Pseudostem: yellowish green with dark brown blotches near the petiole.

Leaves: petiole 63.5 cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $186 \pm 2.1$  cm long,  $65 \pm 1.3$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $30 \pm 0.38$ .

Inflorescence: with basal female, middle male and distal male flowers, positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, ovate, apex obtuse, slightly roll back after opening, colour outside brownish purple, inside bright crimson, inside bract colour continuous to the base, bract sears not prominent.

Female flowers: arranged in two rows, united tepal  $3.9 \pm 0.04$  cm long and  $2.2 \pm 0.01$  cm broad, colour creamy yellow flushed with pink, lobes 3+2, acute, free tepal  $3.2 \pm 0.02$  cm long,  $3.1 \pm 0.01$  cm broad, colour pale pink, below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.1 \pm 0.05$  cm long, creamy white, with no anther lobes; pistil  $13.3 \pm 0.04$  cm long, stigma colour cream, with 6 lobes; ovary  $7.6 \pm 0.03$  cm

long,  $8.3 \pm 0.02$  cm in circumference, greenish yellow with pink flush, ovules arranged in 4 irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4 \pm 0.10$  cm long,  $2.2 \pm 0.08$  cm broad, creamy yellow flushed with pink, lobes 3+2, acuminate, free tepal  $3.0 \pm 0.12$  cm long,  $2.9 \pm 0.08$  cm broad, below tip rarely corrugated; stamens 5, one or two well developed, not fertile, filament  $2.3 \pm 0.07$  cm long, colour yellow, anther lobes  $2.3 \pm 0.10$  cm long, colour yellowish brown, pistillode  $3.3 \pm 0.03$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $14.75 \pm 0.18$  kg, number of fingers  $201 \pm 4.0$ , number of hands  $17 \pm 0.13$ , hands and fingers very compact.

Finger:  $16.75 \pm 0.50$  cm long and  $9.43 \text{ cm} \pm 0.21$  cm in circumference, angular with 5 unequal sides, apex prominent, round, finger weight  $88.75 \pm 1.3$  g, green fruits with ashy coating.

Ripe fruits colour dull yellow, firmly attached to the hand, rind thick, pulp colour creamy white, soft, starchy, not fit for consumption, TSS  $24 \pm 0.21\%$ , total sugars  $9.62 \pm 0.11\%$ , reducing sugars  $8.37 \pm 0.12\%$ , non reducing sugars  $1.19 \pm 0.06\%$ , sugar/acid ratio,  $32.08 \pm 2.1$ , keeping quality medium.





PLATE 35. Musa (ABB Group) 'Ashy bathessa'

1.51 Musa (ABB group) 'Ney vanna'

The plant is  $225 \pm 4.1$  cm tall with a circumference of  $71 \pm 1.5$  cm at the base. It takes  $169 \pm 4.8$  days from planting to flowering and  $105 \pm 2.1$  days from flowering to harvest.

Pseudostem: pale green, slightly glaucous.

Leaves: petiole  $59.25 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, lamina  $190 \pm 3.5$  cm long  $60 \pm 1.2$  cm broad, base of lamina unequal, auricled and apex truncate, number of leaves  $35 \pm 0.78$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder *low*, broadly ovate, apex obtuse, slightly roll back after opening, colour dull purple outside, bright crimson inside, inside colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.5 \pm 0.80$  cm long and  $1.8 \pm 0.04$  cm broad, colour <sup>pink</sup> with yellow tinge, lobes 3+2, colour pale yellow, free tepal  $2.5 \pm 0.09$  cm long,  $2.3 \pm 0.08$  cm broad, colour cream with light pinkish tinge, below tip not corrugated, stamens not fertile, staminodes 5,  $1.8 \pm 0.02$  cm long, colour cream,

with no anther lobes; pistil  $14.4 \pm 0.12$  cm long, stigma colour cream, with 3 lobes; ovary  $10.8 \pm 0.32$  cm long,  $6.8 \pm 0.13$  cm in circumference, colour greenish yellow with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.3 cm long,  $1.3 \pm 0.01$  cm broad, inside colour pink and outside colour pale yellow, lobes 3+2, acuminate, free tepal  $3.5 \pm 0.02$  cm long,  $3.2 \pm 0.01$  cm broad colour light pink, below tip not corrugated, stamens 5, fertile, filament  $2.8 \pm 0.13$  cm long, colour cream anther lobes  $3 \pm 0.23$  cm long, colour creamy white; pistillode  $5.3 \pm 0.3$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $40^\circ - 45^\circ$  to the stem, bunch weight  $6.5 \pm 0.23$  number of fingers  $79.5 \pm 4.2$  fingers, number of hands  $4.5 \pm 0.93$ , fingers and hands compact.

Finger:  $12.38 \pm 0.12$  cm long and  $11.73 \pm 0.13$  cm in circumference, angular with 5 ridges, slightly tapering to the tip, apex indistinct, finger weight  $100.75 \pm 3.2$  g.

Ripe fruit: colour dull greenish yellow do not separate easily from the hand, rind thick, pulp soft, colour white, starchy not fit for consumption, taste insipid, TSS  $23 \pm 0.98\%$ , total sugars  $20.75 \pm 0.13\%$ , reducing sugars  $18.18 \pm 0.58\%$ , non reducing sugars  $2.45 \pm 0.83\%$ , sugar/acid ratio  $42.79 \pm 1.8$  keeping quality medium.

1.52 Musa (ABB Group) 'Alukehel'

The plant is  $204.75 \pm 3.2$  cm tall with a circumference of  $61.75 \pm 1.5$  cm at the base. It takes  $168 \pm 4.5$  days from planting to flowering and  $105 \pm 3.2$  days from flowering to harvest.

Pseudostem: pale green, slightly glaucous.

Leaves: petiole  $42.75 \pm 1.5$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $151.50 \pm 4.5$  cm long,  $72 \pm 1.3$  cm broad, base of lamina unequal, base auricled and apex truncate, number of leaves  $29 \pm 0.89$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex obtuse, slightly roll back after opening, colour dull purple outside, bright crimson inside, inside colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.6 \pm 0.04$  cm long and  $1.7 \pm 0.05$  broad colour with yellow tinge, lobes 3+2, free tepal  $2.6 \text{ cm} \pm 0.02$  long,  $2.2 \pm 0.02$  cm broad, colour creamy white, below tip corrugated; stamens not fertile, staminodes 5,  $1.7 \pm 0.10$  cm long, colour cream, with no anther lobes; pistil  $14.4 \pm$

0.12 cm long, stigma colour cream with 3 lobes; ovary 10.6 cm  $\pm$  0.05 cm long, 7.1  $\pm$  0.03 cm in circumference, colour greenish yellow with pink flush, ovules arranged in 4 irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal 5.4  $\pm$  0.10 cm long, 1.3  $\pm$  0.08 cm broad, colour pink inside and cream outside, lobes 3+2, acute, free tepal 3.2  $\pm$  0.03 cm long, 3.1  $\pm$  0.02 cm broad, colour light pink, below tip not corrugated, stamens 5, all fertile, filament 2.7  $\pm$  0.02 cm long, colour cream, anther lobes 2.8  $\pm$  0.02 cm long colour cream, pistillode 5.2  $\pm$  0.80 cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch 40° - 45° to the stem, bunch weight 4.75  $\pm$  0.25 kg, number of fingers, 87  $\pm$  3.5, number of hands 7  $\pm$  0.12, hands and fingers compact.

Finger: 12.63  $\pm$  1.2 cm long and 11.48  $\pm$  0.58 cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex straight, finger weight 120.50  $\pm$  4.5 g, green fingers are with shining ashy coating.

Ripe fruit: dull greenish yellow, firmly attached to the hand, rind thick, pulp colour creamy white, soft starchy not fit for consumption, taste insipid, TSS 23  $\pm$  1.2%, totalsugars 20  $\pm$  1.05% reducing sugars 18.13  $\pm$  0.95%, non reducing sugars 1.79  $\pm$  0.66%, sugar acid ratio 41.67  $\pm$  2.3, keeping quality medium.



PLATE 36. Musa (ABB Group) 'Alukehel'

1.53 Musa (ABB Group) 'Kapok'

The plant is  $361.5 \pm 1.5$  cm tall with a circumference of  $72.5 \pm 1.2$  cm at the base. It takes  $23\frac{1}{2} \pm 4.2$  days from planting to flowering and  $9\frac{1}{2} \pm 2.2$  days from flowering to harvest.

Pseudostem: yellowish green with black blotches near the base of petiole.

Leaves: petiole  $64.25 \pm 1.5$  cm long, clasping pseudostem, margins of petiole inclosed, slightly winged, margins pink coloured, lamina  $262 \pm 3.1$  cm long,  $69 \pm 2.2$  cm broad, base of lamina unequal, base cordate, apex acute, number of leaves  $26 \pm 0.56$ .

Inflorescence: with basal female and distal male flowers, female and male axes positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.9 \pm 0.14$  cm long and  $1.7 \pm 0.02$  cm broad, colour pink, cream near margins, lobes 3+2, acuminate, free tepal  $4.1 \pm 0.02$  cm long,  $2.3 \pm 0.03$  cm broad, colour cream with pink flush, below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.02$  cm long, colour cream, with no anther lobes;

pistil  $17.2 \pm 0.45$  cm long, stigma colour cream, with 3 lobes; ovary  $10.1 \pm 0.12$  cm long,  $7.1 \pm 0.10$  cm in circumference, yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.1 \pm 0.06$  cm long,  $1.88 \pm 0.02$  cm broad, colour pale pink outside and inside, lobes 3+2, acuminate, free tepal  $2.8 \pm 0.02$  cm long  $2.0 \pm 0.03$  cm broad, below tip rarely corrugated; stamens 5, all fertile, filament  $2.3 \pm 0.01$  cm long, colour cream with pink flush, anther lobes  $3.6 \pm 0.04$  cm long, colour cream, pistillode  $4.5 \pm 0.03$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $8 \pm 0.22$  kg, number of fingers  $113 \pm 4.2$ , number of hands  $6 \pm 0.13$ , hands and fingers loose.

Finger:  $13.46 \pm 0.13$  cm long and  $10.88 \pm 0.25$  cm in circumference, angular with 5 unequal sides, apex prominent, stout, finger weight  $91.00 \pm 4.5$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp creamy white, soft starchy, not fit for consumption, TSS  $24 \pm 0.20\%$ , total sugars  $15.75 \pm 0.50\%$ , reducing sugars  $13.63 \pm 0.30\%$ , non reducing sugars  $2.02 \pm 0.01\%$ , sugar/acid ratio  $34.61 \pm 2.1$ , keeping quality medium.



1.54 Musa (ABB Group) 'Jurmoney kunthali'

The plant is  $338 \pm 3.8$  cm tall with a circumference of  $74.5 \pm 1.5$  cm at the base. It takes  $238 \pm 3.2$  days from planting to flowering and  $117 \pm 2.1$  days from flowering to harvest.

Pseudostem: light green without blotches

Leaves: petiole  $58.5 \pm 0.98$  cm long, clasping pseudostem, margins of petiole inclosed, lamina  $196 \pm 3.6$  cm long,  $68 \pm 1.2$  cm broad, base of lamina unequal, base cordate, apex truncate; number of leaves  $37 \pm 0.51$ .

Inflorescence: with basal female and distal male flowers, female axis and male axis positively geotropic, male flowers deciduous; peduncle long and glabrous.

Bract deciduous, shoulder *low*, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $5.2 \pm 0.08$  cm long and  $2.1 \pm 0.05$  cm broad, yellow with pink flush, lobes 3+2, rich yellow, acuminate, free tepal  $3, 3 \pm 0.03$  cm long,  $2.8 \pm 0.02$  cm broad, colour cream, below tip, slightly corrugated; stamens not fertile, staminodes 5  $2.6 \pm 0.01$  cm long, pale yellow with no anther lobes; pistil  $15.7 \pm 0.03$  cm long, stigma colour cream, with 3 lobes; ovary  $11.2 \pm 0.04$  cm long,  $7.5 \pm 0.02$  cm in

circumference, colour green with pink flush towards the base, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.20$  cm long,  $2.4 \pm 0.01$  cm broad, yellow with pink flush, lobes 3+2, rich yellow, acuminate, free tepal  $3.3 \pm 0.02$  long,  $2.9 \pm 0.02$  cm broad, cream with pink flush, below tip slightly corrugated, stamens 5, none fertile, filament  $2.6 \pm 0.01$  cm long, colour yellow, anther lobes  $3.5 \pm 0.02$  cm long, black thread like, pistillode  $5.8 \pm 0.02$  long, stigma colour cream, ovary yellowish green with pink flush towards the base.

Bunch: position of mature bunch  $25^{\circ}$  -  $30^{\circ}$  to the stem, bunch weight  $14 \pm 0.12$  kg, number of fingers  $181 \pm 3.2$ , number of hands  $13 \pm 0.18$ , hands and fingers compact, fingers with ashy coating.

Finger:  $14.75 \pm 0.52$  cm long and  $9.52 \pm 0.81$  in circumference, angular with 5 sides, slightly tapering to the tip, apex short, distinct, finger weight  $63.5 \pm 2.2$  g.

Ripe fruit: colour dull yellow, do not easily separate from the hand, rind thick, pulp colour cream, soft, starchy, not fit for consumption, taste insipid, TSS  $23 \pm 0.50\%$ , total sugars  $16.75 \pm 0.58\%$ , reducing sugars  $13.65 \pm 0.61\%$ , non reducing sugars  $2.95 \pm 0.08\%$ , Sugar/acid ratio  $47.86 \pm 4.1$ , keeping quality good.

1.55 Musa (ABB Group) 'Peyan'

The plant is  $300.5 \pm 4.1$  cm tall with a circumference of  $62.00 \pm 1.8$  cm at the base. It takes  $234 \pm 3.2$  days from planting to flowering and  $106 \pm 2.6$  days from flowering to harvest.

Pseudostem: pale green with very light black blotches near the base of petioles, glaucous.

Leaves: petiole  $53.75 \pm 0.81$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $205 \pm 5.1$  cm long,  $63 \pm 2.1$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $34 \pm 0.36$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, ovate, apex obtuse, very slightly rollback after opening, colour brownish purple inside and bright crimson outside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.5 \pm 0.05$  cm long and  $1.6 \pm 0.02$  cm broad, colour pink inside, yellowish pink outside, lobes 3+2, acute free tepal  $3.6 \pm 0.02$  cm long,  $2.8 \pm 0.02$  cm broad, colour cream with pink flush, below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.5 \pm 0.03$  cm long, creamy white,

with no anther lobes; pistil  $18 \pm 0.13$  cm long, stigma colour cream, with 3 lobes; ovary  $10 \pm 3.12$  cm long,  $8 \pm 0.08$  cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.4 \pm 0.40$  cm long,  $1.6 \pm 0.02$  cm broad, colour pale pink inside, yellowish pink outside, lobes 3+2, acute, free tepal  $3.2 \pm 0.05$  cm long,  $2.3 \pm 0.01$  cm broad below tip rarely corrugated; stamens 5, all fertile, filament  $2.1 \pm 0.02$  cm long, colour cream, anther lobes  $2.7 \pm 0.07$  cm long, colour yellow; pistillode  $5.0 \pm 0.04$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $6.75 \pm 0.30$  kg, number of fingers  $78 \pm 2.1$ , number of hands  $5 \pm 0.12$  hands, and fingers loose.

Finger:  $13.25 \pm 0.12$  cm long and  $11.63 \pm 0.08$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex distinct, stout, finger weight  $65.95 \pm 1.5$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp colour creamy white, thick, starchy, not fit for consumption, TSS  $23.50 \pm 0.15\%$ , total sugars  $19.63 \pm 0.21\%$ , reducing sugars  $18.50 \pm 0.51\%$ , non reducing sugars  $1.07 \pm 0.03\%$ , sugar/acid ratio  $52.41 \pm 0.81$ , keeping quality medium.

1.56 Musa (ABB Group) 'Pacha bontha bathees'

The plant is  $247.00 \pm 2.7$  cm tall with a circumference of  $54.50 \pm 1.7$  cm at the base. It takes  $171 \pm 3.8$  days from planting to flowering and  $95 \pm 3.1$  days from flowering to harvest.

Pseudostem: pale green, slightly glaucous

Leaves: petiole 51.50 cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $162 \pm 2.1$  cm long,  $54 \pm 1.2$  cm broad, base of lamina unequal, base cordate, apex obtuse, number of leaves  $36 \pm 0.21$ .

Inflorescence: with basal female and distal male flowers, female axis and male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: shoulder *low*, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.6 \pm 0.06$  cm long and  $1.8 \pm 0.02$  cm broad, colour pale pink inside, yellowish pink outside, lobes 3+2, acute, free tepal  $3.8 \pm 0.01$  cm long,  $2.8 \pm 0.02$  cm broad, colour cream with pink flush, below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.3 \pm 0.02$  cm long,

creamy white, with no anther lobes; pistil  $18.8 \pm 0.34$  cm long, stigma colour cream with 3 lobes; ovary  $10.6 \pm 0.31$  cm long,  $8.2 \pm 0.08$  cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.6 \pm 0.12$  cm long,  $1.6 \pm 0.03$  cm broad, colour pale pink inside, yellowish pink outside, lobes 3+2, acute, free tepal  $3.5 \pm 0.03$  cm long,  $2.3 \pm 0.02$  cm broad, below tip rarely corrugated, stamens 5, all fertile, filament  $2.3 \pm 0.03$  cm long, colour cream, anther lobes  $2.6 \pm 0.05$  cm long, colour yellow, pistillode  $5.2 \pm 0.05$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem bunch weight  $9.75 \pm 0.18$  kg, number of fingers  $188 \pm 4.1$ , number of hands  $12 \pm 0.12$ , fingers and hands loose.

Finger:  $15.65 \pm 0.12$  cm long and  $13.08 \pm 0.08$  cm in circumference, almost cylindrical at maturity, apex prominent, round and warty, finger weight  $105.50 \pm 2.5$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp colour creamy white, soft, starchy, not fit for consumption, TSS  $21 \pm 0.21\%$ , total sugars  $18.77 \pm 0.09\%$ , reducing sugars  $14.08 \pm 0.13\%$ , non reducing sugars  $4.95 \pm 0.83\%$ , sugar/acid ratio  $38.70 \pm 1.5$ , keeping quality medium.



PLATE 37. Musa (ABB Group) 'Pacha bontha bathees'

1.57 Musa (ABB Group) 'Muthia'

The plant is  $232.5 \pm 1.6$  cm tall with a circumference of  $56.25 \pm 1.2$  cm at the base. It takes  $174 \pm 3.1$  days from planting to flowering and  $95 \pm 1.6$  days from flowering to harvest.

Pseudostem: pale green, slightly glaucous.

Leaves: petiole  $42.75$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, lamina  $165 \pm 2.1$  cm long  $81 \pm 2.0$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $27 \pm 0.39$ .

Inflorescence: with basal female and distal male flowers, female axis and male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: shoulder *low*, broadly ovate, apex obtuse, slightly roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.2 \pm 0.05$  cm long and  $1.2 \pm 0.02$  cm broad, colour pale pink inside, yellowish pink outside, lobes 3+2, acuminate, free tepal  $3.5 \pm 0.02$  cm long,  $2.5 \pm 0.01$  cm broad, colour pale pink, below tip rarely corrugated; stamens not fertile, staminodes 5,  $2 \pm 0.01$  cm long, colour



creamy white, with no anther lobes; pistil  $16.8 \pm 0.30$  cm long, stigma colour cream, with 3 lobes, ovary  $11.0 \pm 0.12$  cm long,  $76 \pm 0.10$  cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.3 \pm 0.12$  cm long,  $1.4 \pm 0.03$  cm broad, colour pale pink inside and outside, yellow margins, lobes 3+2, acute, free tepal  $2.8 \pm 0.02$  cm long,  $3 \pm 0.04$  cm broad, colour pale pink, below tip rarely corrugated; stamens 5, fertile, filament  $2.3 \pm 0.02$  cm long, colour creamy white, anther lobes  $3.2 \pm 0.10$  cm long, colour yellow; pistillode  $5.2 \pm 0.10$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $9.75 \pm 0.16$  kg, number of fingers  $122 \pm 3.2$ , number of hands  $9 \pm 0.13$ , hands and fingers compact.

Finger:  $13.25 \pm 0.12$  cm long and  $12.28 \pm 0.09$  cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex distinct, stout, finger weight  $103.50 \pm 2.5$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp colour creamy white, soft, starchy, not fit for consumption, TSS  $22 \pm 0.12\%$ , total sugars  $16.88 \pm 0.09\%$ , reducing sugars  $14.5 \pm 0.13\%$ , non reducing sugars  $2.26 \pm 0.05\%$ , sugar/acid ratio  $31.57 \pm 3.0$ , keeping quality medium. (Muthia and identical cultivars - Plates 38, 38a, 38b, 38c)



PLATE 38. Misa (ABB Group) 'Muthia'



Plate 38a Musa (ABB Group) 'Burrharia'



Plate 38b Musa (ABB Group) 'Chakkia'



Plate 38c Musa (ABB Group) 'Kothia'

1.58 Musa (ABB Group) 'Kari bontha'

The plant is  $277 \pm 2.1$  cm tall with a circumference of  $52.75 \pm 1.4$  cm at the base. It takes  $172 \pm 2.6$  days from planting to flowering and  $86 \pm 1.1$  days from flowering to harvest.

Pseudostem: yellowish green with light black blotches near the petiole.

Leaves: petiole  $53.75 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $178 \pm 1.2$  cm long,  $56 \pm 2.1$  cm broad, base of lamina unequal, base and apex truncate; number of leaves  $23 \pm 0.54$ .

Inflorescence: with basal female and distal male flowers, female and male axis positively geotropic, male flowers deciduous; peduncle long and glabrous.

Bract: shoulder *low*, broadly ovate, apex obtuse, do not curl back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.6 \pm 0.2$  cm long and  $1.5 \pm 0.01$  cm broad, colour pink, cream near margins, lobes 3+2, acuminate, free tepal  $4.2 \pm 0.02$  cm long,  $2.3 \pm 0.03$  cm broad, colour cream with pink flush; below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.2 \pm 0.01$  cm long, colour cream with no

anther lobes; pistil  $17.7 \pm 0.22$  cm long, stigma colour cream with 3 lobes; ovary  $10.2 \pm 0.20$  cm long,  $7.5 \pm 0.03$  cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.3 \pm 0.04$  cm long,  $1.9 \pm 0.05$  cm broad, colour pale pink outside and inside, lobes 3+2, acuminate, free tepal  $2.8 \pm 0.02$  cm long,  $1.8 \pm 0.01$  cm broad, below tip rarely corrugated; stamens 5, all fertile, filament  $2.2 \pm 0.02$  cm long, colour creamy white, pistillode  $5.0 \pm 0.05$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $7.25 \pm 0.16$  kg, number of fingers,  $46 \pm 2.5$ , number of hands  $5 \pm 0.12$ , hands and fingers loose.

Finger:  $15.73 \pm 1.2$  cm long and  $12.93 \pm 0.81$  cm in circumference, angular with 5 unequal sides, tapering to the tip apex prominent, stout, finger weight  $119.5 \pm 2.5$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp creamy white, soft, starchy, not fit for consumption, TSS  $20 \pm 0.22\%$ , total sugars  $14.60 \pm 0.48\%$ , reducing sugars  $12.75 \pm 0.10\%$ , non reducing sugars  $1.7 \pm 0.08\%$ , sugar/acid ratio  $39.91 \pm 2.1$ , keeping quality medium.



PLATE 39. Musa (ABB Group) 'Hari bontha'



1.59 Musa (ABB Group) 'Malai monthan'

The plant is  $222.5 \pm 3.21$  cm tall with a circumference of  $49.00 \pm 2.7$  cm at the base. It takes  $167 \pm 1.27$  days from planting to flowering and  $86 \pm 1.25$  days from flowering to harvest.

Pseudostem: yellowish green with very light black blotches near the base of petiole.

Leaves: petiole  $54.75 \pm 0.53$  cm long, clasping pseudostem, margins of petiole inclosed, not winged, lamina  $170 \pm 1.87$  cm long,  $58 \pm 0.98$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $22 \pm 0.36$ .

Inflorescence: with basal female and distal male flowers, female and male axes positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder *low*, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4 \pm 0.03$  cm long and  $1.6 \pm 0.01$  cm broad, colour cream flushed with pink, lobes 3+2, acute, free tepal  $3.6 \pm 0.02$  cm long,  $2.8 \pm 0.03$  cm broad, colour pale pink, below tip rarely corrugated; stamens not fertile, staminodes 5,

2.5  $\pm$  0.02 cm long, creamy white, with no anther lobes; pistil 18.6  $\pm$  1.2 cm long, stigma colour cream, with 3 lobes; ovary 11.6  $\pm$  0.15 cm long, 7  $\pm$  0.08 cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows.

Male flowers: arranged in two rows, united tepal 4.8  $\pm$  0.30 cm long, 1.5  $\pm$  0.05 cm broad, colour pink inside, yellow outside, lobes 3+2, acute, free tepal 3.5  $\pm$  0.05 cm long, 2.1  $\pm$  0.03 cm broad, below tip rarely corrugated; stamens 5, all fertile, filament 2.3  $\pm$  0.01 cm long, colour cream, anther lobes 2.1  $\pm$  0.12 cm long, colour yellow, pistillode 4.8  $\pm$  0.21 cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch 30° to the stem, bunch weight: 8.75  $\pm$  0.26 kg, number of fingers 78  $\pm$  3.4, number of hands 8  $\pm$  0.56, hands and fingers loose.

Finger: 19.25  $\pm$  0.21 cm long and 13.75  $\pm$  0.20 in circumference, almost cylindrical at maturity, apex prominent, stout, warty, finger weight 124.25  $\pm$  2.1 g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp colour creamy white, thick, starchy, not fit for consumption, TSS 18  $\pm$  0.21%, total sugars 14.64  $\pm$  0.41%, reducing sugars 11.95  $\pm$  0.51%, non reducing sugars 2.56  $\pm$  0.14%, sugar/acid ratio 51.38  $\pm$  0.41%, keeping quality medium.



PLATE 40. Musa (ABB Group) 'Malai monthan'

1.60 Musa (ABB Group) 'Bluggoe'

The plant is  $249.25 \pm 5.2$  cm tall with a circumference of  $54 \pm 1.8$  cm at the base. It takes  $170 \pm 3.2$  days from planting to flowering and  $94 \pm 1.5$  days from flowering to harvest.

Pseudostem: pale green, slightly glaucous.

Leaves: petiole  $46.25 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, lamina  $165 \pm 2.3$  cm long,  $63 \pm 1.5$  cm broad, base of lamina unequal, base and apex truncate, number of leaves  $29 \pm 1.8$ .

Inflorescence: with basal female and distal male flowers, male and female axes pendulous, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, broadly ovate, apex obtuse, do not roll back after opening, colour outside brownish purple, inside bright crimson, colour continuous to base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.3 \pm 0.12$  cm long and  $1.3 \pm 0.05$  cm broad, colour pink, margins cream, lobes 3+2, acute, free tepal  $3.6 \pm 0.13$  cm long,  $2.6 \pm 0.08$  cm broad, colour light pink, below tip corrugated; stamens not fertile, staminodes  $5, 2.2 \pm 0.1$  cm long, colour cream with no anther lobes; pistil  $14.6 \pm 0.56$  cm long, stigma colour cream, with 6 lobes; ovary  $10.8 \pm 0.13$  cm long,

6.9  $\pm$  0.12 cm in circumference, greenish yellow with pink flush at the base, ovules arranged in four irregular rows.

Male flowers: arranged in two rows, united tepal 5.2  $\pm$  0.2 cm long, 1.7  $\pm$  0.05 cm broad, pale pink outside and bright pink inside, lobes 3+2, acuminate, free tepal 3.6  $\pm$  0.02 cm long 2.8  $\pm$  0.01 cm broad, colour cream with pink flush, below tip rarely corrugated; stamens 5, all fertile, filament 2.4  $\pm$  0.12 cm long, anther lobes 4.6  $\pm$  0.13 cm long, colour cream, pistillode 5.4  $\pm$  0.03 cm long, stigma colour cream, ovary yellowish green with pink flush towards the base.

Bunch: position of mature bunch 25° - 30° to the stem, bunch weights 7.5  $\pm$  0.15 kg, number of fingers 4.2  $\pm$  3.4, number of hands 5  $\pm$  0.06 hands and fingers loose.

Finger: 16.25  $\pm$  1.2 cm long and 13.35  $\pm$  0.35 cm in circumference, angular with 5 unequal sides, slightly tapering to the tip, apex distinct, short and stout, finger weight 133.43  $\pm$  5.6 g.

Ripe fruit: dull greenish yellow, rind very thick, pulp colour creamy white, soft, starchy, not fit for consumption, TSS 26  $\pm$  1.2%, total sugars 19.5  $\pm$  0.98%, reducing sugars 17.88  $\pm$  0.3%, non reducing sugars 1.55  $\pm$  0.09%, sugar/acid ratio 36.81  $\pm$  3.8, keeping quality medium.

1.61 Musa (ABB Group) 'Chetti'

The plant is  $259 \pm 3.8$  cm tall with a circumference of  $54.25 \pm 2.2$  cm at the base. It takes  $170 \pm 4.2$  days from planting to flowering and  $100 \pm 3.1$  days from flowering to harvest.

Pseudostem: yellowish green with light black blotches near the base of petiole.

Leaves: petiole  $46.75 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, lamina  $172 \pm 3.1$  cm long,  $60 \pm 1.2$  cm broad, base of lamina unequal, base and apex truncate, number of leaves  $28 \pm 0.55$ .

Inflorescence: with basal female and distal male flowers, female and male axes positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder *low*, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.8 \pm 0.2$  cm long and  $1.6 \pm 0.01$  cm broad, colour pink, cream near margins, lobes 3+2, acuminate, free tepal  $4 \pm 0.12$  cm long,  $2.3 \pm 0.04$  cm broad, cream with pink flush below tip rarely corrugated; stamens not fertile, staminodes 5,  $2.2 \pm 0.01$  cm long, colour cream, with no anther lobes;

pistil  $17.0 \pm 0.12$  cm long, stigma colour cream, with 3 lobes; ovary  $10 \pm 0.10$  cm long,  $7 \pm 0.08$  cm in circumference, yellowish green with pink colour at the tip, ovules arranged in 4 irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $4.2 \pm 0.08$  cm long,  $1.8 \pm 0.03$  cm broad, colour pale pink outside and inside, lobes 3+2, acuminate, free tepal  $2.8 \pm 0.01$  cm long,  $1.8 \pm 0.01$  cm broad, below tip rarely corrugated; stamens 5, all fertile, filament  $2.1 \pm 0.02$  cm long, colour cream with pink flush, anther lobes  $3.8 \pm 0.05$  cm, long, colour cream; pistillode  $4.8 \pm 0.13$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem  
bunch weight  $7.25 \pm 0.15$  kg, number of hands <sup>4 to 5, hand</sup> and fingers loose.

Finger:  $19.63 \pm 0.32$  cm long and  $14.88 \pm 0.24$  cm in circumference, angular with 5 unequal sides, tapering to the tip, apex prominent, stout, finger weight  $91 \pm 2.6$  g, green fingers with ashy coating.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp creamy white, soft, starchy, not fit for consumption, TSS  $24 \pm 0.21\%$ , total sugars  $18.54 \pm 0.58\%$ , reducing sugars  $15.59 \pm 0.11\%$ , non reducing sugars  $2.83 \pm 0.05\%$ , sugar/acid ratio  $58.86 \pm 1.2$ , keeping quality medium.



PLATE 41. *Musa* (ABB Group) 'Chetti'



1.62 Musa (ABB group) 'Kallu monthan'

The plant is  $258.5 \pm 3.04$  cm tall with a circumference of  $64.50 \pm 3.21$  cm at the base. It takes  $175 \pm 1.75$  days from planting to flowering and  $94 \pm 1.05$  days from flowering to harvest.

Pseudostem: light green without blotches

Leaves: petiole  $53.25 \pm 1.2$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, lamina  $188 \pm 1.2$  cm long,  $6.0 \pm 0.21$  cm broad, base of lamina unequal, base truncate, apex cordate; number of leaves  $31 \pm 0.25$ .

Inflorescence: with basal female and distal male flowers, female and male axes positively geotropic, male flowers deciduous, male axis very long.

Bract: deciduous, shoulder *low*, broadly ovate, apex obtuse, do not roll back after opening, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.4 \pm 0.06$  cm long and  $2.8 \pm 0.02$  cm broad, colour pink inside and yellowish pink outside, lobes 3+2, acute, free tepal  $3.6 \pm 0.02$  cm long,  $2.6 \pm 0.02$  cm broad, colour cream with pink flush below tip rarely corrugated; stamens not

fertile, staminodes 5,  $2.4 \pm 0.03$  cm long, creamy white, with no anther lobes; pistil  $18.6 \pm 0.32$  cm long, stigma colour cream with 3 lobes; ovary  $10.6 \pm 0.30$  cm long,  $8.6 \pm 0.12$  cm in circumference, colour yellowish green with pink flush, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.4 \pm 0.2$  cm long,  $1.8 \pm 0.03$  cm broad, colour pale pink inside, yellowish pink outside, lobes 3+2, acute, free tepal  $3.6 \pm 0.10$  cm long,  $2.3 \pm 0.08$  cm broad, below tip rarely corrugated; stamens 5, all fertile, filament  $2.5 \pm 0.11$  cm long, creamy white, anther lobes  $2.7 \pm 0.09$  cm long, colour yellow, pistillode  $5.4 \pm 0.06$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $30^\circ$  to the stem, bunch weight  $3 \pm 0.10$  kg, number of fingers  $58 \pm 2.1$  number of hands  $6 \pm 0.10$ , hands and fingers loose.

Finger:  $13.13 \pm 0.12$  cm long and  $11.30 \pm 0.09$  cm in circumference, angular with 5 unequal sides, tapering to the tip, apex prominent, stout, finger weight  $87.25 \pm 1.2$  g.

Ripe fruit: colour dull yellow, firmly attached to the hands, rind thick, pulp colour creamy white, soft, starchy, not fit for consumption, TSS  $23 \pm 0.23\%$ , total sugars  $13.9 \pm 1.01\%$ , reducing sugars  $12.54 \pm 0.05\%$ , non reducing sugars  $1.30 \pm 0.8\%$ , sugar/acid ratio  $30.23 \pm 1.7$ , keeping quality medium.



PLATE 42. Musa (ABB Group) 'Kallu monthan'

1.63 Musa (ABBB Group) 'Hybrid Sawai'

The plant is  $212.5 \pm 3.8$  cm tall with a circumference  $58 \pm 2.5$  cm at the base. It takes  $209 \pm 4.4$  days from planting to flowering and  $95 \pm 2.6$  days from flowering to harvest.

Pseudostem: pale green without brown or black blotches.

Leaves: petiole  $48 \pm 0.85$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, 1st leaf  $148 \pm 1.2$  cm long  $67 \pm 0.75$  cm broad, base of lamina unequal, base cordate, apex truncate, number of leaves  $26 \pm 0.45$ .

Inflorescence: with basal female and distal male flowers, female axis semipendulous, male axis positively geotropic, male flowers deciduous, peduncle long and glabrous.

Bract: deciduous, shoulder low, do not roll back after opening, ovate, apex obtuse, colour brownish purple outside, bright crimson inside, inside bract colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $3.7 \pm 0.05$  cm long and  $3.6 \pm 0.04$  cm broad, colour cream variably flushed with pink, lobes 3+2, free tepal  $2.6 \pm 0.08$  cm long,  $2.2 \pm 0.03$  cm broad, cream with pink flush below tip not corrugated; stamens not fertile, staminodes 5,  $1.6 \pm$

0.02 cm long, creamy white, with no anther lobes; pistil  $14.4 \pm 0.12$  cm long, stigma creamy white with 3 lobes; ovary  $10.6 \pm 0.07$  cm long,  $8.1 \pm 0.09$  cm in circumference, yellowish green flushed with pink, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.4 \pm 0.04$  cm long,  $1.3 \pm 0.01$  cm broad, colour cream variably flushed with pink, lobes 3+2, free tepal  $3.2 \pm 0.05$  cm long,  $3.1 \pm 0.04$  cm broad, cream with pink flush, below tip not corrugated; stamens 5, all fertile, filament  $2.7 \pm 0.06$  cm long, colour creamy white, anther lobes  $2.8 \pm 0.03$  cm long, colour creamy, pistillode  $5.3 \pm 0.05$  cm long, stigma colour cream, ovary yellowish green with pink flush.

Bunch: position of mature bunch  $40^{\circ}$ - $45^{\circ}$  to the stem, bunch weight  $5.75 \pm 0.12$  kg, number of fingers,  $93 \pm 1.2$ , number of hands  $6 \pm 0.16$ , hands and fingers loose.

Finger: 9.88 cm long and 11.32 cm in circumference, with 5 indistinct sides, plumpy, apex distinct, short finger weight  $72.50 \pm 1.5$  g.

Ripe fruit: colour dull yellow, firmly attached to the hand, rind thick, pulp colour white, soft, starchy, not fit for consumption, TSS  $23 \pm 0.85\%$ , total sugars  $14.76 \pm 0.26\%$ , reducing sugars  $11.81 \pm 0.25\%$ , non reducing sugars  $2.87 \pm 0.51\%$ , sugar/acid ratio  $38.48 \pm 1.5$ , keeping quality medium.



PLATE 43. *Musa* (ABBB Group) 'Hybrid Sawai'

1.64 Musa (BB Group) 'Elavazhai' (Musa balbisiana)

The plant is  $451.5 \pm 4.8$  cm tall at flowering with a circumference of  $82 \pm 1.5$  cm at the base. It takes  $433 \pm 3.5$  days from planting to flowering and  $128 \pm 2.5$  days from flowering to harvest.

Pseudostem: green without brown or black blotches.

Leaves: petiole  $67.75 \pm 1.5$  cm long, clasping pseudostem, margins of petiole inclosed, not winged below, lamina  $175 \pm 2.2$  cm long  $61 \pm 1.0$  cm broad, base of lamina unequal, base cordate, apex broadly obtuse; number of leaves  $60 \pm 1.5$ .

Inflorescence: with basal female and distal male flowers, male and female axes positively geotropic, male flowers deciduous, male axis very long, peduncle long and glabrous.

Bract: deciduous, shoulder low, lift but do not roll back after opening, broadly ovate, apex obtuse, colour brownish purple outside, bright crimson inside, inside colour continuous to the base, bract scars not prominent.

Female flowers: arranged in two rows, united tepal  $4.1 \pm 0.04$  cm long and  $3.6 \pm 0.02$  cm broad, cream, variably flushed with pink lobes 3+2, free tepal  $3.0 \pm 0.01$  cm long,  $2.5 \pm 0.02$  cm broad, colour light pink, below tip not corrugated; stamens not fertile, staminodes 5,  $2.0 \pm 0.01$  cm long, with no anther lobes; pistil  $14.5 \pm 0.13$  cm long,

stigma creamy white, with 3 lobes; ovary  $9.6 \pm 0.10$  cm long,  $7.9 \pm 0.05$  cm in circumference, green flushed with pink, ovules arranged in four irregular rows in each loculus.

Male flowers: arranged in two rows, united tepal  $5.2 \pm 0.03$  cm long,  $1.5 \pm 0.01$  cm broad, colour pink with cream margins, lobes 3+2, free tepal  $2.8 \pm 0.02$  cm long,  $2.2 \pm 0.02$  cm broad, below tip not corrugated, stamens 5, all fertile, filament  $2.6 \pm 0.02$  cm long, colour creamy white, anther lobes  $3.1 \pm 0.11$  cm long, colour cream; pistillode  $4.9 \pm 0.13$  cm long, stigma colour creamy white, ovary green with pink flush.

Bunch - position of mature bunch  $30^\circ$  to the stem, bunch weight  $7 \pm 0.13$  kg, number of fingers  $53 \pm 1.2$ , number of hands  $5 \pm 0.08$ , hands and fingers loose.

Finger:  $10.88 \pm 0.12$  cm long and  $12.02 \pm 0.05$  cm in circumference, angular with 5 indistinct sides, apex not prominent, finger weight  $76.5 \pm 1.5$  g, contains well developed, black seeds.

Ripe fruit: colour dull yellow, rind thick, pulp colour white, soft, starchy, not fit for consumption, TSS  $24 \pm 0.075\%$ , total sugars  $13.65 \pm 0.13\%$ , reducing sugars  $10.25 \pm 0.18\%$ , non reducing sugars  $3.24 \pm 0.06\%$ , sugar/acid ratio  $48.55 \pm 1.5$ , keeping quality medium.



## 2. Genomic grouping of cultivars

The cultivars were scored taxonomically and their somatic chromosome numbers were determined, based on which they were grouped into genomic groups (Table 2). The cultivars which scored 15 to 23 were Musa acuminata cultivars, which included diploids (AA), triploids (AAA), and tetraploids (AAAA). The cultivars which scored 26 to 46 belonged to the genomic group AAB, around 49, to AB, 59 to 63 to ABB and around 67, to ABBB according to the taxonomic scoring system (Table 1). The somatic chromosomes of banana are presented in Plates 44-46.

The cultivars listed below were found to be identical in all the morphological characters. The taxonomic scores and chromosome numbers of these were also similar (Table 2).

'Gros Michel' and 'Pisang ambon'; 'Pedda pachcha' and 'Mouritius'; 'Galanamalu' and 'Pacha kadali'; 'Red banana' and 'Chenkadali'; 'Rasthali' and 'Suwandali'; 'Palayankodan' and 'Nalla chakkrakeli'; 'China' and 'Chinia'; 'Pacha nadan', 'Padaththi ponnani', 'Lady's finger' and 'Nendra kunnan'; 'Chara padaththi', 'Kali', 'Nendra vannan' and 'Redjasirre'; 'Chinali' and 'Pisang raja'; 'Adakka kunnan' and 'Poocha kunnan'; 'Valiya kunnan', 'Adukken and Poomkalli'; 'Ney poovan', 'Njali poovan' and 'Vadakkan kadali'; 'Pey kunnan', 'Pisang awak', 'KNR 2/75' and

'Nanguneri peyan'; 'Ney vanna', 'Ney mannan' and 'Boodi'; 'Kapok', 'Kapur' and 'Pisang mas'; 'Pacha bontha bathees', 'Beula' and 'Dakshinsagar'; 'Muthia', 'Kothia', 'Chakkia' and 'Burrharia'; 'Bluggoe', 'Nalla bontha' and 'Nalla bontha bathees'; 'Chetti and 'Ash monthan'; 'Kallu monthan' and 'Thella bontha'; 'Hybrid Sawai' and 'Neyvanna Sawai'.

Certain deviations were observed in the cultivars. 'Eraichivazhai' (AA), 'Sanna chenkadali' (AA), 'Krishna vazhai' (AB), 'Vanman' (AB), 'Virupakshi' (AB), 'Sirumalai' (AB), 'Mannan' (AAB), 'Malakali' (AAB), 'Agniswar' (AAB), 'Pacha nadan' (AAB), 'Kostha bontha' (AB), 'Venneettu mannan' (AB), 'Karpooravally' (ABB), 'Chirapunchi' (ABB) and 'Pey kunnan' (ABB), from the characteristic behaviour of the genomic groups (Table 2).

The cultivar 'Eraichivazhai' scored 26. Unlike Musa acuminata cultivars, this cultivar had *low* length/breadth ratio of bract. The cultivar 'Sanna chenkadali' scored 28. This cultivar resembled Musa acuminata cultivars in all the other characters except in the *low* length/breadth ratio of bract and brownish purple bract colour which were characteristics of Musa balbisiana. The chromosome counts ( $2n = 22$ ) confirmed the diploid nature of these cultivars and they were assigned to the

genomic group AA, though the total score was higher than that Musa acuminata cultivars.

In taxonomic scoring, cultivars 'Krishna vazhai', 'Vannan', 'Virupakshi', 'Sirumalai', 'Mannan', 'Malakali', 'Agniswar', and 'Pacha nadan' scored 41 to 43. The total score for the triploid cultivars of the genomic group AAB was 26 to 46. Somatic cell cytology revealed that 'Krishna vazhai', 'Vannan', 'Virupakshi', 'Sirumalai' and 'Agniswar' were diploids ( $2n = 22$ ) and 'Mannan', 'Malakali', and 'Pacha nadan' were triploids ( $2n = 33$ ). Thus the former cultivars were assigned to the genomic group AB and the latter to AAB.

Cultivars 'Kostha bontha' and 'Venneettu mannan' scored high (59) which was characteristic of ABB cultivars. On cytological examination they were found to be diploids ( $2n = 22$ ). Both the cultivars resembled each other, and had bunches oriented at an angle of more than  $60^\circ$  to the pseudostem, similar to 'Ney poovan', a typical AB cultivar.

Cultivars 'Karpooravally', 'Chirapunchi' and 'Pey kunnan' scored lower than the triploid ABB cultivars (56). The somatic chromosome number of these cultivars were  $2n = 33$  and they were assigned to the ABB group.



Plate 44 Somatic chromosomes of banana ( $2n = 22$ )  
(x 6000)

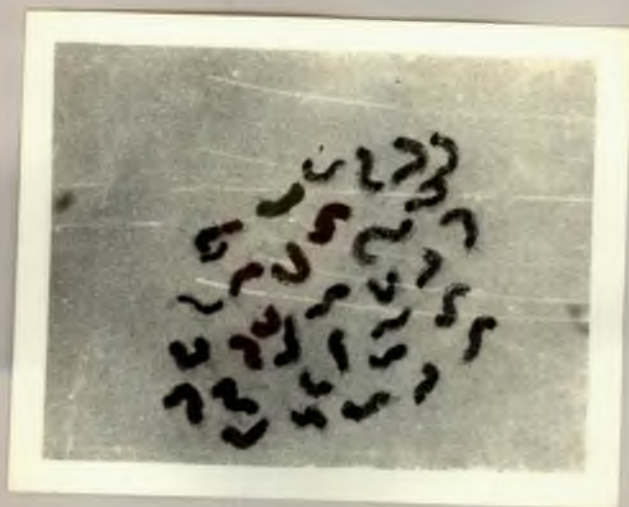


Plate 45 Somatic chromosomes of banana ( $2n = 33$ )  
(x 6000)



Plate 46 Somatic chromosomes of banana ( $2n = 44$ )  
( $\times 6000$ )

Table 2. Genomic grouping of banana cultivars

	Character/Plant part																	
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Cultivar	Pseudostem colour	Petiolar canal	Peduncle	Pedical	Ovules	Bract shoulder	Bract curling	Bract shape	Bract apex	Bract colour	Colour fading	Bract scars	Free tepal of male flower	Male flower colour	Stigma colour	Total score	Somatic chromosome number (2n)
<sup>AA</sup> Nemeral	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	17	22
Chingan	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	18	22
Rongat	2	2	2	2	1	1	1	1	1	1	1	2	1	1	1	1	19	22
Matti	2	2	2	2	1	1	1	1	1	1	1	3	1	1	1	1	20	22
Erachivazhal	2	1	1	2	3	1	5	2	2	1	2	1	1	1	1	1	26	22
Sanna Chenkadali	1	1	1	1	2	1	5	3	2	2	4	2	1	1	1	1	28	22
<sup>AAA</sup> Gros Michel	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	19	33
Pisang ambon	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	19	33
Hlghgate	1	1	1	1	1	1	1	1	2	2	2	2	1	1	1	1	19	33

(Contd.)

Table 2 (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<u>AAAA</u>																	
Bodles	1	1	1	1	1	1	1	2	2	2	2	1	1	2	1	20	44
Altafort																	
<sup>^</sup> <sup>^</sup> <sup>^</sup> Pedda pachcha	2	1	1	1	1	1	1	2	2	2	2	1	1	1	1	20	33
Mouritius	2	1	1	1	1	1	1	2	2	2	2	1	1	1	1	20	33
Basrai	2	1	1	1	1	1	1	2	2	2	2	1	1	1	1	20	33
Harichal	2	1	1	1	1	1	1	2	2	2	2	1	1	1	1	20	33
Sapumal onamalu	3	1	1	1	1	1	1	2	2	2	2	1	1	1	1	21	33
Manoranjithm	1	1	1	1	1	1	1	1	1	2	5	1	2	1	1	21	33
Galanamalu	1	1	1	1	1	1	1	3	2	3	3	1	1	1	1	22	33
Pacha kadali	1	1	1	1	1	1	1	3	2	3	3	1	1	1	1	22	33
Red banana	1	1	1	1	1	1	1	3	2	3	2	1	1	2	1	22	33
Chenkadali	1	1	1	1	1	1	1	3	2	3	2	1	1	2	1	22	33
Wather	1	2	1	1	1	1	2	2	2	3	2	1	2	1	1	23	33
Karim kadali	1	2	1	1	1	5	1	1	2	2	1	1	2	1	1	23	33
<u>AAB</u>																	
Thiruvananthapuram	3	3	2	1	1	5	2	3	3	3	2	1	2	2	2	35	33
Pacha chingan	3	2	4	2	1	5	1	3	3	3	4	2	1	1	1	36	33

(Contd.)



Table 2 (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Rasthali	2	3	1	1	1	5	2	3	2	3	3	1	3	3	3	36	33
Suwandai	2	3	1	1	1	5	2	3	2	3	3	1	3	3	3	36	33
Dudhsagar	2	3	2	1	1	5	2	3	2	5	5	1	1	2	2	37	33
Sugandhi	3	2	2	1	1	5	2	3	2	5	5	1	2	2	2	38	33
Palayankodan	2	3	2	1	1	5	2	3	2	5	5	1	2	2	2	38	33
Nalla chakkarakeli	2	3	2	1	1	5	2	3	2	5	5	1	2	2	2	38	33
China	3	3	2	1	1	5	2	3	2	5	5	1	2	2	2	39	33
China <u>AB</u>	3	3	2	1	1	5	2	3	2	5	5	1	2	2	2	39	33
Krishna vazhai	1	2	4	3	1	5	1	4	5	3	4	2	2	2	2	41	22
Vannan	3	2	4	1	1	5	1	4	5	3	4	2	2	2	2	42	22
Virupakshi	3	2	3	2	1	5	1	3	3	3	5	3	1	3	4	42	22
Sirumalai <u>AB</u>	3	2	3	2	1	5	1	3	3	3	5	3	2	3	4	43	22
Mannan	3	2	4	2	1	5	1	4	5	4	5	2	2	1	2	43	33
Malakali	3	3	4	3	1	5	1	2	2	5	4	2	2	3	3	43	33

(Contd.)

Table 2 (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<sup>AB</sup>																	
<b>Agniswar</b>	4	2	4	2	1	1	4	4	3	5	3	5	1	2	2	43	22
<sup>AAB</sup>																	
<b>Pacha nadan</b>	4	2	4	2	1	1	1	4	3	5	3	5	2	3	3	43	33
<b>Padaththi ponnani</b>	4	2	4	2	1	1	1	4	3	5	3	5	2	3	3	43	33
<b>Lady's finger</b>	4	2	4	2	1	1	1	4	3	5	3	5	2	3	3	43	33
<b>Nendra kuman</b>	4	2	4	2	1	1	1	4	3	5	3	5	2	3	3	43	33
<b>Nendra padaththi</b>	4	2	4	2	1	1	4	4	3	5	3	5	2	2	2	46	33
<b>Chara padaththi</b>	3	3	4	3	1	5	4	2	2	5	4	2	2	3	3	46	33
<b>Kali</b>	3	3	4	3	1	5	4	2	2	5	4	2	2	3	3	46	33
<b>Nendra vanna</b>	3	3	4	3	1	5	4	2	2	5	4	2	2	3	3	46	33
<b>Redjasirre</b>	3	3	4	3	1	5	4	2	2	5	4	2	2	3	3	46	33
<b>Kullan</b>	3	3	4	3	1	5	4	2	2	5	4	2	2	3	3	46	33
<b>Chinali</b>	3	2	2	2	1	5	3	5	4	3	5	3	3	3	2	46	33
<b>Pisang raja</b>	3	2	3	4	1	5	3	5	3	3	5	1	3	3	2	46	33
<b>Nendran</b>	3	2	4	3	1	5	3	4	4	4	5	2	2	2	2	46	33
<sup>AE</sup>																	
<b>Adakka kunnan</b>	3	4	4	4	1	5	1	4	5	2	5	2	1	5	3	49	22

(Contd.)

Table 2 (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Poocha kuman	3	4	4	4	1	5	1	4	5	2	5	2	1	5	3	49	22
Valiya kunnan	3	4	4	4	1	5	1	4	5	2	5	2	1	5	3	49	22
Adukkam	3	4	4	4	1	5	1	4	5	2	5	2	1	5	3	49	22
Poomkalli	3	4	4	4	1	5	1	4	5	2	5	2	1	5	3	49	22
Thaen kuman	4	4	4	4	1	5	1	4	5	2	5	2	1	5	3	50	22
Pedali moongil	3	4	4	4	1	5	1	4	5	2	5	2	-	-	-	-	22
Ney poovan	5	4	4	4	1	5	1	4	5	2	5	2	1	5	3	51	22
Njali poovan	5	4	4	4	1	5	1	4	5	2	5	2	1	5	3	51	22
Vadakkan kadali	5	4	4	4	1	5	1	4	5	2	5	2	1	5	3	51	22
Kostha bontha	5	3	2	2	5	5	5	4	4	4	4	5	3	4	4	59	22
Venneettamannan	5	3	2	2	5	5	5	4	4	4	4	5	3	4	4	59	22
<u>ABB</u>																	
Karpooravally	3	2	4	4	5	5	2	4	4	4	4	4	4	3	4	56	33
Chirapunchi	3	2	4	4	5	5	2	4	4	4	5	4	4	3	3	56	33
Pay kunnan	3	2	4	4	5	5	2	4	4	4	4	4	4	3	4	56	33
Pisang awak	3	2	4	4	5	5	2	4	4	4	4	4	4	3	4	56	33
KNR 2/75	3	2	4	4	5	5	2	4	4	4	4	4	4	3	4	56	33

(Contd.)

**Table 2 (Contd.)**

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
<b>Manguneri peyan</b>	3	2	4	4	5	5	2	4	4	4	4	4	4	4	3	4	56	33
<b>Walha</b>	5	4	4	5	5	5	3	3	4	3	4	4	4	4	4	4	61	33
<b>Ashy batheesa</b>	5	4	4	5	5	5	3	3	4	3	4	4	4	4	4	4	61	33
<b>Ney vannan</b>	5	3	4	5	5	5	3	3	4	3	4	4	5	5	5	5	63	33
<b>Ney mannan</b>	5	3	4	5	5	5	3	3	4	3	4	4	5	5	5	5	63	33
<b>Boodi</b>	5	3	4	5	5	5	3	3	4	3	4	4	5	5	5	5	63	33
<b>Alukehel</b>	5	3	4	5	5	5	3	3	4	3	4	4	5	5	5	5	63	33
<b>Kapok</b>	3	3	4	4	5	5	4	4	4	5	4	4	4	4	5	5	63	33
<b>Kapur</b>	3	3	4	4	5	5	4	4	4	5	4	4	4	4	5	5	63	33
<b>Pisang mas</b>	3	3	4	4	5	5	4	4	4	5	4	4	4	4	5	5	63	33
<b>Jurmoney kunthali</b>	5	4	3	2	5	5	5	4	4	4	4	4	5	3	5	5	63	33
<b>Peyan</b>	4	4	4	5	5	5	3	3	4	3	4	4	4	5	5	5	63	33
<b>Pacha bontha bathees</b>	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	4	63	33
<b>Beula</b>	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	4	63	33
<b>Dakshin sagar</b>	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	4	63	33

(Contd.)

Table 2 (Contd.)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Muthia	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Kothia	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Chakkia	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Burrharia	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Kari bontha	4	4	5	4	5	5	3	4	3	5	4	4	4	4	5	63	33
Malai monthan	5	4	5	4	5	5	3	4	3	5	4	4	3	4	5	63	33
Bluggoe	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Nalla bontha	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Nalla bontha bathees	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Chetti	5	4	5	4	5	5	3	3	4	5	4	4	4	4	4	63	33
Ash monthan	5	4	5	4	5	5	3	3	4	5	4	4	4	4	4	63	33
Kallu monthan	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
Thella bontha	5	4	5	4	5	5	3	4	3	5	4	4	4	4	4	63	33
<sup>A</sup> BBB Hybrid Sawai	5	5	5	5	5	5	5	4	4	5	4	4	4	4	4	68	44
Neyvanna Sawai	5	5	5	5	5	5	5	4	4	5	4	4	4	4	4	68	44
<sup>B</sup> B Elavazhai	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	75	22

### 3. Effect of ploidy and genomic constitution on quantitative characters of banana cultivars

The mean values of the 26 characters of the different ploidy groups, the genomic groups under each ploidy level and the cultivars under each genomic group are given in Tables 3 to 12. The analysis of variance of the characters are given in appendices 1-5. Sixty two cultivars were used for the analysis excluding 'Matti' and 'Nendran', since sufficient number of plants were not available in these two cultivars. The following comparisons were made to study the effect of ploidy level and genomic constitution on the characters.

1. The diploids were compared with the polyploids
2. Within the polyploids, the triploids were compared with the tetraploids.
3. The genomic groups within the diploids (AA, AB and BB), the triploids (AAA, AAB and ABB) and the tetraploids (AAAA and ABBB) were compared.

#### 3.1. Growth parameters

The mean values of the growth parameters like the height, the girth, the number of leaves, the leaf area per plant and the petiole length of the diploids, the polyploids which included triploids and tetraploids, and of the genomic groups under each ploidy level are presented in Table 3. The growth parameters of cultivars belonging to different genomic groups are presented in Table 4.

Table 3 Effect of ploidy and genome on the growth parameters of banana cultivars

Groups	Growth parameters				
	Height (cm)	Girth (cm)	Leaves per plant	Leaf area per plant (m <sup>2</sup> )	Petiole length (cm)
Diploids	247.81	54.72	28.47	24.12	46.78
Polyploids	241.80	57.44	27.79	26.76	45.70
C.D. (0.05)	1.81	2.39	0.22	0.04	0.34
<u>Polyploids</u>					
Triploids	242.54	57.45	27.96	27.02	45.39
Tetraploids	226.25	57.13	24.38	21.98	52.50
C.D. (0.05)	4.69	6.18	0.87	0.10	0.87
<u>Diploids</u>					
AA	183.30	46.20	24.75	17.22	35.90
AB	257.71	56.00	27.40	24.73	49.63
BB	451.50	82.00	60.00	51.24	67.00
C.D. (0.05)	7.34	9.66	0.88	0.16	1.37
<u>Triploids</u>					
AAA	217.00	53.70	27.70	25.33	35.64
AAB	224.14	55.56	25.05	25.65	43.14
ABB	274.21	61.34	30.53	29.24	53.55
C.D. (0.05)	3.05	4.02	0.36	0.07	0.57
<u>Tetraploids</u>					
AAAA	240.00	56.13	22.50	21.94	57.00
ABBB	212.50	58.00	26.25	21.02	48.00
C.D. (0.05)	9.17	12.08	1.10	0.10	1.71

Table 4 Mean values of the growth parameters of 62 cultivars of banana belonging to different genomic groups

Cultivars	Growth parameters				
	Height (cm)	Girth (cm)	Leaves per plant	Leaf area per plant (m <sup>2</sup> )	Petiole length (cm)
1	2	3	4	5	6
<b>AA</b>					
Namarai	128.00	36.25	23.25	12.00	37.75
Chingan	207.50	42.75	26.75	21.10	38.50
Tongat	179.50	44.00	25.50	17.86	28.25
Eraichivazhai	199.00	60.50	26.50	17.61	28.25
Sanna chenkadali	202.50	47.50	21.75	17.54	46.75
<b>AB</b>					
Krishna vazhai	237.00	58.00	21.75	19.93	34.25
Vannan	227.00	52.50	18.25	17.33	32.75
Virupakshi	251.00	54.00	19.25	17.51	53.75
Sirumalai	229.00	52.50	21.00	17.25	33.00
Agniswar	232.50	44.80	29.50	23.82	37.25
Adakka kunnan	246.00	62.25	31.25	31.87	67.50
Valiya kunnan	234.50	59.50	29.50	33.13	59.50
Thaen kunnan	245.00	51.50	36.00	34.82	39.25
Padali moongil	232.50	46.25	28.25	18.14	60.75
Ney poovan	280.50	55.50	27.25	19.36	56.75
Kostha bontha	315.50	69.50	35.67	28.88	54.25
Venneettu mannan	362.00	77.50	31.00	34.22	66.75
<b>BB</b>					
Elavazhai ( <i>M. balbisiana</i> )	451.50	82.00	60.00	51.24	67.75
<b>AAA</b>					
Gros Michel	282.00	57.00	29.00	34.16	42.00
Highgate	197.50	60.50	28.00	34.19	32.50

(Contd.)



Table 4 (Contd.)

1	2	3	4	5	6
Pedda pachcha	158.00	42.50	21.25	17.76	27.50
Basrai	132.00	47.00	31.75	19.69	27.25
Harichal	212.50	44.50	21.50	19.15	30.00
Sapumal anamalu	262.50	58.00	31.50	32.65	33.25
Manoranjithm	250.75	54.00	32.50	33.26	34.50
Galanamalu	274.50	71.50	28.00	26.73	59.25
Red banana	287.00	69.25	31.17	28.83	46.50
Wather	174.00	44.50	25.50	15.66	31.00
Karim kadali	186.50	42.00	24.50	18.50	28.25
<b><u>AAB</u></b>					
Thiruvananthapuram	210.00	48.75	23.75	26.59	37.75
China	233.50	54.50	33.00	26.70	41.75
Rasthali	264.00	66.75	32.84	30.30	54.00
Dudhsagar	251.00	55.00	26.75	36.71	63.25
Sugandhi	283.00	63.00	29.67	37.69	48.25
Palayankodan	228.00	53.75	25.00	33.60	45.00
Pacha chingan	208.50	51.50	21.25	21.25	35.00
Mannan	212.50	52.50	19.50	17.41	32.65
Malakali	214.00	53.00	23.75	20.16	34.00
Pacha nadan	202.50	56.00	19.00	14.11	32.75
Nendra padaththi	222.50	55.75	18.50	19.20	44.50
Chara padaththi	212.50	51.25	26.75	26.14	51.00
Kullan	159.00	53.75	25.75	19.40	25.25
Chinali	241.00	63.75	25.25	29.82	58.75
<b><u>ABB</u></b>					
Karpooravally	286.00	63.00	30.25	27.28	51.50
Chirapunchi	327.00	85.25	38.25	46.84	59.75
Pey kunnan	307.00	69.50	34.00	33.45	50.65

(Contd.)

Table 4 (Contd.)

1	2	3	4	5	6
Walha	264.00	69.00	31.75	31.61	57.50
Ashy batheesa	310.00	62.00	29.75	28.53	63.50
Ney vanna	225.00	71.00	34.85	31.10	59.25
Alukehel	204.75	61.75	28.75	24.87	42.75
Kapok	361.50	72.50	26.00	37.60	64.25
Jurmoney kunthali	338.00	74.50	37.10	39.24	58.50
Peyan	300.50	62.00	34.00	35.13	53.75
Pacha bontha bathees	247.00	54.50	35.75	24.84	51.50
Muthia	232.50	56.25	27.25	28.87	42.75
Kari bontha	277.00	52.75	22.50	17.94	53.75
Malai monthan	225.50	49.00	22.00	17.35	54.75
Bluggoe	249.25	54.00	28.50	23.28	46.25
Chetti	259.00	54.25	27.75	21.05	46.75
Kallu monthan	258.50	64.50	30.50	28.42	53.25
<b>AAAA</b>					
Bodles Altafort	240.00	56.25	22.50	21.94	57.00
<b>ABBB</b>					
Hybrid Sawai	212.50	58.00	26.25	21.02	48.00
C.D. (0.05)	9.17	120.08	1.09	0.10	1.712

The diploids were significantly superior to the polyploids in plant height, number of leaves per plant and petiole length while the polyploids recorded higher values in girth and leaf area per plant. Among the genomic groups 'BB' recorded the highest values in all the characters. The genomic groups and the cultivars under each genomic group differed significantly in all the characters.

### 3.1.1. Plant height

When the diploids and the polyploids were compared, the diploids (247.81 cm) were significantly taller than the polyploids (241.80 cm). Within the polyploids the triploids (242.54 cm) were significantly taller than the tetraploids (226.25 cm).

Among the genomic groups within the diploids, variation in height was significant. Musa balbisiana (BB) was the tallest (451.50 cm) followed by the genomic groups AB (257.71 cm) and AA (183.30 cm).

Within the triploids also, the genomic groups varied significantly among themselves. The tallest among the three genomic groups, ABB, recorded the maximum height (274.21 cm) followed by AAB (224.14 cm) and AAA (217.00 cm).

Within the tetraploids, the genomic group AAAA (240.00 cm) was significantly superior to ABBB (212.50 cm) in plant height.

Among the 62 cultivars studied, the plant height varied from 128.00 cm in 'Namarai' (AA) to 451.50 cm in 'Elavazhai' (BB).

In the genomic group AA, the maximum height recorded was in 'Chingan' (207.50 cm). In AB, it varied from 227.00 cm in 'Vannan' to 362.00 cm in 'Venneettu mannan'. In the genomic group AAA the variation in height was from 132.00 cm in 'Basrai' to 287.00 cm in 'Red banana', while in AAB, plant height varied from 159.00 cm in 'Kullan' to 264.00 cm in 'Rasthali'. In the group ABB, the tallest cultivar was 'Kapok' (361.50 cm) and the dwarfest was 'Ney vannan' (225.00 cm) and 'Malai Monthan' (225.50 cm). The tetraploid 'Bodles Altafort' was 240.00 cm tall at flowering, while 'Hybrid Sawai' (ABBB) was only 212.50 cm tall.

### 3.1.2. Plant girth

The polyploids (57.44 cm), as compared to the diploids (54.72 cm), showed significantly greater girth. Within the polyploids, the triploids and the tetraploids were on par for plant girth.

Within the diploids, the genomic groups showed a wide and significant variation for plant girth. In Musa balbisiana (BB), the mean plant girth was 82.00 cm followed by the genomic groups AB (56.00 cm) and AA (46.20 cm).

Within the triploids, the genomic group ABB (61.34 cm) differed significantly from AAB (55.56 cm) and AAA (53.70 cm) while AAB and AAA were on par.

Within the tetraploids the two genomic groups did not show significant difference in plant girth.

Among the 62 cultivars, plant girth varied from 36.25 cm in 'Namarai' (AA) to 85.25 cm in 'Chirapunchi' (ABC)

Among the cultivars belonging to the genomic group AA, 'Braichivazhai' recorded the maximum girth (60.50 cm). Among the cultivars of the genomic group AB, the girth varied from 44.80 cm in 'Agniswar' to 77.50 cm in 'Venneettu maman'.

Among the triploid Musa aguinata cultivars, the variation in girth was from 42.00 cm in 'Karim kadali' to 71.50 cm in 'Galanamalu'. In the genomic group AAB, plant girth varied from 48.75 cm in 'Thiruvananthapuram' to 66.75 cm in 'Rasthali' and among the ABB cultivars, from 49.00 cm in 'Malai Monthan' to 85.25 cm in 'Chirapunchi'.

'Bodles Altafort' (AAA) recorded a girth of 56.25 cm and Hybrid Sawai (ABBB), 58.00 cm at the time of flowering.

### 3.1.3. Leaves per plant

The diploids (29.47), compared to the polyploids (27.79) produced significantly more leaves per plant. Within the polyploids, the total leaf production was

significantly lower in the tetraploids (24.38) than in the triploids (27.96).

The diploid genomic groups showed significant variation in the total number of leaves. It varied from 24.75 in AA to 60.00 in Musa balbisiana (BB) while in AB the total leaves produced was 27.40.

The genomic groups within the triploids also showed significant variation in the leaves per plant. The group ABB produced the largest number of leaves per plant (30.53), followed by AAA (27.70) and AAB (25.05).

Within the two tetraploid groups, ABBB (26.25) produced significantly larger number of leaves than AAAA (22.50).

Among the 62 cultivars studied, the leaves per plant varied from 18.25 in 'Vannan' (AB) to 60.00 in 'Elavashai' (Musa balbisiana - BB).

Though the cultivars within the group AA varied significantly with respect to leaves per plant, the variation was not so wide as in the other genomic groups. The variation was from 21.75 in 'Sanna chenkadali' to 26.75 in 'Chingan'. Among the cultivars of genomic constitution AB, 'Vannan' (18.25) produced the least number of leaves and 'Thaen kunnan' (36.00) produced the largest.

Among the cultivars in the genomic group AAA, leaves per plant varied from 21.25 in 'Pedda pachcha' to 32.50 in 'Manoranjithm', while in AAB it varied from 18.50 in 'Nendra padaththi' to 33.00 in 'China'. Among the ABB cultivars, 'Chirapunchi' had the largest number of leaves (38.25), while the least was found in 'Malai monthan' (22.00).

'Hybrid Sawai' (ABBB) produced 26.25 leaves per plant, while 'Bodles Altafort' (AAAA) produced only 22.50.

#### 3.1.4. Leaf area per plant

The polyploids ( $26.76 \text{ m}^2$ ) compared to the diploids ( $24.12 \text{ m}^2$ ) had significantly more total leaf area per plant. Within the polyploids, there was a significant variation between the triploids ( $27.02 \text{ m}^2$ ) and the tetraploids ( $21.98 \text{ m}^2$ ).

The genomic groups within the diploids showed a significant variation. The leaf area per plant was  $51.24 \text{ m}^2$  in Musa balbisiana (BB) as against  $24.73 \text{ m}^2$  in AB and  $17.22 \text{ m}^2$  in AA.

The genomic groups within the diploids also showed a significant variation in leaf area per plant. The genomic group ABB recorded the largest leaf area per plant ( $29.24 \text{ m}^2$ ), followed by AAB ( $25.65 \text{ m}^2$ ) and AAA ( $25.33 \text{ m}^2$ ).

Within the tetraploids, the genomic group AAAA recorded significantly more leaf area per plant ( $21.94 \text{ m}^2$ ) than ABBB ( $21.02 \text{ m}^2$ ).

Among the 62 cultivars belonging to the different genomic groups, the leaf area per plant varied from  $12.00 \text{ m}^2$  in 'Namarai' (AA) to  $51.24 \text{ m}^2$  in 'Elavazhai' (BB). Among the cultivars of the group AA, 'Chingan' recorded the highest leaf area ( $21.10 \text{ m}^2$ ) and among the diploid cultivars of the genomic group AB, it varied from  $17.25 \text{ m}^2$  in 'Sirumalai' to  $34.82 \text{ m}^2$  in 'Thaen kunnan'.

Among the Musa acuminata triploids (AAA), leaf area per plant varied from  $15.66 \text{ m}^2$  in 'Wather' to  $34.19 \text{ m}^2$  in 'Highgate'; among the cultivars of the group AAB, it varied from  $14.11 \text{ m}^2$  in 'Pacha nadan' to  $37.69 \text{ m}^2$  in 'Sugandhi' and among the ABB cultivars from  $17.35 \text{ m}^2$  in 'Malai monthan' to  $46.84 \text{ m}^2$  in 'Chirapunchi'.

Bodles Altafert (AAAA) recorded a total leaf area of  $21.94 \text{ m}^2$  and 'Hybrid Sawai' (ABBB),  $21.02 \text{ m}^2$ .

### 3.1.5. Petiole length

The diploids ( $46.78 \text{ cm}$ ) had significantly longer petioles than the polyploids ( $45.70 \text{ cm}$ ). Within the polyploids, the tetraploids had longer petioles ( $52.50 \text{ cm}$ ) than the triploids ( $45.39 \text{ cm}$ ).

Within the diploids, the genomic groups varied significantly in petiole length. Musa balbisiana (BB) had



the longest petioles (67.00 cm) followed by the groups AB (49.63 cm) and AA (35.90 cm).

Within the triploids, the genomic group ABB had the longest petiole (53.55 cm) and AAA the shortest (35.64 cm). The genomic group AAB recorded a mean petiole length of 43.14 cm.

Within the tetraploids, the two genomic groups differed significantly in petiole length. Between the two, AAAA had longer petioles (57.00 cm) than ABBB (48.00 cm).

Among the 62 cultivars, petiole length varied from 25.25 cm in 'Kullan' (AAB) to 67.75 cm in 'Elavashai' of genomic constitution BB.

Among the cultivars of the genomic group AA, petiole length varied from 28.25 cm ('Tongat' and 'Eraichi vashai') to 46.75 cm ('Sanna chenkadali'). Among the cultivars of the genomic group AB, petiole length varied from 32.75 cm in 'Vannan' to 67.50 cm in 'Adakka kunnan'.

Among the cultivars of the genomic group AAA, petiole length varied from 27.25 cm in 'Basrai' to 59.25 cm in 'Galanamalu'. Among the AAB cultivars it varied from 25.25 cm in 'Kullan' to 63.25 cm in 'Dudhsagar' and among the ABB cultivars from 42.75 cm 'Alukehel' and 'Muthia' to 64.25 cm in 'Kapok'.

The petiole length in 'Bodles Altafort' (AAAA) was 57.00 cm and in 'Hybrid Sawai' (ABBB) it was 48.00 cm.

### 3.2. Duration

The duration from planting to flowering (planting to flowering interval) and from flowering to harvest (flowering to harvest interval) of the diploids and the polyploids (triploids and tetraploids) and of the genomic groups under each ploidy level are presented in Table 5. The duration of individual cultivars belonging to the different genomic groups are presented in Table 6. Wide and significant variations were observed among ploidy levels, genomic groups and cultivars.

#### 3.2.1. Planting to flowering interval

When the diploids and the polyploids were compared, the diploids took longer from planting to flowering (215.56 days) than the polyploids (196.06 days). Within the polyploids, the duration was significantly more in the tetraploids (205.52 days) than in the triploids (195.62 days).

Within the diploids, the genomic groups differed significantly with respect to time taken to flower. The longest duration was of Musa balbisiana (432.50 days) and the shortest of AA (199.50 days), while AB recorded a mean duration of 204.17 days from planting to flowering.

Table 5 Effect of ploidy and genome on the duration of banana cultivars

Groups	Duration of the crop (days)	
	Planting to flowering interval	Flowering to harvest interval
Diploids	215.56	95.92
Polyploids	196.06	98.74
C.D. (0.05)	0.88	0.70
<u>Polyploids</u>		
Triploids	195.62	98.80
Tetraploids	205.52	97.50
C.D. (0.05)	2.27	1.81
<u>Diploids</u>		
AA	199.50	87.10
AB	204.17	96.96
BB	432.50	127.50
C.D. (0.05)	4.91	3.12
<u>Triploids</u>		
AAA	204.59	103.09
AAB	192.00	107.88
ABB	192.72	101.24
C.D. (0.05)	1.47	1.17
<u>Tetraploids</u>		
AAAA	205.00	100.00
ABBB	205.50	95.00
C.D. (0.05)	4.43	3.53

Table 6 Mean values of the duration of 62 cultivars of banana belonging to different genomic groups

Cultivars	Duration of the crop (days)	
	Planting to flowering interval	Flowering to harvest interval
1	2	3
<b>AA</b>		
Namarai	182.50	85.00
Chingan	205.00	63.00
Tongat	206.00	103.50
Eraichivazhai	203.00	93.00
Sanna chenkadali	201.00	91.00
<b>AB</b>		
Krishna vazhai	170.50	71.00
Vannan	174.00	70.00
Virupakshi	174.00	70.00
Sirumalai	169.50	70.50
Agniswar	176.50	107.50
Adakka kunnan	232.50	114.50
Valiya kunnan	233.50	99.50
Thaen kunnan	227.50	123.50
Padali moongil	228.00	114.50
Ney poovan	186.00	110.00
Kostha bontha	232.50	107.50
Venneettu mannan	245.50	105.00
<b>BB</b>		
Elavazhai ( <i>M. balbisiana</i> )	432.50	127.50

(Contd.)

Table 6 (Contd.)

1	2	3
<b>AAA</b>		
Gros Michel	198.00	107.00
Highgate	198.00	109.00
Pedda pacheha	173.50	105.00
Basrai	187.50	105.50
Harichal	185.00	106.50
Sapumal Ganamalu	196.50	105.50
Manoranjithm	234.00	95.50
Galanamalu	237.50	117.00
Red banana	232.50	106.00
Wather	203.50	92.00
Karim kadali	204.50	84.50
<b>AAB</b>		
Thiruvananthapuram	207.00	94.50
China	229.00	137.00
Rasthali	224.50	114.00
Dudhsagar	207.50	116.50
Sugandhi	207.50	92.00
Palayankodan	163.50	100.50
Pacha chingan	177.00	81.00
Mannan	171.50	86.00
Malakali	162.50	82.50
Pacha nadan	185.50	75.50
Nendra padaththi	181.00	82.50
Chara padaththi	167.50	74.00
Kullan	172.50	95.00
Chinali	231.50	93.50

(Contd.)



Table 6 (Contd.)

1	2	3
<b><u>ABB</u></b>		
Karpooravally	225.00	117.00
Chirapunchi	232.50	115.50
Pey kunnan	213.00	114.00
Walha	180.50	99.50
Ashy batheesa	187.50	101.00
Ney vannan	168.50	104.50
Alukehel	167.50	105.00
Kapok	233.50	93.50
Jurmoney kunthali	237.50	116.50
Peyan	233.50	106.00
Muthia	174.00	94.50
Kari bontha	171.50	86.00
Malai monthan	167.00	86.00
Bluggoe	169.50	94.00
Chetti	169.50	100.00
Kallu monthan	174.50	93.50
<b><u>AAAA</u></b>		
Bodles Altafort	205.00	100.00
<b><u>ABBB</u></b>		
Hybrid Sawai	208.50	95.00
C.D. (0.05)	4.43	3.53

The genomic groups differed significantly within the triploids. The planting to flowering interval in AAA was 204.59 days which was significantly more than that of ABB (192.72 days) and AAB (192.00 days).

Within the tetraploids, the two groups did not significantly vary for time taken <sup>from</sup> planting to flowering.

Among the 62 cultivars, duration from planting to flowering varied from 162.50 days in 'Malakali' (AAB) to 432.50 days in 'Elavashai' (BB).

Among the cultivars belonging to the group AA, the planting to flowering interval varied from 182.50 days in 'Namari' to 206.00 days in 'Tongat'. In AB cultivars, it ranged from 169.50 days ('Sirumalai') to 245.50 days ('Venneettu mannan').

The duration from planting to flowering varied in the genomic group AAA from 173.50 days in 'Pedda pachcha' to 237.50 days in 'Galanamalu' and in AAB, from 162.50 days in 'Malakali' to 231.50 days in 'Chinali' while in ABB it varied from 167 days in 'Malai monthan' to 237.50 days 'Jurmoney kunthali'.

In 'Bodles Altafort' (AAAA) planting to flowering interval was 205.00 days while in 'Hybrid Sawai' (ABBB) it was 208.50 days.

### 3.2.2. Flowering to harvest interval

The diploids and the polyploids were compared for the days taken from flowering to harvest. The polyploids took longer (98.74 days) than the diploids (95.92 days). Within the polyploids, flowering to harvest interval did not vary significantly between the triploids and the tetraploids.

The genomic groups within the diploids showed significant variation. In Musa balbisiana (BB), the flowering to harvest interval was 127.50 days as against 96.96 days in AB and 87.10 days in AA.

The genomic groups within the triploids also differed significantly for the time from flowering to harvest. It was the highest in AAB (107.88 days) followed by AAA (103.09 days) and ABB (101.24 days).

Within the tetraploids, the genomic groups varied significantly. Flowering to harvest interval was 100 days in AAAA and 95 in ABBB.

The 62 cultivars studied showed a wide and significant variation for the time taken from flowering to harvest. It varied from 63.00 days in 'Chingan' to 137.00 days in 'China'.

Among the cultivars belonging to the diploid Musa acuminata group (AA), the flowering to harvest



**Table 7** Effect of ploidy and genome on the bunch characters of banana cultivars

Groups	Bunch weight (kg)	Hand weight (g)	Number of hands	Number of fingers
Diploids	6.86	762.43	8.07	108.08
Polyploids	8.83	1245.15	7.86	102.34
C.D. (0.05)	0.15	54.30	0.33	2.98
<u>Polyploids</u>				
Triploids	8.59	1236.11	7.96	103.48
Tetraploids	7.50	1435.00	5.75	78.50
C.D. (0.05)	0.38	140.72	0.83	7.72
<u>Diploids</u>				
AA	6.20	743.15	8.28	108.50
AB	7.13	761.08	8.25	112.54
BB	7.00	875.00	5.00	52.50
C.D. (0.05)	0.60	219.98	1.30	12.07
<u>Triploids</u>				
AAA	8.84	1602.95	6.68	79.36
AAB	8.41	1059.29	8.04	101.71
ABB	9.32	1141.35	8.74	120.53
C.D. (0.05)	0.25	91.45	0.54	5.02
<u>Tetraploids</u>				
AAAA	9.25	1900.00	5.50	64.00
ABBB	5.75	970.50	6.00	93.00
C.D. (0.05)	0.75	274.98	1.62	15.09

Table 8 Mean values of the bunch characters of 62 cultivars of banana belonging to different genomic groups

Cultivars	Bunch weight (kg)	Hand weight (g)	Number of hands	Number of fingers
1	2	3	4	5
<b>AA</b>				
Namarai	3.00	70.75	6.25	86.50
Chingan	4.25	775.00	5.00	61.00
Tongat	10.25	585.00	12.75	231.50
Eraichivazhai	6.25	1025.00	6.00	53.50
Sanna chenkadali	7.25	1260.00	10.88	110.00
<b>AB</b>				
Krishna vazhai	5.25	835.00	5.50	77.50
Vannan	3.75	520.00	5.75	80.50
Virupakshi	4.00	475.00	5.00	63.00
Sirumalai	4.00	765.00	6.25	73.50
Agniswar	5.00	432.50	6.50	74.00
Adakka kunnan	5.50	694.00	10.00	125.50
Valiya kunnan	10.25	1250.00	11.50	160.00
Thaen kunnan	7.25	675.00	9.50	108.50
Padali moongil	2.50	405.00	3.50	19.50
Ney poovan	10.00	925.00	11.50	187.50
Kostha bontha	12.75	902.50	11.50	172.00
Vermeettu mannan	15.25	1250.00	12.50	209.00
<b>BB</b>				
Elavazhai ( <i>M. balbisiana</i> )	7.00	875.00	5.00	52.50
<b>AAA</b>				
Gros Michel	9.75	1160.00	7.45	97.00
Highgate	13.25	1375.00	10.00	112.50
Pedda pachcha	8.00	1360.00	6.00	76.00

(Contd.)

Table 8 (Contd.)

1	2	3	4	5
Basrai	5.50	825.50	6.00	83.00
Harichal	9.25	21.25	8.00	82.00
Sapumal anamalu	6.25	1500.00	7.00	78.50
Manoranjithm	5.75	1100.00	6.50	56.50
Galanamalu	15.25	2725.00	4.50	77.00
Red banana	12.50	1862.50	5.50	76.50
Wather	5.75	1100.00	6.00	58.00
Karim kadali	6.00	2500.00	6.50	76.00
<b><u>AAB</u></b>				
Thiruvananthapuram	11.25	950.00	7.50	91.00
China	7.25	715.00	9.50	138.50
Rasthali	12.75	1340.00	10.50	117.00
Dudhsagar	12.75	1310.00	13.50	177.50
Sugandhi	10.25	1275.00	9.50	125.00
Palayankoden	13.25	1300.00	10.50	188.50
Pacha chingan	6.25	740.00	6.50	84.50
Mannan	6.25	785.00	7.50	73.50
Malakali	9.00	1475.00	5.50	82.50
Pacha nadan	5.75	800.00	6.50	51.00
Nendra padaththi	3.75	990.00	3.50	49.00
Chara padaththi	7.50	1250.00	7.00	89.00
Kullan	3.75	390.00	6.50	72.00
Chinali	8.00	1600.00	8.50	85.00
<b><u>ABB</u></b>				
Karpooravally	11.50	852.50	11.25	170.00
Chirapunchi	14.25	464.00	11.55	193.50
Pey kunnan	10.50	975.00	10.50	170.50
Walha	14.75	970.00	16.50	203.00

(Contd.)

Table 8 (Contd.)

1	2	3	4	5
Ashy batheesa	14.75	990.00	16.50	201.00
Ney vannan	6.50	1050.00	4.50	79.50
Alukehel	4.75	1100.00	6.50	86.50
Kapok	8.00	990.00	6.00	112.50
Jurmoney kunthali	14.00	1100.00	12.50	181.00
Peyan ✓	6.75	1100.00	4.50	77.50
Pacha bontha bathees	9.75	1325.00	12.25	188.00
Muthia	9.75	1250.00	8.75	122.00
Kari bontha	7.25	1730.00	5.00	46.00
Malai monthan ✓	8.75	1950.00	7.50	78.00
Bluggoe	7.50	1567.50	4.50	42.00
Chetti	7.25	1104.00	4.00	40.10
Kallu monthan	3.00	450.00	6.00	57.50
<b>AAAA</b>				
Bodles Altafort	9.25	1900.00	5.50	64.00
<b>ABBB</b>				
Hybrid Sawai	5.75	970.00	6.00	93.00
C.D. (0,05)	0.75	274.98	1.62	15.089

interval varied from 63.00 days ('Chingan') to 103.50 days (Tongat). In AB the shortest duration was in 'Vannan' and 'Virupakshi' (70.00 days) and the longest duration in 'Thaen kunnan' (123.50 days). In 'Elavazhai' (3B) the days from flowering to harvest was the highest among the diploids, being 127.50 days.

Among the cultivars of the triploid Musa acuminata group (AAA), the duration from flowering to harvest varied from 84.50 days in 'Karim kadali' to 117 days in 'Galanamalu'.

### 3.3. Bunch characters

The mean values of bunch weight, hand weight, the number of hands and fingers of different ploidy levels and genomic groups, under each ploidy level, are presented in Table 7. The bunch characters of cultivars belonging to the different genomic groups are presented in Table 8. In bunch weight and hand weight the polyploids recorded significantly higher values than the diploids while in number of hands and fingers the diploids were superior to the polyploids. The genomic groups and the cultivars differed significantly with respect to these characters.

#### 3.3.1. Bunch weight

When the polyploids and the diploids were compared with respect to the bunch weight, the polyploids (8.83 kg) were significantly superior to the diploids (6.86 kg).

Within the polyploids, the triploids (8.59 kg) recorded significantly higher bunch weight than the tetraploids (7.50 kg).

Within the diploids, the genomic groups AB (7.13 kg) and BB (7.00 kg) were on par in bunch weight. The two genomic groups were significantly superior to the genomic group AA (6.20 kg). Within the triploids, the genomic groups differed significantly in bunch weight. The group ABB recorded the maximum value (9.32 kg), followed by AAA (8.84 kg) and AAB (8.41 kg). Within the tetraploids, the genomic group AAAA recorded a significantly higher value for bunch weight (9.26 kg) than ABBB (5.75 kg).

The cultivars differed significantly for bunch weight, varying from 2.5 kg in 'Padali moongil' to 15.25 kg in 'Venneettu mannan' and 'Galanamalu'.

Among the cultivars of the genomic group AA, bunch weight varied from 3.00 kg ('Namarai') to 10.25 kg ('Tongat') and in AB from 2.50 kg ('Padali moongil') to 15.25 kg ('Venneettu mannan'). In 'Elavazhali' the bunch weight was 7 kg.

Among the triploid Musa acuminata cultivars, the bunch weight varied from 5.5 kg in 'Basrai' to 15.25 kg in 'Galanamalu'. Among the AAB cultivars the variation in bunch weight was from 3.75 kg in 'Nendra padaththi' and 'Kullan' to 12.75 kg in 'Rasthali' and 'Dudhsagar' and

among the ABB cultivars from 3 kg ('Kallu monthan') to 14.75 kg ('Walha' and 'Ashy batheesa').

Within the tetraploids 'Bodles Altafort' (AAAA) had heavier bunches (9.25 kg) than 'Hybrid Sawai' (5.75 kg) which belonged to the genomic group ABBB.

### 3.3.2. Hand weight

The polyploids (1245.15 g) were significantly superior to the diploids (762.43 g) in hand weight. Within the polyploids, the tetraploids (1435 g) had a higher hand weight than the triploids (1236.11 g).

Among the diploids the genomic groups did not differ significantly in hand weight. Musa balbisiana (BB) recorded the highest value (875 g) among the three diploid genomic groups.

Within the triploids, the genomic groups differed significantly with respect to the hand weight. The triploid Musa acuminata group (AAA) recorded a significantly higher value (1602.95 g) than ABB (1141.35 g) and AAB (1059.29 g), which also differed significantly between themselves.

Within the tetraploids, 'Bodles Altafort' (AAAA) with an average hand weight of 1900.00 g was significantly superior to 'Hybrid Sawai' (ABBB) with an average weight of 970.50 g.

The 62 cultivars showed wide and significant variation among themselves with respect to hand weight, from 70.75 g in 'Namarai' (AA) to 2725.00 g in 'Galanamalu' (AAA).

Among the cultivars of the genomic group AA, 'Sanna chenkadali' had the heaviest hands (1260.00 g). Among the AB cultivars, hand weight varied from 405.00 g in 'Pedali moongil' to 1250.00 g in 'Valiya kunnan' and 'Venneettu mannan'. The cultivar 'Elavazhai' representing the genomic group BB, recorded 875.00 g as the mean hand weight.

Among the cultivars belonging to the triploid Musa acuminata group, the mean hand weight varied from 825.00 g in 'Basrai' to 2725.00 g in 'Galanamalu'; among the AAB cultivars from 300.00 g in 'Kullan' to 1600 g in 'Chinali' and among the ABB cultivars from 450.00 g in 'Kallu monthan' to 1950.00 g in 'Malai monthan'.

The tetraploids showed a wide and significant variation in mean hand weight from 970.00 g in 'Hybrid Sawai' (ABBB) to 1900.00 g in 'Bodles Altafort' (AAAA).

### 3.3.3. Number of hands

When the diploids (8.07) and the polyploids (7.86) were compared, no significant difference was observed between them in the average hands per bunch. Within the



polyploids, the triploids (7.96) were significantly superior to the tetraploids (5.75).

Within the diploids, the genomic groups AB and AA did not differ significantly for number of hands. But they were significantly superior to Musa balbisiana (BB) in the number of hands (5.00).

Within the triploids the genomic groups differed significantly in hands per bunch. The group ABB recorded the highest value (8.74) followed by AAB (8.04) and AAA (6.68).

Within the tetraploids, the genomic groups were on par for hands per bunch.

The cultivars belonging to the different genomic groups showed a wide and significant variation in hand number ranging from 3.5 in 'Padali moongil' (AB) to 16.5 in 'Walha' and 'Ashy batheesa' (ABB).

The cultivars of the diploid Musa acuminata group (AA) recorded significant variation in the number of hands from 5.00 in 'Chingan' to 12.75 in 'Tongat'. Among the cultivars of the genomic group AB, the number of hands varied, from 3.5 in 'Padali moongil' to 12.5 in 'Venneettu mannan'. The number of hands in 'Elavazhai' (BB) was only 5.00.

Among the cultivars of the genomic group AAA, the number of hands varied from 4.50 in 'Galanaalu' to 10.0 in 'Highgate'. Among the AAB cultivars, the variation was from 3.5 in 'Nendra padaththi' to 13.5 in 'Dudhsagar' and among the ABB cultivars from 4.00 in 'Chetti' to 16.50 in 'Walha' and 'Ashy batheesa'.

The tetraploids 'Bodles Altafort' (AAAA) and 'Hybrid Sawal' did not differ significantly for number of hands.

#### 3.3.4. Number of fingers

When the diploids and the polyploids were compared for the mean number of fingers per bunch, the diploid bunches had significantly more fingers (108.08) than the polyploids (102.34). Within the polyploids, the triploids (103.48) were significantly superior to the tetraploids (78.5).

Within the diploids, the genomic groups AB (112.54) and AA (108.50) were on par for fingers per bunch and Musa dalbisiiana (BB) was significantly inferior to them (52.50).

Within the triploids, the genomic groups differed significantly. Among the three triploid genomic groups, ABB group produced the maximum fingers per bunch, (120.53) followed by AAB (101.71) and AAA (79.36).

Within the tetraploids, ABBB (93.00) was significantly superior to AAAA(64.00) fingers per bunch.

Among the 62 cultivars, the number of fingers varied from 19.5 in 'Padali moongil' (AB) to 231.50 in 'Tongat' (AA).

Among the cultivars of the genomic constitution AA, the mean fingers per bunch varied from 61.00 in 'Chingam' to 231.50 in 'Tongat'. Among the cultivars of the genomic group AB, the mean values, varied from 19.50 in 'Padali moongil' to 209.00 in 'Venneettu mannan'. 'Elavazhai' (BB) produced only 52.5 fingers per bunch.

Among the cultivars of the triploid Musa acuminata group (AAA), the variation in fingers per bunch was from 56.50 (Manoranjitha) to 112.50 in 'Aighate' and among the AAB cultivars from 49.00 in 'Nendra padaththai' to 188.5 in 'Palayankodan'. Wide and significant variation

was also observed among the cultivars of the genomic group ABB, from 40.10 in 'Chetti' to 203.00 in 'Walna'.

The tetraploid Musa acuminata cultivar 'Bodles Altafort' had significantly lesser number of fingers (64.00) than 'Hybrid Sawai' (ABBB) which had 93.00 fingers per bunch.

### 3.4. Finger characters

The mean pedicel length; length,irth, volume and weight of fingers, percentage of pulp weight, percentage of pulp volume, and pulp to peel ratio by volume

and weight of fruits of the diploids and the polyploids and of the genomic groups under each ploidy level are presented in Table 9. Table 10 shows the mean values of the above parameters in the cultivars under each genomic group. The diploids recorded significantly higher values than the polyploids with respect to the pedicel length, percentage of pulp and pulp/peel ratio, while the polyploids had significantly longer and heavier fruits which also had higher girth and volume than the fingers of diploids. The genomic groups in diploids and polyploids and the cultivars under each genomic group also showed significant differences with respect to finger characters.

#### 3.4.1. Pedicel length

The diploids (3.17 cm) were significantly superior to the polyploids (2.88 cm) for pedicel length. Within the polyploids, the triploids (2.87 cm) and the tetraploids (2.85 cm) were on par. Within the diploids, the triploids and the tetraploids; the genomic groups differed significantly.

Within the diploids, the genomic group BB had the maximum pedicel length (4.13 cm) followed by AB (3.40 cm) and AA (2.42 cm). Within the triploids, ABB (4.06 cm) was followed by AAB (2.34 cm) and AAA (1.71 cm) in pedicel length.

Within the tetraploids ABBB (3.63 cm) group had significantly longer pedicel than AAAA (2.08 cm) group.

**Table 9** Effect of ploidy and genome on the finger characters of banana cultivars

Groups	Pedicle length (cm)	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Finger volume (cc)	Pulp weight (%)	Pulp/peel (wt. basis)	Pulp volume (%)	Pulp/peel (Vol. basis)
1	2	3	4	5	6	7	8	9	10
Diploids	3.17	11.97	9.63	60.61	57.83	68.98 (56.42)	2.57	69.01 (56.30)	2.40
Polyploids	2.88	14.05	11.30	96.51	99.40	63.62 (53.01)	1.90	63.85 (52.09)	1.90
C.D. (0.05)	0.06	0.15	0.24	0.90	1.27	0.25	0.50	0.20	0.01
<u>Polyploids</u>									
Triploids	2.87	14.03	11.29	95.42	100.70	63.84 (53.14)	1.93	63.74 (51.97)	1.89
Tetraploids	2.85	14.50	11.64	119.34	85.25	58.85 (50.11)	1.41	66.15 (54.59)	2.18
C.D. (0.05)	0.14	0.40	0.61	2.34	3.28	0.66	0.14	0.51	0.03
<u>Diploids</u>									
AA	2.42	11.54	9.05	55.27	47.80	65.43 (54.14)	3.87	67.97 (55.68)	2.40
AB	3.40	12.25	9.67	61.51	61.08	71.08 (57.77)	2.92	70.16 (56.69)	2.47
BB	4.13	10.88	12.02	76.50	69.00	61.50 (51.65)	3.20	60.50 (51.06)	1.53
C.D. (0.05)	0.23	0.62	0.96	3.66	5.13	1.02	0.23	0.80	0.05

(Contd.)

Table 9 (Contd.)

1	2	3	4	5	6	7	8	9	10
<b><u>Triploids</u></b>									
AAA	1.71	14.91	11.29	120.81	113.59	66.34 (54.70)	2.17	65.53 (54.54)	2.05
AAB	2.34	12.32	10.92	77.57	81.89	68.36 (55.65)	2.29	66.09 (54.65)	2.12
ABB	4.06	14.87	11.58	93.70	106.29	58.51 (50.07)	1.50	60.64 (51.14)	1.58
C.D. (0.05)	0.09	0.26	0.40	1.52	2.13	0.43	0.09	0.33	0.02
<b><u>Tetraploids</u></b>									
AAAA	2.08	19.13	11.95	166.18	99.00	60.13 (50.86)	1.47	75.10 (60.07)	3.02
ABBB	3.63	9.88	11.32	72.50	71.50	57.57 (49.37)	1.36	57.19 (49.11)	1.34
C.D. (0.05)	0.28	0.77	1.20	4.57	6.42	1.28	0.28	1.00	0.06

Table 10 Mean values of the finger characters of 62 cultivars of banana belonging to different genomic groups

Cultivars	Pedicle length (cm)	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Finger volume (cc)	Pulp weight (%)	Pulp/peel (wt. basis)	Pulp volume (%)	Pulp/peel (vol. basis)
1	2	3	4	5	6	7	8	9	10
<b>AA</b>									
Namarai	1.80	8.88	7.13	30.25	25.50	60.88 (51.40)	1.56	60.25 (50.92)	1.52
Chingan	3.05	13.10	9.63	57.50	49.50	60.79 (51.36)	0.79	59.75 (50.63)	1.49
Tongat	2.28	8.88	8.88	41.25	34.50	64.00 (53.65)	1.78	65.00 (53.73)	1.86
Eraichivazhai	2.50	13.75	10.38	74.60	75.50	61.51 (51.65)	1.60	73.29 (58.59)	2.75
Sanna chenkadali	2.47	13.08	9.25	72.75	54.00	79.75 (63.26)	3.94	81.50 (64.53)	4.41
<b>AB</b>									
Krishna vazhai	2.00	13.75	10.88	58.00	66.50	56.72 (48.48)	1.31	61.77 (51.80)	1.62
Vannan	3.00	10.48	10.25	45.50	53.50	62.88 (52.45)	1.70	56.85 (48.94)	1.32
Virupakshi	3.13	9.88	9.50	42.58	31.00	65.66 (54.12)	1.86	66.73 (54.79)	2.01
Sirumalai	3.63	10.88	9.75	54.38	61.00	55.78 (48.34)	1.26	75.25 (60.17)	3.04
Agniswar	2.08	9.13	7.18	54.64	56.00	74.80 (59.87)	2.97	72.62 (58.44)	2.66
Adakka kunnan	3.98	10.68	8.75	48.45	45.50	74.50 (59.61)	2.93	74.38 (59.67)	2.90
Valiya kunnan	4.40	14.25	10.18	77.79	71.00	79.75 (63.26)	3.94	76.25 (60.84)	3.22

(Contd.)

Table 10 (Contd.)

1	2	3	4	5	6	7	8	9	10
Thaen kunnan	3.75	19.68	8.23	51.25	69.00	81.26 (64.38)	4.34	75.28 (60.20)	3.05
Padali moongil	4.13	15.88	11.88	96.50	41.50	87.75 (69.30)	7.17	72.22 (58.18)	2.60
Ney poovan	4.58	11.13	8.65	62.63	70.50	72.87 (58.60)	2.69	74.98 (60.00)	3.00
Kostha bontha	2.55	12.63	11.33	68.42	64.50	74.67 (59.81)	2.95	65.57 (54.09)	1.71
Venneettu mannan	3.63	13.63	9.48	78.00	53.00	66.33 (54.55)	1.97	70.09 (56.85)	2.34
<b>BB</b> Elavazhai ( <u>M. balbisiana</u> )	4.13	10.88	12.02	76.50	69.00	61.50 (51.65)	1.60	60.50 (51.06)	1.53
<b>AAA</b> Gros Michel	1.38	14.38	11.38	<del>121.75</del>	<del>102.50</del>	61.75 (51.83)	1.61	65.13 (53.83)	1.87
Highgate	2.13	19.75	10.50	111.25	113.00	59.95 (50.74)	1.50	60.49 (51.07)	1.54
Pedda pachcha	1.38	14.13	10.88	94.38	120.00	61.40 (51.59)	1.59	63.00 (52.54)	1.71
Basrai	1.78	13.25	9.98	68.38	72.50	63.38 (52.74)	1.73	64.75 (53.58)	1.84
Harichal	1.48	14.75	12.25	188.02	184.00	62.25 (52.09)	1.65	63.55 (52.91)	1.75
Sapumal anamalu	2.47	17.38	9.38	133.00	131.00	60.81 (51.27)	1.56	69.21 (56.29)	2.25
Manoranjithm	2.33	12.98	10.25	71.08	76.50	65.00 (53.73)	1.86	61.00 (51.36)	1.57
Galanamalu	1.28	11.83	13.75	193.50	120.50	81.35 (64.45)	4.37	79.18 (62.87)	3.80

(Contd.)



Table 10 (Contd.)

1	2	3	4	5	6	7	8	9	10
Red banana	1.38	12.18	14.53	195.60	131.00	80.18 (63.58)	4.05	65.30 (59.97)	2.99
Wather	1.63	16.83	10.88	80.25	97.50	66.94 (55.00)	2.01	63.21 (52.63)	1.72
Karim kadali	1.59	16.03	9.80	74.79	91.00	66.41 (54.61)	1.98	61.06 (54.10)	1.57
<b>AAB</b>									
Thiruvananthapuram	2.62	10.53	8.65	90.63	83.00	65.79 (54.07)	1.93	60.00 (50.77)	1.50
China	2.35	10.38	9.25	49.25	61.00	67.09 (55.00)	2.04	58.85 (49.81)	1.94
Rasthali	2.63	16.95	12.13	92.92	132.00	75.88 (60.62)	3.15	65.30 (53.41)	1.88
Dudhsagar	2.50	13.88	13.00	103.75	102.50	72.25 (58.21)	2.61	74.75 (59.84)	2.86
Sugandhi	2.23	13.38	13.50	90.75	121.50	74.90 (59.94)	2.98	64.25 (53.28)	1.80
Palayankodan	3.00	11.60	10.63	74.25	74.50	79.18 (63.44)	4.00	79.93 (63.40)	3.98
Pacha chingan	2.21	11.88	10.00	54.75	51.50	62.69 (52.36)	1.68	59.88 (50.71)	1.49
Mannan	2.15	11.38	8.75	58.73	61.00	60.23 (50.92)	1.52	58.23 (50.01)	1.40
Malakali	2.33	15.25	11.14	99.25	91.50	62.89 (52.48)	1.69	61.06 (51.38)	1.59
Pacha nadan	2.43	11.23	11.83	68.00	64.00	59.53 (50.34)	1.82	64.72 (53.88)	1.83
Nendra padaththi	2.25	11.25	12.08	64.64	64.00	65.55 (54.00)	1.91	65.50 (54.07)	1.90

(Contd.)

Table 10 (Contd.)

1	2	3	4	5	6	7	8	9	10
Chara padaththi	1.88	11.04	10.73	86.25	85.50	64.54 (53.40)	1.82	70.59 (57.26)	2.40
Kullan	2.08	9.83	9.00	45.50	53.00	74.75 (59.84)	2.96	79.83 (63.35)	3.98
Chinali	2.13	10.38	9.25	107.23	101.50	66.10 (55.00)	2.04	58.85 (49.87)	1.94
<u>ABB</u>									
Karpooravally	3.00	13.13	11.70	57.29	55.50	68.63 (55.93)	2.19	65.50 (54.15)	1.91
Chirapunchi	2.50	14.00	9.25	63.00	63.50	64.13 (55.03)	2.05	62.15 (52.03)	1.64
Pey kunnan	3.63	12.63	9.75	63.15	61.50	63.04 (52.57)	1.71	60.63 (51.15)	1.54
Walha	5.13	17.03	9.93	80.63	128.50	49.88 (44.95)	1.00	61.90 (51.89)	1.63
Ashy batheesa	5.13	16.75	9.43	88.75	84.00	50.88 (45.52)	1.04	60.48 (51.07)	1.53
Ney vannan	3.58	12.38	11.73	100.75	95.00	55.78 (48.34)	1.26	60.25 (50.92)	1.52
Alukehel	3.63	12.63	11.48	120.50	98.50	55.61 (48.25)	1.25	61.35 (51.59)	1.59
Kapok	4.23	13.46	10.88	91.00	64.00	50.00 (45.00)	1.00	58.29 (49.78)	1.40
Jurmoney kunthali	4.93	14.75	9.52	63.50	62.50	64.63 (53.52)	1.83	61.62 (51.74)	1.61
Peyan	4.43	13.25	11.63	65.95	62.50	50.00 (45.00)	1.00	54.80 (47.80)	1.21

(Contd.)

Table 10 (Contd.)

1	2	3	4	5	6	7	8	9	10
Pacha bontha bathees	3.25	15.65	13.08	105.50	205.50	59.88 (50.71)	0.99	61.12 (51.44)	1.57
Muthia	4.00	13.25	12.28	103.50	110.50	61.75 (51.70)	1.62	62.38 (52.18)	1.66
Kari bontha	4.63	15.73	12.93	119.50	155.00	58.67 (49.98)	1.42	46.76 (43.17)	0.88
Malai monthan	3.38	19.25	13.75	124.25	206.50	73.97 (59.31)	2.85	73.22 (58.80)	2.74
Bluggoe	3.63	16.25	13.35	133.43	109.50	54.01 (47.23)	1.18	63.58 (52.92)	1.71
Chetti	5.55	19.63	14.88	125.00	162.50	58.40 (49.84)	1.41	60.24 (50.89)	1.62
Kallu monthan	4.43	13.13	11.30	87.25	82.00	55.50 (48.19)	1.25	56.60 (48.80)	1.31
<b>AAAA</b>									
Bodles Altafort	2.08	19.13	11.95	116.18	99.00	60.13 (50.86)	1.47	75.10 (60.01)	3.02
<b>ABBB</b>									
Hybrid Sawai	3.63	9.88	11.32	72.50	71.50	57.57 (49.37)	1.36	57.19 (49.11)	1.34
C.D. (0.05)	0.28	0.77	1.20	4.57	6.42	1.28	0.28	1.00	0.06

Musa acuminata groups had the shortest pedicels. Within each ploidy level, pedicel length increased with increase in 'B' genome.

Pedicel length varied from 1.28 cm in 'Galanamalu' (AAA) to 5.55 cm in 'Chetti' (ABB). All the cultivars belonging to Musa acuminata groups (AA, AAA and AAAA) had shorter pedicels than cultivars of the other genomic groups.

Among the cultivars of the genomic group AA, the pedicel length varied from 1.80 cm in 'Namarai' to 3.05 cm in 'Chingan', and among the cultivars of AB group from 2.00 cm in 'Krishna vazhai' to 4.58 cm in 'Neypoovan'. In 'Elavazhai' the fruits had pedicels of mean length 4.13 cm.

Among the triploid acuminata (AAA) cultivars, pedicel length varied significantly from 1.28 cm in 'Galanamalu' to 2.47 cm in 'Sapumal anamalu'. Among the triploids of AAB group, cultivar 'Chara padaththai' had the shortest pedicels (1.88 cm) and 'Palayankodan' the longest (3.00 cm). Among the cultivars of ABB group, 'Chir punchi' had the shortest pedicel (2.50 cm) while 'Chetti' had the longest (5.55 cm).

In the tetraploids, the pedicel length varied significantly from 2.08 cm in 'Bodles Altafort' (AAAA) to 3.63 cm in 'Hybrid Sawai' (ABBB).

### 3.4.2. Finger length

The polyploids with a mean finger length of 14.05 cm was significantly superior to the diploids (11.97 cm). Within the polyploids, the tetraploids (14.50 cm), were significantly superior to the triploids (14.03 cm).

Within the diploids the genomic groups AB (12.25 cm) and AA (11.54 cm) were on par with respect to the finger length and both the groups were significantly superior to BB (10.88 cm).

Within the triploids, the genomic groups AAA (14.91 cm) and ABB (14.87 cm) were on par while AAB (12.32 cm) had significantly shorter fruits than these two groups.

Within the tetraploids the genomic group AAAA (19.13 cm) had significantly longer fruits than ABBB (9.88 cm).

The finger length varied significantly, among the 62 cultivars studied, cultivars 'Namarai' (AA) and 'Tongat' (AA)(8.88 cm) having the shortest fingers and 'Highgate' (AAA) having the longest (19.75). Among the diploid Musa acuminata cultivars fruit length varied from 8.88 cm (Namarai and Tongat) to 13.75 in 'Eraichivazhai' and among the diploids of 'AB' group from 9.13 in 'Agniswar' to 19.68 in 'Thaen kunnan'. 'Elavazhai' (BB) recorded a mean finger length of 10.88 cm.

Among the Musa acuminata triploids (AAA), the finger length varied from 11.83 cm in 'Galanamalu' to 19.75 in 'Highgate'; among the cultivars of the AAB group from 9.83 cm in 'Kullan' to 16.95 cm in 'Basthali' and among the ABB cultivars, from 12.38 cm in 'Ney vanna' to 19.63 cm in 'Chetti'.

'Bodles Altafort' recorded a mean finger length of 19.13 cm and 'Hybrid Sawai' (ABBB), 9.88 cm.

### 3.4.3. Finger girth

When the diploids and the polyploids were compared on the basis of finger girth, the mean value of the polyploids (11.30 cm) was significantly higher than that of diploids (9.63 cm). Within the polyploids, the triploids and the tetraploids did not differ significantly.

Within the diploids, Musa balbisiana (BB) had the maximum finger girth (12.02 cm), followed by AB (9.67 cm) and AA (9.05 cm) which were on par.

Within the triploids, the genomic groups AAA (11.29 cm) and ABB (11.58 cm) were on par in finger girth while the AAB group recorded a significantly lower value than the former two groups (10.92 cm).

Within the tetraploids, the genomic groups were on par with respect to finger girth.

Among the 62 cultivars, the finger girth varied significantly from 7.13 cm in 'Namarai' (AA) to 14.88 cm in 'Chetti' (ABB).

Among the cultivars of the genomic group AA, the finger girth varied from 7.13 cm<sub>A</sub> to 10.38 cm in 'Eraichivazhai' and among the AB cultivars it varied from 7.18 in 'Agniswar' to 11.88 in 'Padali moongil'. In Elavazhai (BB) the mean finger girth was 12.02 cm.

Among the cultivars of the genomic constitution AAA, the finger girth varied from 9.38 cm in 'Sapunal anamalu' to 14.53 cm in 'Red banana'; among the cultivars of the genomic constitution AAB, from 8.65 cm in 'Thiruvananthapuram' to 13.5 cm in 'Sugandhi' and among the ABB cultivars, from 9.25 cm in 'Chirapunchi' to 14.88 cm in 'Chetti'.

The finger girth in 'Bodles Altafort' (AAA) and 'Hybrid Sawai' (ABBB) did not differ significantly, being 11.95 cm in the former and 11.32 cm in the latter.

#### 3.4.4. Finger weight

The mean finger weight in the polyploids was significantly higher (96.51 g) than that of the diploids (60.61 g). Within the polyploids, the tetraploids recorded higher finger weight (119.34 g) than the triploids (95.42 g).

Within the diploids, the triploids and the tetraploids, the genomic groups differed significantly in finger weight. Within the diploids, Musa balbisiana (BB) recorded the highest value (76.50 g) followed by AB (61.51 g)

and AA (55.27 g). Within the triploids, the genomic group AAA recorded the highest value (120.81 g) followed by ABB (93.70 g) and AAB (77.57 g). Within the tetraploids, the genomic group AAAA differed significantly in finger weight from ABBB group (166.18 g and 72.50 g respectively).

The cultivars showed a significant variation among themselves with respect to finger weight from 30.25 g in 'Namarai' (AA) to 195.60 g in 'Red banana' (AAA). Within the genomic groups also the cultivars showed a significant variation.

In the genomic group AA, cultivar 'Erachivazhai' had the heaviest fruits (74.60 g). Among the cultivars of the group AB, the finger weight varied from 42.58 g in 'Virupakshi' to 96.50 g in 'Padali moongil'. 'Elavazhai' (BB) produced fingers of mean weight 76.50 g.

The finger weight varied significantly among the cultivars belonging to each of the three triploid groups. In the genomic group AAA it varied from 68.38 g in 'Basrai' to 195.60 g in 'Red banana'; in AAB, from 49.25 g in 'China' to 107.23 g in 'chinali' and in ABB, from 57.29 g in 'Karpooravally' to 133.43 g in 'Blugoe'.

The Musa acuminata tetraploid (AAAA) had significantly heavier fruits (116.18 g) than 'Hybrid Sawai' (ABBB - 72.50 g).



### 3.4.5. Finger volume

When the ploidy levels were compared with respect to the finger volume, the polyploids (99.40 cc) were significantly superior to the diploids (57.83 cc). Within the polyploids, the tetraploids (100.70 cc) were significantly superior to the <sup>te</sup>triploids (85.25 cc).

Within the diploids, the genomic groups differed significantly in finger volume. The group BB had the maximum mean value for volume (69.00 cc) followed by AB (61.08 cc) and AA (47.80 cc).

Within the triploids, the genomic groups differed significantly in mean finger volume. The group AAA recorded the maximum value in finger volume (113.59 cc), followed by ABB (106.29 cc) and AAB (81.89 cc).

Within the tetraploids, the group AAAA with a mean volume of 99.00 cc for finger, was significantly superior to AB BB (71.50 cc).

The finger volume varied significantly among the 62 cultivars from 25.50 cc in 'Namara' (AA) to 206.50 cc in 'Malai Sonthan'. Among the cultivars of the group AA the highest fruit volume was recorded by 'Eraichivazhai' (75.50 cc).

Among the cultivars of the AB group, the volume of finger varied from 31.00 cc in 'Virupakshi' to 71.00 cc

in 'Valiya kunnan'. 'Elavazhai' (BB) fruits recorded a mean volume of 69.00 cc.

Among the triploids of Musa acuminata group (AAA), the mean finger volume varied from 72.50 cc in 'Basrai' to 184.00 cc in 'Harichai', among the AAB cultivars, from 51.50 cc in 'Pacha chingan' to 132.00 cc in 'Pasthanli' and among the ABB cultivars from 55.50 cc in 'Karpooravally' to 206.50 cc in 'Malai monthan'.

Within the tetraploids, 'Bodles Altafort' (AAAA) recorded a significantly higher value (99.00 cc) for finger volume than 'Hybrid Sawai' (ABBB, 71.50 cc).

#### 3.4.6. Percentage of pulp weight

When the diploids and the polyploids were compared, the diploids (68.98%) were found significantly superior to the polyploids (63.62%) in percentage of pulp weight. The triploids (63.84%) were significantly superior to the tetraploids (58.85%) within the polyploids.

Within the diploids the genomic groups differed significantly. The AB group had the highest mean percentage of pulp (71.08%), followed by AA (65.43%) and BB (61.50%).

Within the triploids, the genomic groups differed significantly. The group AAB had the highest percentage of pulp (68.36%), followed by AAA (66.34%) and ABB (58.51%).

Within the tetraploids, the genomic group AAAA (60.13%) was significantly superior to ABBB (57.57%).

The percentage of pulp varied significantly among the 62 cultivars from 49.88 in 'Walha' (ABB ) to 87.75 in 'Padali moongil' (AB).

Among the cultivars of the diploid Musa acuminata group (AA) the percentage of pulp weight varied from 60.79 in 'Chingan' to 79.75 in 'Sanna chenkadali', among the cultivars of the genomic group AB, from 55.78 in 'Sirumalai' to 87.75 in 'Padali moongil'. In 'Elavazhai' (BB) the percentage of pulp weight was 61.50.

Among the triploid Musa acuminata cultivars (AAA), the percentage of pulp varied from 59.95 in 'Highgate' to 81.36 in 'Galanamalu', among the AAB cultivars from 59.53 in 'Pacha nadan' to 79.18 in 'Palayankodan' and among the ABB cultivars from 49.88 in 'Walha' to 73.97 in 'Malai monthan'.

In the tetraploids the percentage of pulp weight varied significantly, being 57.57 in 'Hybrid Sawai' (ABBB) and 60.13 in 'Boules Altafort' (AAAA).

#### 3.4.7. Pulp/Peel ratio on weight basis

The diploids (2.57) were significantly superior to the polyploids (1.90) and within the polyploids, the triploids (1.93) were significantly superior to the

tetraploids (1.41) in pulp/peel ratio of the fruit on weight basis.

Within the diploids, the genomic groups differed significantly. The group AA (3.87) recorded the highest value for pulp/peel ratio followed by BB (3.20) and AB (2.92).

Within the triploids, the genomic group AAB recorded the highest value (2.29) followed by AAA (2.17) and ABB (1.50) and the groups differed significantly.

Within the tetraploids, the genomic group AAAA (1.47) was on par with ABBB (1.36),

Among the cultivars the pulp/peel ratio of fruits varied from 0.79 in 'Chingan' (AA) to 7.17 in 'Padali moongil' (AB).

Among the cultivars of the genomic group AA the highest value for pulp/peel ratio was recorded by 'Sanna chenkadali' (3.94). Among the cultivars of the AB group it varied from 1.26 in 'Sirumalai' to 7.71 in 'Padali moongil'. The Musa balbisiana (BB) recorded a pulp/peel ratio of 1.60 on weight basis.

Among the cultivars of the genomic group AAA, the variation was from 1.50 in 'Highgate' to 4.37 in 'Galanamalu'; among the AAB cultivars, from 1.52 in 'Mannan' to 4.00 in 'Palayankodan' and among the ABB cultivars from 0.99 in 'Pacha bontha bathees' to 2.85 in 'Malai monthan'.

The tetraploid 'Bodles Altafort' (AAAA) recorded a value of 1.47 and Hybrid Sawai (ABBB), 1.36 for pulp/peel ratio on weight basis.

#### 3.4.8. Percentage of pulp volume

The diploids had significantly higher value (69.01%) for percentage of pulp volume than the polyploids (63.85%). Within the polyploids, the tetraploids (66.15%) were significantly superior to the triploids (63.74%).

Within the diploids, the genomic groups differed significantly in percentage of pulp volume. The genomic group AB recorded the highest value (70.16%) followed by AA (67.96%) and BB (60.50%).

Within the triploids, among the three genomic groups, the group AAB recorded the highest percentage of pulp volume (66.09%) which was on par with AAA (65.53%). The group ABB recorded the lowest value among the triploids (60.64%) and was significantly inferior to the other two groups.

Within the tetraploids, AAAA (75.10%) was significantly superior to ABBB (57.19%).

The percentage of pulp volume varied from 46.76 in 'Kari bontha' (ABB) to 81.50 in 'Sanna chenkadali' (AA).

Among the cultivars belonging to the diploid Musa acuminata group, the percentage of pulp volume

varied from 59.75 in 'Chingan' to 81.50 in 'Sanna chenkadali'; among the AB cultivars from 56.85 in 'Vannan' to 76.25 in 'Valiya kuman'. 'Elavashai' (BB) recorded a value of 60.50 per cent.

Among the cultivars belonging to the triploid Musa acuminata group, the percentage of pulp volume varied from 60.49 in 'Highgate' to 79.18 in 'Galanamalu'; among the AAB cultivars from 58.23 in 'Mannan' to 79.93 in 'Palayankodan' and among the ABB cultivars from 46.76 in 'Kari bontha' to 73.22 in 'Malai monthan'.

'Bodles Altafort' (AAAA) recorded 75.10 as percentage of pulp volume while the hybrid tetraploid, 'Hybrid Sawai' (ABBB) recorded a lower value, 57.19.

#### 3.4.9. Pulp/Peel ratio on volume basis

The behaviour of the diploids, triploids and tetraploids and the different genomic groups under each ploidy level was almost similar to that in the case of percentage of pulp volume. The diploids recorded significantly higher value (2.40) than polyploids (1.90) and within the polyploids, the tetraploids (2.18) were superior to the triploids (1.89).

When the diploid genomic groups were compared, significant variation was observed among them. The pulp peel ratio was the highest in AB group (2.47) followed by the group AA (2.40) and the BB (1.53).

Within the triploids the genomic group AAB had the highest pulp/peel ratio (2.12) which significantly <sup>wab</sup> lower than that of the group AAA (2.05) and ABB (1.58).

When the two tetraploid groups were compared, the group AAAA recorded a pulp/peel ratio of 3.02 which was significantly higher than that of the group ABBB (1.34).

Among the 62 cultivars, the pulp/peel ratio on volume basis varied significantly, from 1.21 in 'Peyan' (ABB) to 4.41 in 'Sanna chenkadali' (AA).

Among the cultivars of the genomic group AA, the lowest value for pulp/peel ratio was recorded by 'Chingan' (1.49). In the genomic group AB, the pulp/peel ratio varied from 1.32 in 'Vannan' to 3.05 in 'Thaen kunnan' while Musa balbisiana (BB) recorded a value of 1.53.

Among the cultivars of the genomic group AAA, the pulp/peel ratio of fruits on volume basis varied from 1.54 in 'Highgate' to 3.80 in 'Galanamalu'; among the AAB cultivars from 1.40 in 'Mannan' to 3.98 in 'Palayankodan' and among the ABB cultivars from 1.21 in 'Peyan' to 2.74 in 'Malai monthan'.

The tetraploid 'Bodles Altafort' recorded a value of 3.02 and 'Hybrid Sawai' (ABBB), 1.34.

Table 11 Effect of ploidy and genome on the quality characters of banana cultivars

Groups	TSS (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Acidity (%)	Sugar acid ratio
1	2	3	4	5	6	7
Diploids	24.10 (29.23)	14.92 (22.25)	13.53 (20.69)	1.76 (7.38)	0.34 (3.29)	45.71
Polyploids	22.14 (28.04)	14.38 (22.10)	12.46 (20.26)	1.95 (7.85)	0.32 (3.22)	47.22
C.D. (0.05)	0.16	0.23	0.35	0.29	0.08	1.48
<u>Polyploids</u>						
Triploids	22.07 (28.01)	14.47 (22.16)	12.57 (20.35)	1.95 (7.85)	0.33 (3.23)	47.49
Tetraploids	23.06 (28.66)	12.69 (20.80)	10.09 (18.43)	2.03 (7.89)	0.25 (2.86)	41.53
C.D. (0.05)	0.42	0.61	0.90	0.76	0.20	3.84
<u>Diploids</u>						
AA	21.15 (27.30)	10.80 (18.83)	9.20 (16.63)	1.52 (6.49)	0.29 (3.05)	38.74
AB	25.33 (30.03)	16.73 (24.17)	15.57 (22.56)	1.74 (7.50)	0.36 (3.40)	48.38
BB	21.63 (29.33)	13.65 (21.74)	10.25 (18.68)	3.24 (10.31)	0.30 (3.14)	48.55
C.D. (0.05)	0.66	0.95	1.41	1.19	0.32	6.01

(Contd.)



Table 11 (Contd.)

1	2	3	4	5	6	7
<b><u>Triploids</u></b>						
AAA	19.77 (26.42)	11.02 (19.18)	9.24 (17.47)	1.64 (7.40)	0.21 (2.56)	59.64
AAB	22.68 (28.43)	14.77 (22.53)	13.14 (20.58)	2.00 (7.97)	0.38 (3.51)	38.92
ABB	23.06 (28.68)	16.44 (23.78)	14.26 (22.02)	2.10 (8.14)	0.37 (3.44)	46.68
C.D.(0.05)	0.27	0.39	0.59	0.49	0.13	2.50
<b><u>Tetraploids</u></b>						
AAAA	23.06 (28.66)	10.61 (19.00)	8.37 (16.78)	1.19 (6.20)	0.21 (2.60)	44.58
ABBB	23.06 (28.66)	14.76 (25.59)	11.81 (20.08)	2.87 (9.58)	0.30 (3.13)	38.48
C.D. (0.05)	0.82	1.18	1.77	1.48	0.40	7.51

Letters in parantheses represent the means of transformed values (angular transformation)

Table 12 Mean values of the quality characters of 62 cultivars of banana belonging to different genomic groups

Cultivars	TSS (%)	Total sugars (%)	Reducing sugars (%)	Non-reducing sugars (%)	Acidity (%)	Sugar acid ratio
1	2	3	4	5	6	7
<b>AA</b>						
Namarai	15.50 (23.19)	6.52 (14.83)	5.99 (14.18)	0.50 (4.05)	0.15 (2.18)	44.92
Chingan	24.25 (29.80)	19.27 (26.03)	14.87 (22.62)	4.19 (11.82)	0.48 (3.97)	40.15
Tongat	23.01 (28.66)	10.85 (19.24)	9.55 (18.00)	1.24 (6.29)	0.26 (2.90)	42.56
Eraichivazhai	19.00 (25.84)	6.87 (15.18)	5.69 (13.81)	1.07 (5.94)	0.38 (3.51)	18.51
Sanna Chenkadali	24.03 (29.33)	10.51 (18.91)	9.90 (14.54)	0.58 (4.37)	0.22 (2.69)	47.77
<b>AB</b>						
Krishna vazhai	24.03 (29.33)	16.11 (23.70)	15.00 (22.79)	1.05 (5.81)	0.52 (4.11)	31.65
Vannan	21.50 (27.63)	16.91 (24.27)	14.51 (22.38)	2.28 (8.72)	0.46 (3.87)	37.15
Virupakshi	22.50 (27.97)	19.12 (25.92)	17.85 (25.11)	1.54 (6.55)	0.35 (3.37)	55.43
Sirumalai	24.00 (29.33)	19.25 (26.03)	18.31 (25.10)	1.19 (6.20)	0.42 (3.70)	46.40
Agniswar	23.50 (29.00)	17.18 (24.50)	15.35 (23.07)	1.57 (7.16)	0.40 (3.63)	38.58
Adakka kunnan	26.00 (30.66)	13.25 (21.35)	12.78 (20.83)	0.95 (5.59)	0.27 (2.98)	49.08
Valiya kunnan	26.00 (30.66)	14.58 (22.47)	12.90 (21.05)	1.60 (7.26)	0.29 (3.06)	51.16
Thaen kunnan	29.00 (32.58)	17.65 (24.89)	14.50 (21.38)	3.04 (9.98)	0.31 (3.17)	58.04
Padali moongil	28.00 (31.95)	16.72 (24.16)	13.70 (21.93)	2.87 (9.90)	0.29 (3.09)	57.64

(Contd.)

Table 12 (Contd.)

1	2	3	4	5	6	7
Ney poovan	28.50 (30.62)	15.65 (23.34)	13.95 (21.93)	1.62 (7.38)	0.27 (2.95)	59.25
Kostha bontha	27.00 (31.31)	17.54 (25.27)	15.00 (22.79)	2.42 (8.97)	0.36 (3.42)	49.17
Venneettu mannan	24.00 (29.33)	16.85 (24.24)	14.86 (22.56)	1.32 (6.55)	0.36 (3.44)	46.81
<b>BB</b>						
Elavazhai ( <u>M. balbisiana</u> )	24.00 (29.33)	13.65 (21.69)	10.25 (18.68)	3.24 (10.31)	0.30 (3.14)	48.55
<b>AAA</b>						
Gros Michel	21.00 (27.28)	12.90 (21.05)	11.95 (20.23)	0.90 (5.50)	0.16 (2.26)	83.24
Highgate	18.00 (25.10)	10.40 (18.82)	9.37 (17.80)	0.99 (5.67)	0.18 (2.39)	60.34
pedda pachcha	22.00 (27.97)	12.08 (20.34)	8.13 (16.58)	3.76 (11.17)	0.14 (2.11)	89.41
Basrai	8.50 (25.47)	7.91 (16.23)	6.38 (14.65)	1.46 (6.92)	0.14 (2.14)	56.47
Harichal	18.50 (25.47)	13.05 (20.68)	12.00 (20.27)	1.00 (5.67)	0.17 (2.33)	79.19
Sapumal anamalu	19.00 (25.84)	10.25 (16.68)	7.62 (16.00)	2.50 (9.09)	0.19 (2.50)	53.95
Manoranjithm	20.00 (26.56)	7.95 (16.38)	6.40 (14.65)	1.48 (6.92)	0.21 (2.63)	37.93
Galanamalu	21.50 (27.63)	13.68 (21.73)	12.55 (20.75)	1.07 (5.94)	0.17 (2.33)	82.99
Red banana	21.00 (27.28)	13.50 (21.56)	11.50 (19.92)	1.90 (7.92)	0.19 (2.46)	64.29
Wather	18.00 (25.10)	5.60 (13.68)	4.27 (11.81)	1.27 (6.31)	0.32 (3.19)	17.76
Karim kadali	20.00 (26.92)	13.87 (21.85)	11.50 (19.92)	1.76 (8.62)	0.46 (3.87)	30.49

(Contd.)

Table 12 (Contd.)

1	2	3	4	5	6	7
<b><u>AAB</u></b>						
Thiruvananthapuram	23.00 (28.66)	8.59 (17.06)	6.78 (15.12)	1.49 (7.98)	0.35 (3.37)	23.47
China	22.00 (27.97)	11.53 (19.42)	8.55 (16.95)	2.35 (8.82)	0.37 (3.47)	30.20
Rasthali	23.00 (28.66)	14.68 (22.50)	13.50 (21.56)	1.13 (6.00)	0.43 (3.76)	34.18
Dudhsagar	21.50 (27.63)	15.15 (22.90)	13.00 (21.13)	2.05 (8.23)	0.34 (3.32)	45.51
Sugandhi	24.00 (29.33)	12.94 (21.09)	12.80 (20.14)	1.10 (5.80)	0.30 (3.07)	43.87
Palayankodan	21.50 (27.63)	16.85 (24.24)	13.33 (21.40)	3.34 (10.55)	0.38 (3.51)	44.93
Pacha chingan	25.00 (30.00)	22.78 (28.49)	18.72 (25.71)	3.87 (11.29)	0.38 (3.50)	60.76
Mannan	21.50 (27.63)	17.67 (24.89)	16.59 (24.05)	1.03 (5.88)	0.45 (3.83)	39.10
Malakali	21.00 (27.28)	16.39 (23.89)	13.35 (21.43)	2.90 (9.81)	0.46 (3.89)	35.64
Pacha nadan	24.00 (29.33)	17.15 (24.46)	14.20 (22.14)	1.81 (7.67)	0.41 (3.67)	41.43
<b>Chara padaththi</b>	<b>21.00 (27.28)</b>	<b>15.43 (23.15)</b>	<b>13.80 (21.81)</b>	<b>1.55 (7.11)</b>	<b>0.44 (3.79)</b>	<b>35.51</b>
	(28.66)	(18.55)	(14.71)	(8.11)	(3.19)	
<b><u>ABB</u></b>						
Karpooravally	24.50 (29.67)	18.40 (25.41)	16.30 (23.78)	2.05 (8.23)	0.25 (2.84)	63.91
Chirapunchi	23.00 (28.65)	18.13 (25.22)	15.59 (23.25)	2.44 (8.97)	0.24 (2.81)	75.52
Pey kunnan	25.00 (30.00)	16.75 (24.26)	15.09 (22.87)	1.29 (6.53)	0.21 (2.63)	79.76

(Contd.)

Table 12 (Contd.)

1	2	3	4	5	6	7
Walha	25.00 (30.00)	6.94 (15.79)	5.66 (13.75)	1.22 (6.29)	0.20 (2.53)	35.57
Ashy batheesa	24.00 (29.33)	9.62 (18.10)	8.37 (16.80)	1.19 (6.27)	0.24 (3.14)	32.08
Ney vanna	23.00 (28.66)	20.75 (27.10)	18.18 (25.25)	2.45 (8.97)	0.49 (3.99)	42.79
Alukehel	23.00 (28.66)	20.00 (26.57)	18.13 (25.22)	1.79 (7.57)	0.48 (3.97)	41.67
Kapok	24.00 (29.33)	15.75 (23.39)	13.63 (21.69)	2.02 (8.03)	0.46 (3.87)	34.61
Jurmoney kunthali	23.00 (28.66)	16.75 (24.16)	13.65 (21.69)	2.95 (9.90)	0.35 (3.39)	47.86
Peyan	23.50 (29.00)	19.63 (26.32)	18.50 (25.77)	1.07 (5.94)	0.38 (3.51)	52.41
Pacha bontha bathees	21.00 (27.28)	18.77 (25.60)	14.08 (22.05)	4.95 (12.85)	0.49 (3.99)	38.70
Muthia	22.00 (27.97)	16.88 (24.27)	14.50 (22.38)	2.26 (8.63)	0.54 (4.19)	31.57
Kari bontha	20.00 (26.56)	14.60 (22.47)	12.75 (20.92)	1.76 (7.60)	0.33 (3.29)	39.91
Malai monthan	18.00 (25.10)	14.64 (22.55)	11.95 (20.23)	2.56 (9.19)	0.29 (3.06)	51.38
Bluggoe	26.00 (30.66)	19.50 (26.20)	17.88 (25.03)	1.55 (7.15)	0.53 (4.17)	36.81
Chetti	24.00 (29.33)	18.54 (25.48)	15.57 (23.23)	2.83 (9.72)	0.32 (3.22)	58.86
Kallu monthan	23.00 (28.66)	13.90 (21.69)	12.54 (20.75)	1.30 (6.55)	0.46 (3.87)	30.23
<b>AAAA</b>						
Bodles Altafort	23.00 (28.66)	10.61 (19.00)	8.37 (16.78)	1.19 (6.20)	0.21 (2.60)	44.58
<b>ABBB</b>						
Hybrid Sawai	23.00 (28.66)	14.76 (9.58)	11.81 (20.00)	2.87 (9.58)	0.30 (3.13)	38.48
C.D.(0.05)	0.82	1.18	1.77	1.48	0.40	7.51

Letters in parantheses represent the means of transformed values (angular transformation)

#### 4. Effect of ploidy and genomic constitution on quality characters of banana cultivars

Data pertaining to the quality characters of fruits of different ploidy groups and the genomic groups under each ploidy level are presented in Table 11. The mean values of the quality characters of cultivars belonging to different genomic groups are presented in Table 12.

The diploids, and within the diploids, the genomic group AB, recorded significantly higher values than the polyploids in all the quality characters except in the percentage of non reducing sugars and sugar/acid ratio. Within the triploids, the genomic group ABB recorded higher values in all the characters except in these two. The cultivars within each genomic group differed significantly in all the characters.

##### 4.1. Total soluble solids

The diploids (24.10%) compared to the polyploids (22.14%) showed significantly higher TSS content. Within the polyploids TSS content was significantly higher in the tetraploids (23.06%) than in the triploids (22.07%).

Within the diploids, the genomic groups differed significantly in TSS. The highest TSS content was in AB (25.33%) and the lowest in AA (21.15%), while BB recorded a TSS content of 21.63%.

Within the triploids also, significant variation was observed among the genomic groups for TSS content. The genomic group ABB had the highest TSS content (23.06%) followed by AAB (22.68%) and AAA (19.77%). Between the two genomic groups in the tetraploids, AAAA and ABBB, no variation was observed in TSS content.

The percentage of total soluble solids varied from 15.50 in 'Namarai' (AA) to 29.00 in 'Thaen kunnan' (AB).

Among the cultivars belonging to the diploid Musa acuminata group the percentage of total soluble solids varied from 15.50 <sup>(Namarai)</sup> to 24.25 in 'Chingan'; among the AB cultivars from 21.50 in 'Vanman' to 29.00 in 'Thaen kunnan' while 'Elavazhai' (BB) recorded a TSS content of 24.00%.

Among the cultivars belonging to the triploid Musa acuminata group the percentage of total soluble solids varied from 18.00 in 'Wather' to 22.00 in 'Pedda pachcha', among the AAB cultivars, from 21.00 in 'Chara padatathi' to 25.00 in 'Pacha chingan' and among the ABB cultivars from 18.00 in 'Malai monthan' to 26.00 in 'Eluggoe'.

'Boxles Altafort' (AAAA) recorded 23.00 per cent total soluble solids. The hybrid tetraploid, 'Hybrid Sawai' (ABBB) also recorded the same value.

#### 4.2. Total sugars

The diploids and the polyploids did not show any significant variation for total sugar content. When the

variation was observed. The total sugar content was significantly higher in the triploids (14.75%) than in the tetraploids (10.69%).

The genomic groups in the diploids showed significantly different total sugar contents; the highest being in the group AB (16.73%) followed by BB (13.65%) and AA (10.80%).

The genomic groups within the triploids also differed significantly for total sugar content. The genomic group ABB had the highest sugar content (16.44%) followed by AAB (14.77%) and AAA (11.02%).

Within tetraploids the genomic group ABBB recorded a total sugar content of 14.76% which was significantly higher than that of AAAA (10.61%).

The percentage of total sugars varied from 5.60% in 'Wather' to 22.78% in 'Pacha chingan'.

Among the cultivars belonging to the diploid Musa acuminata group, the total sugars varied from 6.52 per cent in 'Namarai' to 19.27 per cent in 'Chingan'; among the AB cultivars from 13.25 per cent in 'Adakka kunnan' to 19.21 per cent in 'Sirumalai'. In 'Elavazhai' (BB) the percentage of total sugars was 13.65.

Among the cultivars belonging to the triploid Musa acuminata group, the percentage of total sugars



Varied from 5.60 in 'Wather' to 13.87 in 'Karim kadali', among the AAB cultivars from 8.59 in 'Thiruvananthapuram' to 22.78 in 'Pacha chingan' and among the ABB cultivars, from 6.94 in 'Walha' to 20.75 in 'Ney vanna'.

The tetraploid 'Bodles Altafort' (AAAA) recorded 10.61 per cent of total sugars, while the hybrid tetraploid 'Hybrid Sawai' (ABBB) recorded a higher value of 14.76%.

#### 4.3. Reducing sugars

The reducing sugar content was significantly lower in the polyploids (12.46%) compared to the diploids (13.53%). Within the polyploids, the triploids (12.51%) and the tetraploids (10.09%) also showed significant variation.

Within the diploids, the genomic groups differed significantly. The highest reducing sugar content was in the group AB (15.51%) followed by BB (10.25%) and AA (9.20%).

Within the triploids, the genomic groups showed significant variation for reducing sugar content. The genomic group ABB showed the highest reducing sugar content (14.26%) followed by AAB (13.14%) and AAA (9.24%).

The tetraploid 'Bodles Altafort' (AAAA) recorded a reducing sugar content of 8.37% which <sup>was</sup> significantly lower than that of 'Hybrid Sawai' (11.81%).

The reducing sugar content of the genomic groups followed a general pattern of distribution similar to that of total sugars.

The percentage of reducing sugars varied from 4.27 in 'Wather' (AAA) to 18.72 in 'Pacha chingan' (AAB).

Among the cultivars belonging to the diploid Musa acuminata group (AA), the percentage of reducing sugars varied from 5.69 in 'Eraichivazhai' to 14.87 in 'Chingan'; among the AB cultivars, from 12.78 in 'Adakka kunnan' to 18.31 in 'Sirumalai'. Elavazhai (B3) was having 10.25 per cent of reducing sugars.

Among the cultivars belonging to the triploid Musa acuminata group, the percentage of reducing sugars varied from 4.27 in 'Wather' to 12.55 in 'Galanamalu'; among the AAB cultivars, from 6.45 in 'Chinali' to 18.72 in 'Pacha chingan' and in the ABB cultivars, from 5.66 in 'Walha' to 18.50 in 'Peyan'.

The tetraploid 'Bodles Altafort' (AAAA) recorded 8.37 per cent of reducing sugars, whereas the hybrid tetraploid, Hybrid Sawai (ABBB) recorded a higher value of 11.81 per cent.

#### 4.4. Non reducing sugars

The non reducing sugar content of fruits differed significantly between the polyploids (1.95%) and the

diploids (1.76%). Within the polyploids the triploids and the tetraploids were on par.

Among the diploid genomic groups, the group BB had the highest non reducing sugar content (3.24%) followed by AB (1.74%) and AA (1.52%).

Among the triploid genomic groups, ABB had the highest non reducing sugar content (2.10%) and was significantly superior to AAB (2.00%) and AAA (1.64%) which did not differ significantly.

Among the tetraploid genomic groups, ABBB group recorded a non reducing sugar content of 2.87% which was significantly higher than that of AAAA group (1.19%).

The percentage of non reducing sugars showed a wide variation from 0.50 in 'Namarai'(AA) to 4.95 in 'Pacha bontha bathees' (ABB).

Among the cultivars belonging to the diploid Musa acuminata group, the percentage of non reducing sugars varied from 0.50 in 'Namari' to 4.19 in 'Chingan' and among the AB cultivars from 1.05 in 'Krishna vazhai' to 3.04 in 'Thaen kunnan'. Elavazhai (BB) had a non reducing sugar content of 3.24 per cent.

Among the cultivars belonging to the triploid Musa acuminata group, the percentage of non reducing sugars, varied from 0.90 in 'Gros Michel' to 3.76 in

'Pedda Pachaha' and among the AAB cultivars, from 1.10 in 'Sugandhi' to 3.87 in 'Pacha chingan' and in ABB cultivars from 1.07 in 'Peyan' to 4.95 in 'Pacha bontha bathees'.

The tetraploid of Musa acuminata group (AAAA) Bodles Altafort, recorded 1.19 per cent of non reducing sugars, while the hybrid tetraploid 'Hybrid Sawai' (ABBB) recorded 2.87 per cent.

#### 4.5. Acidity

The diploids and polyploids did not show significant difference in the acidity of fruits. Between triploids and tetraploids the acidity varied significantly being 0.33 per cent in the triploids and 0.25 per cent in the tetraploids.

Within the diploids the genomic group AB showed an acidity of 0.35 per cent which was significantly higher to that of BB 0.30 per cent and AA 0.29 per cent. The genomic groups AA and BB did not show any significant difference.

Within the triploids, the genomic groups AAB and ABB were on par with respect to acidity, being 0.38 per cent in AAB and 0.37 per cent in ABB. The acidity in the genomic group AAA 0.21 per cent was significantly lower to those of the other two groups.

Within the tetraploids, ABBB recorded a significantly higher acidity of 0.30 per cent as against that of 0.21 per cent in AAAA.

The percentage of acidity ranged from 0.14 in 'Pedda pacha' and 'Basrai' (AAA) to 0.54 in 'Muthia' (ABB).

Among the cultivars of the diploid Musa acuminata group, the percentage of acidity varied from 0.15 in 'Namarai' to 0.48 in 'Chingan'; among the AB cultivars, from 0.27 in 'Ney poovan' to 0.52 in 'Krishna vazhai'. In Musa balbisiana (Elavazhai) the acidity percentage was 0.30.

Among the triploid Musa acuminata cultivars, the percentage of acidity varied from 0.14 in 'Pedda pachcha' and 'Basrai' to 0.46 in 'Karim kadali', among the AAB cultivars, from 0.30 in 'Sugandhi' to 0.46 in 'Malakali' and in the ABB cultivars, from 0.20 in 'Walha' to 0.54 in 'Muthia'.

'Bodles Altafort', of the tetraploid Musa acuminata (AAAA) group, recorded an acidity percentage of 0.21 while the tetraploid, 'Hybrid Sawai' (ABBB) recorded 0.30 per cent.

#### 4.6. Sugar acid ratio

When the sugar/acid ratio of the polyploids and diploids was compared it was found that the polyploids (47.22) had significantly higher sugar/acid ratio than the diploids.

Within the polyploids the triploids recorded higher sugar/acid ratio (47.49) than the tetraploids (41.53).

Within the diploids, the genomic groups BB (48.55) and AB (48.38) did not show significant variation in respect of sugar/acid ratio while it was significantly lower in AA (38.74).

Within the triploids, the three genomic groups differed significantly in sugar/acid ratio, the highest value was in AAA (59.64) followed by ABB (46.88) and AAB (38.92).

Between the genomic groups in the tetraploids, the sugar/acid ratio did not vary significantly, though the genomic group AAAA recorded a higher value (44.58) than ABBB (38.48).

The sugar acid ratio among the different cultivars showed a wide range of variation from 17.76 per cent from 'Wather' to 89.41 in 'Pedda pachcha'.

Among the cultivars belonging to the diploid Musa acuminata group (AA), the sugar acid ratio varied from 18.31 in 'Eraichivazhai' to 47.77 in 'Sanna chenkadali', among the AB cultivars, from 31.65 in 'Krishna vazhai' to 59.25 in 'Ney poovan' and in 'Elvazhai' (BB) the ratio was 48.55.

Among the cultivars belonging to the triploid Musa acuminata group (AAA) the sugar acid ratio varied from 17.76 in 'Wather' to 89.41 in 'Pedda pachcha'. Among the AAB cultivars, the range was from 23.47 in 'Thiruvananthapuram' to 60.76 in 'Pacha chingan'. In the ABB group, sugar/acid ratio varied from 30.23 in 'Kallu monthan' to ~~79.96~~ in 'Pey kunnan'.

The cultivar belonging to the tetraploid Musa acuminata group (AAAA), 'Bodles Altafort' recorded a sugar acid ratio of 44.58, whereas in the tetraploid hybrid (ABBB), 'Hybrid Sawai', the ratio was slightly lower (38.48).

#### 5. Effect of ploidy and genomic constitution on pollen characters of banana cultivars

Among the 62 cultivars, 22 cultivars were non-polleniferous. All the cultivars belonging to the genomic group AB; 'Pacha chingan', 'Mannan', 'Malakali', 'Pacha nadan', 'Nendra padaththi', 'Chara padaththi' and 'Kullan' belonging to the genomic group AAB; and 'Walha', 'Ashy batheesa' and 'Jurmoney kunthali' belonging to the genomic group ABB, did not produce pollen grains. The list of non polleniferous cultivars are given in Table 13.

Pollen viability, size of the pollen grains and the pollen production per anther, as influenced by the ploidy and the genome are presented in Table 14 (Plate 47-49). The pollen characters of cultivars under each genomic group are presented in Table 15.

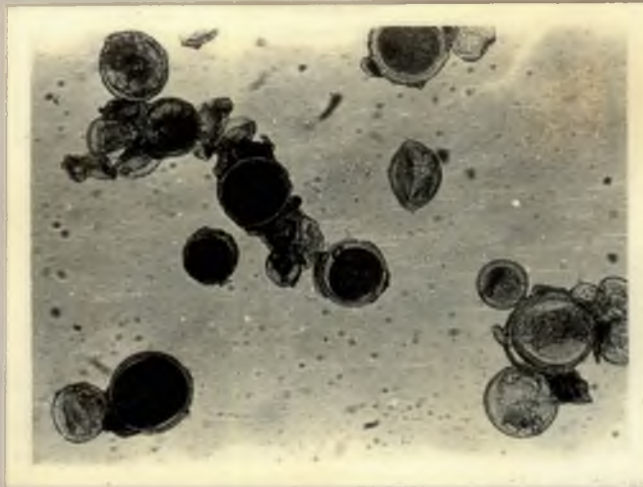
Table 13. Non polleniferous banana cultivars

Genomic group	Cultivar	Remarks
AB	Agniswar	Anther lobes black, thread like structures
	Krishna vashai	Anther lobes well developed; but contain no pollen grains
	Virupakshi	
	Sirumalai	
	Vannan	
	Ney poovan	
	Adakka kunnan	
	Valiya kunnan	
	Thaen kunnan	
	AB	Kostha bontha
Venneettu mannan		
Padalimoongil		Male axis absent
AAB	Nendra padaththi	Anther lobes well developed, but do not contain pollen grains
	Pacha nadan	
	Charapadaththi	Anther lobes black, thread like structures
	Malakali	
	Mannan	
Pacha chingan		
	Kullan	Anther lobes of some of the flowers are well developed others black thread like
ABB	Walha	Each female flower has one or two well developed stamens the anther lobes of which do not contain pollen grains.
	Ashy batheesa	
	Jumoney kunthali	Anther lobes are black thread like structures

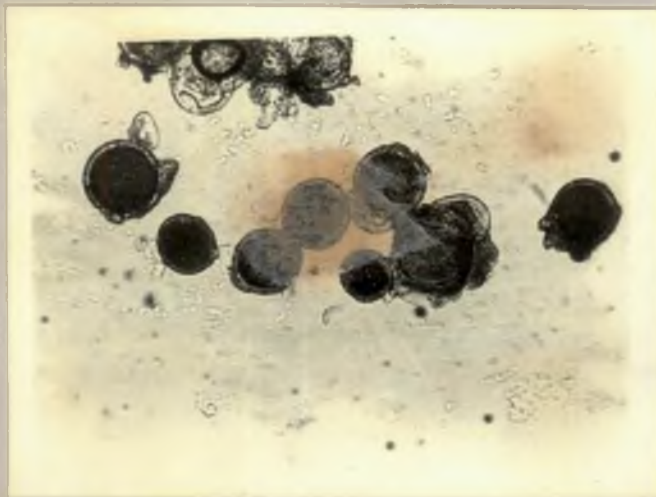


Table 14 Effect of ploidy and genome on pollen characters of banana cultivars

Groups	Size of pollen (micron)	Pollen viability (%)	Pollen production per anther
Diploids	175.28	67.67 (56.18)	7129.78 (3.76)
Polyploids	207.67	51.37 (45.48)	5431.77 (3.68)
C.D. (0.05)	2.396	0.369	0.026
<u>Polyploids</u>			
Triploids	209.68	49.85 (44.50)	5022.40 (3.66)
Tetraploids	175.50	75.75 (61.13)	11981.67 (4.08)
<u>Diploids</u>			
AA	178.20	62.51 (52.47)	5129.09 (3.66)
AB	-	-	-
BB	160.67	93.10 (74.80)	17133.33 (4.23)
C.D. (0.05)	5.928	0.914	0.064
<u>Triploids</u>			
AAA	224.55	62.89 (51.21)	5452.12 (3.70)
AAB	220.86	43.80 (41.44)	3167.62 (3.47)
ABB	192.40	42.64 (40.76)	5612.14 (3.73)
C.D. (0.05)	192.99	0.461	0.032
<u>Tetraploids</u>			
AAAA	186.67	86.80 (68.70)	11546.67 (4.06)
ABBB	164.33	64.69 (53.55)	12416.67 (4.09)
C.D. (0.05)	7.65	1.18	0.082



A



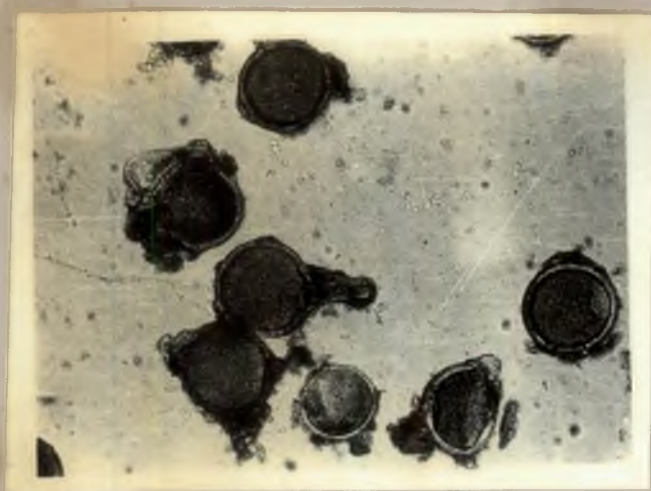
B

Plate 47 Pollen grains of banana ( $2n = 22$ )

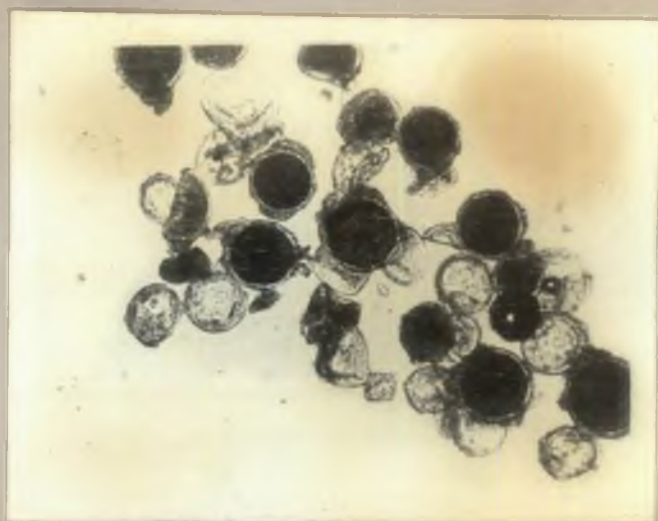
A Musa (AA Group) 'Namarai'

B Musa (BB Group) 'Elavazhai' (Musa balbisiana)

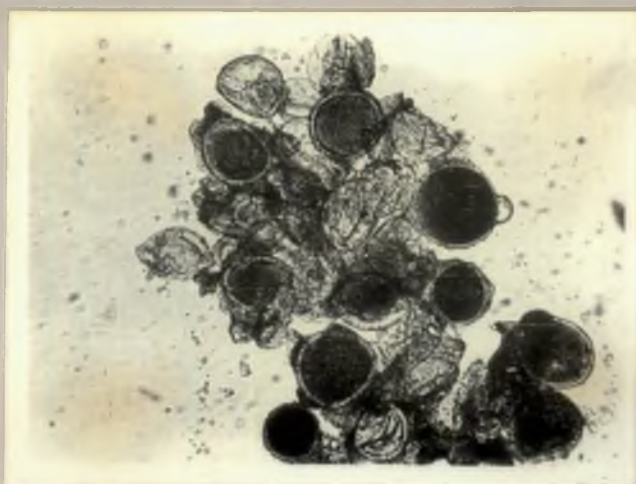
(A, B -  $\times 500$ )



A



B



C

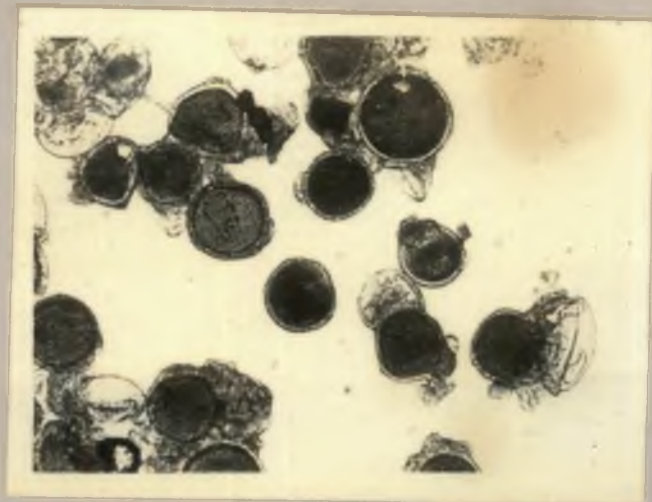
Plate 48 Pollen grains of banana ( $2n = 33$ )

A Musa (AAA Group) 'Gros Michel'

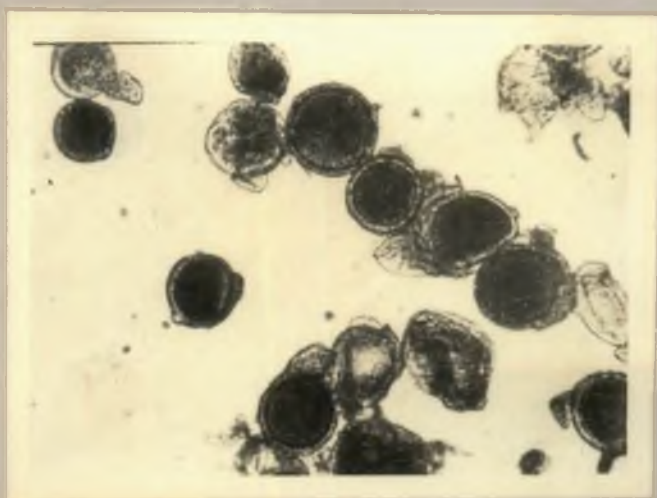
B Musa (AAB Group) 'Dudhsagar'

C Musa (ABB Group) 'Pacha bontha bathees'

(A, B, C - x 500)



A



B

Plate 49 Pollen grains of banana ( $2n = 44$ )  
A Musa (AAAA Group) 'Bodles Altafort'  
B Musa (ABBB Group) 'Hybrid Sawai'  
(A, B - x 500)

Table 15 Mean values of the pollen characters of 40 cultivars of banana belonging to different genomic groups

Cultivars	Pollen characters		
	Pollen viability (%)	Size of pollen (micron)	Pollen production per anther
1	2	3	4
<b>AA</b>			
Namarai	71.92 (57.99)	172.70	4552.00 (3.658)
Chingan	72.30 (58.27)	177.67	3530.00 (3.551)
Tongat	74.23 (59.49)	160.67	4680.00 (3.67)
Eraichivazhai	41.96 (40.38)	200.00	10310.00 (4.01)
Sanna chenkadali	52.12 (46.19)	180.00	2573.33 (3.410)
<b>BB</b>			
Elavazhai ( <u>Musa balbisiana</u> )	93.10 (74.80)	161.00	17133.33 (4.234)
<b>AAA</b>			
Gros Michel	78.02 (62.03)	242.00	7806.67 (3.892)
Highgate	56.00 (45.46)	218.00	5513.33 (3.741)
Pedda pachcha	80.45 (63.77)	221.00	4510.00 (3.654)
Basrai	35.28 (36.57)	241.00	3526.67 (3.544)
Harichal	80.38 (63.12)	201.00	4520.00 (3.653)
Sapumal anamalu	79.80 (63.29)	240.00	7516.67 (3.876)
Manoranjithm	17.26 (24.52)	200.00	5023.33 (3.701)
Galanamalu	78.85 (62.49)	242.33	5916.67 (3.772)

(Contd.)

Table 15 (Contd.)

1	2	3	4
Red banana	69.11 (56.25)	235.00	5283.33 (3.723)
Wather	45.91 (42.65)	210.00	5906.67 (3.771)
Karim kadali	40.67 (39.62)	220.00	4450.00 (3.648)
<u>AAB</u>			
Thiruvananthapuram	47.50 (43.57)	212.00	3730.00 (3.572)
China	33.39 (35.30)	244.00	3406.67 (3.532)
Rasthali	43.69 (41.38)	216.00	3120.00 (3.294)
Dudhsagar	45.55 (42.48)	204.00	4283.33 (3.6317)
Sugandhi	41.07 (39.84)	218.00	3110.00 (3.493)
palayankodan	46.87 (43.22)	215.00	1110.00 (3.045)
Chinalli	48.50 (44.23)	238.00	3413.33 (3.533)
<u>ABB</u>			
Karpooravally	55.30 (48.06)	260.00	3110.00 (3.493)
Chirapunchi	41.73 (40.24)	256.00	3610.00 (3.080)
Pey kunnan	65.72 (54.17)	275.00	3030.00 (3.481)
Ney vannan	45.20 (42.26)	160.00	7806.67 (3.893)
Alukehel	41.95 (40.38)	160.00	6816.67 (3.834)
Kapok	38.69 (38.57)	182.00	6503.33 (3.813)
Peyan	31.90 (34.39)	150.00	6006.67 (3.785)

(Contd.)

Table 15 (Contd.)

1	2	3	4
Pacha bontha bathees	39.80 (39.11)	180.00	6216.67 (3.793)
Muthia	44.17 (41.65)	178.00	7033.33 (3.849)
Kari bontha	32.15 (34.55)	200.00	5506.67 (3.741)
Malai monthan	37.15 (37.56)	163.00	4506.67 (3.654)
Bluggoe	45.25 (42.42)	160.00	6003.33 (3.778)
Chetti	46.61 (43.07)	163.00	6210.00 (3.793)
Kallu monthan	31.58 (34.18)	207.00	6210.00 (3.792)
<u>AAAA</u>			
Bodles Altafort	86.80 (68.70)	186.67	11546.67 (4.063)
<u>ABBB</u>			
Hybrid Sawai	64.69 (53.55)	164.33	12416.69 (4.094)
C.D. (0.05)	1.18	7.65	0.082

Letters in parenthesis denote mean of transformed values  
(Angular and logarithmic)

### 5.1. Pollen viability

When the diploids and the polyploids were compared with respect to pollen viability, the diploids (67.67%) were significantly superior to the polyploids (51.37%). Within the polyploids, the triploids were found to have significantly lower pollen viability (49.85%) than the tetraploids (75.75%).

Within the diploids, Musa balbisiana (BB) recorded 93.10 per cent pollen viability as against 62.51 per cent in the group AA, the former being significantly higher than the latter.

Within the triploids, the groups differed significantly. Pollen viability was the highest in AAA (62.89%) followed by AAB (43.80%) and ABB (42.64%).

Within the tetraploids, the genomic group AAAA recorded 86.80 per cent pollen viability, which was significantly higher than that of ABBB (64.69%).

Among the 40 cultivars the pollen viability varied from 17.26 per cent in 'Manoranjithm' to 93.10 per cent in 'Elavazhai' (Musa balbisiana).

Among the diploids of the genomic group AA, it varied from 41.96 per cent in 'Eraichivazhai' to 74.23 per cent in 'Tongat'.

Among the triploids of the genomic group AAA, the viability of pollen grains was generally high except in



'Manoranjithm' which recorded the lowest value, 17.26 per cent. The percentage pollen viability was the highest in 'Pedda pachcha' (80.45). Among the cultivars of the genomic group AAB, pollen viability varied from 33.39 per cent in 'China' to 48.50 per cent in 'Chinali'; among the ABB cultivars, from 31.58 per cent in 'Kallu monthan' to 65.72 per cent in 'Pey kunnan'. The pollen viability was below 50 per cent in cultivars of ABB group, except in 'Karpooravally' (55.30%) and 'Peykunnan' (65.72%).

The tetraploid 'Bodles Altafort' (AAAA) recorded a pollen viability of 86.80 per cent while it was 64.69 per cent in 'Hybrid Sawai' (ABBB).

## 5.2. Size of pollen

The polyploids recorded a mean size of 207.67 and the diploids, 175.28  $\mu$  which was significantly lower than that of the former. Within the polyploids, the mean size of pollen grains in the triploid was 209.68  $\mu$  as against 175.50  $\mu$  in the tetraploids.

Within the diploids, the groups differed significantly with respect to the size of pollen grains. In AA it was 178.2  $\mu$  which was significantly higher than that of BB (160.67  $\mu$ ).

Within the triploids also, the genomic groups differed significantly. The largest pollen grains were produced by AAA group (224.55  $\mu$ ) followed by AAB (220.86  $\mu$ ) and ABB (192.40  $\mu$ ).

Within the tetraploids, the genomic group AAAA (186.67  $\mu$ ) had longer pollen grains than ABBB (164.33  $\mu$ ).

The mean size of pollen grains varied significantly among the 40 cultivars from 150  $\mu$  in 'Peyan' (ABB) to 275  $\mu$  in 'Pey kunnan' (ABB).

Among the cultivars of the genomic group AA the size of pollen grains varied from 160.67  $\mu$  in 'Tongat' to 200  $\mu$  in 'Eraichivazhai'. In 'Elavazhai' Musa balbisiana the pollen size was 161  $\mu$ .

The triploid Musa acuminata group produced pollen grains varying in size from 200  $\mu$  in 'Menoranjithm' to 242.23  $\mu$  in 'Galanamalu'. In the genomic group AAB the size of pollen grains varied from 204  $\mu$  in 'Dudh sagar' to 244  $\mu$  in 'China' and among the ABB cultivars from 150  $\mu$  in 'Peyan' to 275  $\mu$  in 'Pey kunnan'.

The tetraploid, 'Bodles Altafort' (AAAA), produced pollen grains of mean size 186.67  $\mu$  and 'Hybrid Sawai' (ABBB) 164.33  $\mu$ .

### 5.3. Pollen production

When the diploids and the triploids were compared, the diploids produced 7129.78 pollen grains per anther and the polyploids, 5431.77 per anther. The two differed significantly. Within the polyploids the tetraploids (11981.67)

produced significantly higher number of pollen grains per anther than the triploids (5022.40).

Within the diploids the pollen production per anther in Musa balbisiana (BB) was 17133.33 and this was significantly higher than that of the genomic group AA (5129.09).

Within the triploids the number of pollen grains produced per anther was the highest in the group ABB(5612.14) followed by AAA (5452.12) and AAB (3167.62). The groups AAA and ABB were on par, while group AAB differed significantly from the two.

The two tetraploid groups did not show significant difference with respect to pollen production.

Among the 40 polleniferous cultivars, the pollen production per anther varied from 2573.33 in 'Sanna chenkadali' (AA) to 17133.33 in 'Elavazhai' (BB). Among the cultivars of the diploid Musa acuminata group (AA) 'Eraichivazhai' produced the largest number of pollen grains per anther (10310).

Among the cultivars belonging to the genomic group AAA, the pollen production per anther ranged from 3526.67 in 'Harichal' to 7806.67 in 'Gros Michel'; among the AAB cultivars from 1110 in 'Palayankodan' to 4283.33 in 'Dudh sagar' and among the ABB cultivars from 3030 per anther in 'Pey kunnan' to 7806.67 per anther in 'Ney vanna'.

The tetraploid 'Bodles Altafort' (AAAA) produced 11546.67 pollen grains per anther and 'Hybrid Sawai' (ABBB) 12416.69 pollen grains per anther.

## 6. Ranking of cultivars on the basis of quantitative, quality and pollen characters

In Table 16, the ranks given to genomic groups and the rank totals are given when they are arranged in descending order with respect to each of the characters. In each character rank 1 denotes the genomic group having the highest value and rank 8 denotes the group having the lowest value.

### 6.1. Growth parameters

Plant height, plant girth, leaves per plant, leaf area per plant and petiole length were influenced by the genomic constitution of the cultivars. In all the characters, Musa balbisiana (BB) recorded the highest values while the lowest values were recorded by the Musa acuminata groups. Within the triploids, the genomic group ABB recorded the highest values and the group AAA recorded the lowest values in all the characters except in the number of leaves.

### 6.2. Duration

The duration of the crop was not influenced by the genomic constitution and ploidy level.

Table 16 Ranking of genomic groups on the basis of quantitative, quality and pollen characters of banana cultivars

Characters	AA	AB	BB	AAA	AAB	ABB	AAAA	ABBB
1	2	3	4	5	6	7	8	9
<u>Growth parameters</u>								
Plant height (cm)	8	3	1	6	5	2	4	7
Plant girth (cm)	8	5	1	7	6	2	4	3
Leaves per plant	7	4	1	3	6	2	8	5
Leaf area per plant (m <sup>2</sup> )	8	5	1	4	3	2	6	7
Petiole length (cm)	7	4	1	8	6	3	2	5
Rank Total	38	21	5	28	26	11	24	27
<u>Duration (days)</u>								
Planting to flowering interval	6	5	1	4	8	7	3	2
Flowering to harvest interval	8	6	1	3	2	4	5	7
Rank Total	14	11	2	7	10	11	8	9

(Contd.)

Table 16 (Contd.)

1	2	3	4	5	6	7	8	9
<u>Bunch characters</u>								
Bunch weight (kg)	7	5	6	3	4	2	1	8
Hand weight (g)	8	7	6	2	4	3	1	5
Number of hands	3	4	8	5	2	1	7	6
Number of fingers	3	2	8	6	4	1	7	5
Rank Total	21	18	28	16	14	7	16	24
<u>Finger characters</u>								
Pedicel length (cm)	6	4	1	8	5	2	7	3
Finger length (cm)	6	5	7	2	4	3	1	8
Finger girth (cm)	8	7	1	5	6	3	2	4
Finger weight (g)	8	7	5	2	4	3	1	6
Finger volume (cc)	7	6	8	1	4	2	3	5
Per cent pulp weight	4	5	1	3	2	7	6	8
Pulp/peel ratio on weight basis	1	3	2	5	4	6	7	8
Per cent pulp volume	3	2	7	4	5	6	1	8
Pulp/peel ratio on volume basis	3	2	7	5	4	6	1	8
Rank Total	45	14	19	34	25	16	37	26

(Contd.)

Table 16 (Contd.)

1	2	3	4	5	6	7	8	9
<u>Quality characters</u>								
TSS (%)	8	1	2	7	6	3	4	5
Total sugars (%)	8	1	5	6	4	2	7	3
Reducing sugars (%)	8	1	5	6	4	2	7	3
Non reducing sugars (%)	8	5	1	6	4	3	7	2
Acidity (%)	6	3	4	8	1	2	7	5
Sugar/acid ratio	7	3	2	1	6	4	5	8
Rank Total	45	14	19	34	25	16	37	26
<u>Pollen characters</u>								
Pollen viability (%)	4	-	1	5	6	7	2	3
Size of pollen ( $\mu$ )	5	-	7	1	2	3	4	6
Pollen production per anther	6	-	1	5	7	4	3	2
Rank Total	15	-	9	11	15	14	9	11

Musa balbisiana (BB) took the longest duration from planting to flowering and from flowering to harvest. Planting to flowering interval was the least in the genomic group AAB while the flowering to harvest interval was the least in AA. The other two Musa acuminata genomic groups, AAA and AAAA took longer time than the genomic groups having both Musa acuminata and Musa balbisiana genomes.

### 6.3. Bunch characters

The characters bunch weight, hand weight, number of hands and number of fingers were influenced by the ploidy and genomic constitution of the cultivars. The triploids were superior to the diploids and tetraploids in bunch characters as indicated by their lower total scores. Within the diploids, the genomic group AB and within the triploids, the genomic groups AAB and ABB were superior to Musa acuminata groups (AA and AAA) and Musa balbisiana (BB).

### 6.4. Finger characters

The length of pedicel was influenced by the genomic constitution of the cultivars. Musa balbisiana (BB) and the genomic groups AB<sup>3</sup> and ABBB had longer pedicels than Musa acuminata groups (AA, AAA and AAAA). Genomic groups AB and AAB were intermediate between predominantly Musa balbisiana groups (ABB and ABBB) and Musa acuminata group (AA, AAA and AAAA).



The length, girth, weight, volume, percentage of pulp and pulp/peel ratio were influenced by the ploidy, and the genomic constitution of the cultivars. The triploids and the tetraploid (AAAA) were superior to the diploids in finger characters. Among the genomic groups Musa acuminata groups obtained the first two ranks (AAAA and AAA) followed by predominantly Musa acuminata group (AAB). Musa balbisiana (BB) and predominantly Musa balbisiana groups (ABB and ABBB) were inferior in finger characters.

#### 6.5. Quality characters

The quality characters the percentages of TSS, total sugars, reducing sugars, non reducing sugars, acidity and sugar/acid ratio were influenced by the genomic constitution of the cultivars. The genomic groups with both Musa acuminata and Musa balbisiana genomes (AB, AAB, ABB and ABBB) recorded higher values for total sugars, reducing sugars, non reducing sugars and acidity than Musa acuminata groups (AA, AAA and AAAA). The genomic group AAA recorded the highest value for sugar/acid ratio.

#### 6.6. Pollen characters

Musa balbisiana (BB) and the tetraploids recorded higher values for pollen viability and pollen production. Within the triploids and the tetraploids, the genomic groups AAA and AAAA recorded the highest values for pollen viability. The triploids had larger pollen grains than the

diploids and the tetraploids. Within each ploidy Musa acuminata groups had the largest pollen grains. Within the diploids, Musa balbisiana (BB), within the triploids, the genomic group ABB, and within the tetraploids, the genomic group AB3B, produced larger number of pollen grains per anther than the other genomic groups.

## 7. Growth functions and assessment of growth rates

The linear functions gave a better fit for the genomic groups and cultivars than the exponential function, the coefficients of determination being higher in linear function. The linear growth curves of the genomic groups for plant height, plant girth, leaves per plant, leaf area per plant and petiole length are presented in Fig.1.

### 7.1. Influence of ploidy and genomic constitution on growth rate

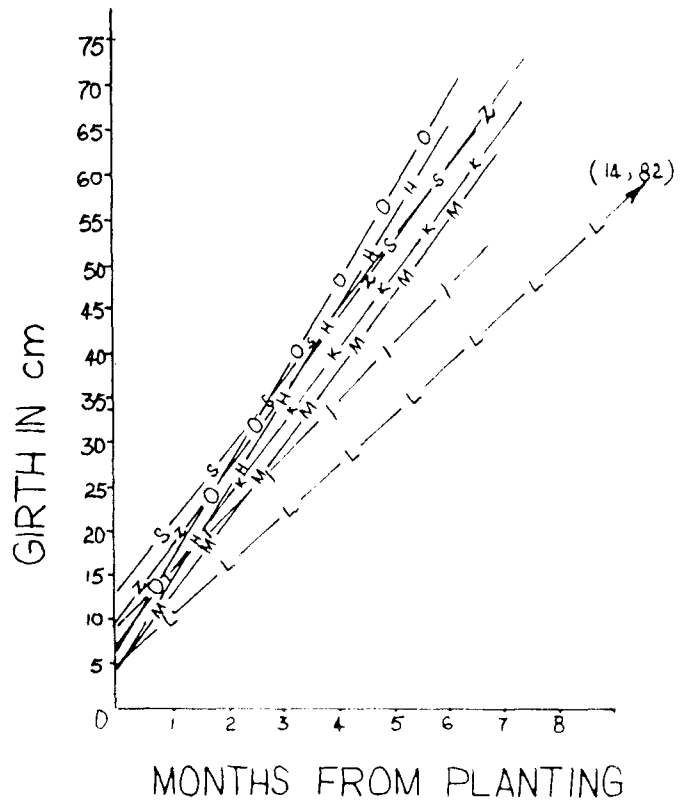
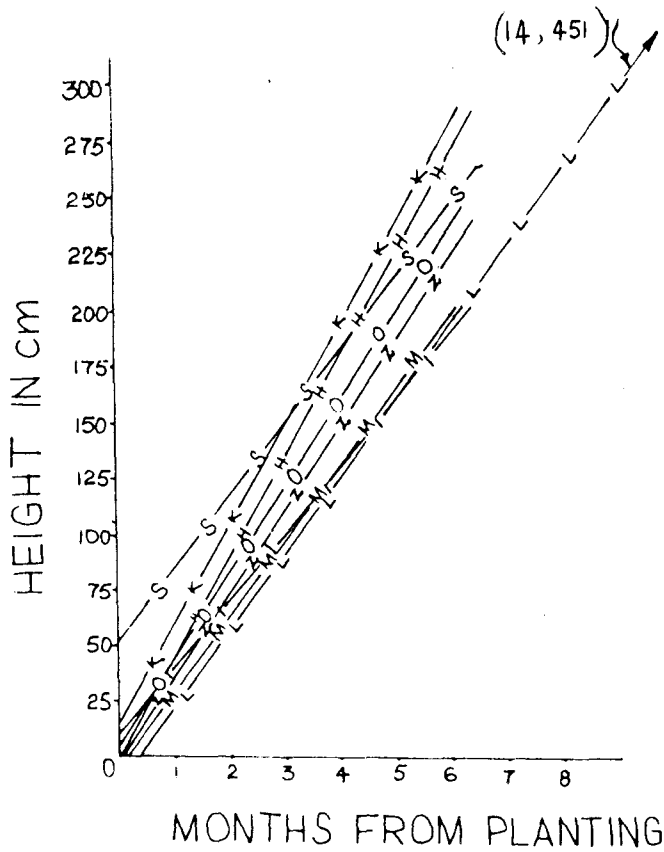
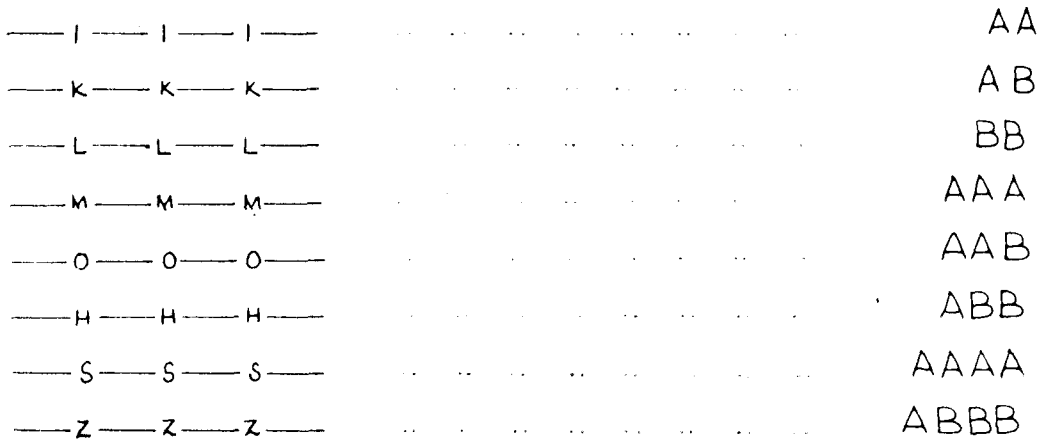
The growth rates, the regression equation and the coefficients of determination for plant height, girth, leaves per plant, leaf area per plant and petiole length, for the genomic groups are presented in Table 17. The linear functions were having higher coefficients of determination, ranging from 0.8817 to 0.9982, than the exponential function.

The genomic groups were ranked according to the growth rates (linear) for different characters (Table 18). The growth rates of the genomic groups are presented in Fig.2.

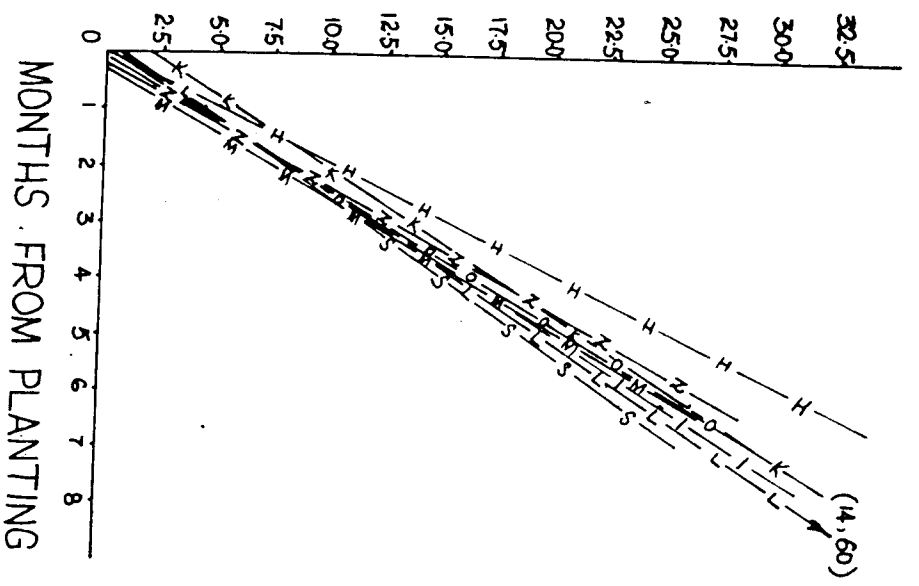
FIG. 1

LINEAR GROWTH CURVES OF GENOMIC GROUPS

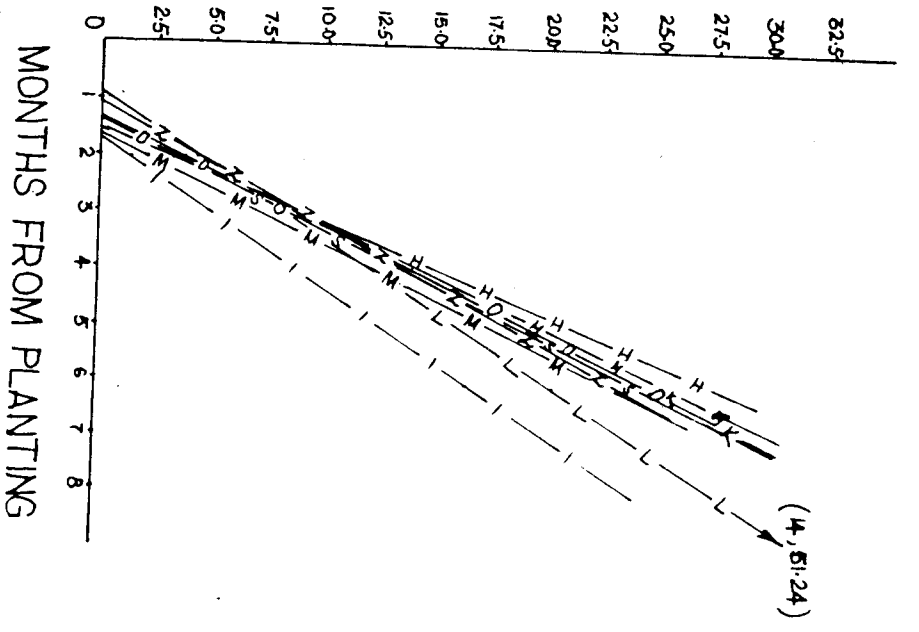
$$\hat{Y} = A + Bt$$



NUMBER OF LEAVES



LEAF AREA PER PLANT IN m<sup>2</sup>



LENGTH OF PETIOLE IN cm

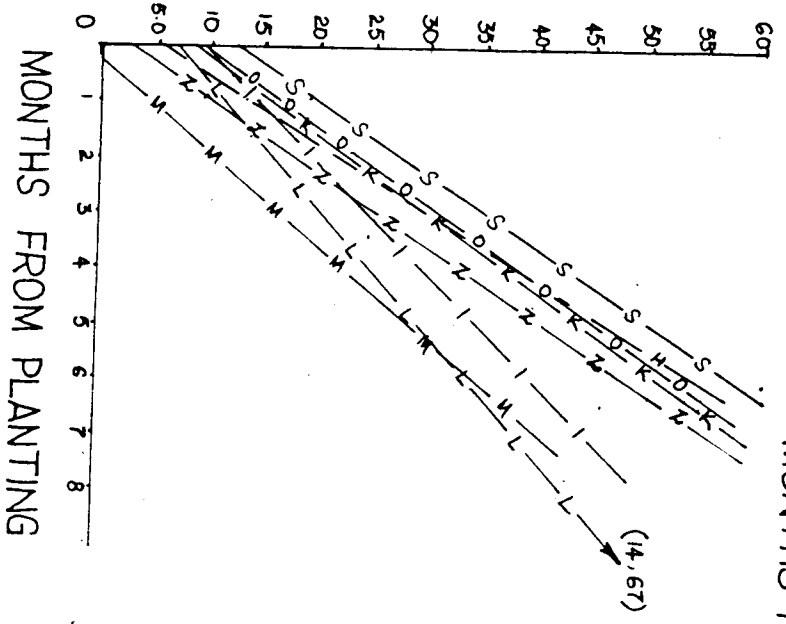


Table 17. Growth rate, prediction equation and coefficient of determination for different characters of the genomic groups of banana

Character	Growth rate		Prediction equation			Coefficient of determination	
	Relative	Linear	Exponential		Linear	Exponential	Linear
1	2	3	4	5	6	7	
<b>AA</b>							
Plant height (cm)	42.90	31.76	29.14	$(1.429)^t$	$7.76 + (31.76)t$	0.8686	0.9506
Plant girth (cm)	10.22	6.56	1.12	$(1.102)^t$	$9.49 + (6.56)t$	0.8714	0.9312
Leaves per plant	42.72	4.20	3.51	$(1.427)^t$	$-0.29 + (4.20)t$	0.9285	0.9982
Leaf area per plant (m <sup>2</sup> )	150.84	3.34	1.22	$(2.508)^t$	$-4.98 + (3.34)t$	0.8482	0.9438
Petiole length (cm)	23.25	4.92	12.12	$(1.233)^t$	$9.65 + (4.92)t$	0.8853	0.9589
<b>AB</b>							
Plant height (cm)	34.03	37.30	44.03	$(1.340)^t$	$17.91 + (37.30)t$	0.8409	0.9526
Plant girth (cm)	10.07	7.28	1.16	$(1.100)^t$	$11.74 + (7.28)t$	0.7961	0.8817
Leaves per plant	34.15	3.99	4.61	$(1.342)^t$	$1.61 + (3.99)t$	0.8608	0.9504
Leaf area per plant (m <sup>2</sup> )	103.33	5.18	0.42	$(2.033)^t$	$-6.67 + (5.18)t$	0.8172	0.9883
Petiole length (cm)	24.39	7.64	14.34	$(1.244)^t$	$7.90 + (7.64)t$	0.8409	0.9667

(Contd.)

Table 17. (Contd.)

	1	2	3	4	4	5	6	7
<b><u>BB</u></b>								
Plant height (cm)	25.00	32.85	19.58	(1.250) <sup>t</sup>	-8.35 + (32.85)t	0.8172	0.9883	
Plant girth (cm)	16.50	5.44	9.66	(1.165) <sup>t</sup>	5.81 + (5.44)t	0.8935	0.9315	
Leaves per plant	23.80	4.33	3.03	(1.238) <sup>t</sup>	-0.58 + (4.33)t	0.8415	0.8915	
Leaf area per plant (m <sup>2</sup> )	59.00	4.36	0.76	(1.590) <sup>t</sup>	-3.81 + (3.93)t	0.8718	0.8816	
Petiole length (cm)	15.10	3.93	9.34	(1.151) <sup>t</sup>	6.39 + (4.36)t	0.8215	0.9519	
<b><u>AAA</u></b>								
Plant height (cm)	47.47	34.80	24.15	(1.475) <sup>t</sup>	-7.09 + (34.80)t	0.9035	0.9982	
Plant girth (cm)	34.96	8.23	10.44	(1.350) <sup>t</sup>	4.96 + (8.23)t	0.8742	0.9730	
Leaves per plant	46.86	4.55	3.14	(1.469) <sup>t</sup>	-1.29 + (4.54)t	0.9413	0.9982	
Leaf area per plant (m <sup>2</sup> )	165.95	5.30	0.13	(2.659) <sup>t</sup>	-8.37 + (5.30)t	0.9370	0.9370	
Petiole length (cm)	31.46	5.58	8.63	(1.315) <sup>t</sup>	5.48 + (5.58)t	0.8601	0.9602	

(Contd.)

Table 17. (Contd.)

	1	2	3	4	5	6	7
<b><u>AAB</u></b>							
Plant height (cm)	43.15	38.98	33.15 (1.432) <sup>t</sup>	1.38 + (38.99)t	0.8879	0.9793	
Plant girth (cm)	31.31	8.43	13.41 (1.313) <sup>t</sup>	9.28 + (8.43)t	0.8208	0.9151	
Leaves per plant	43.62	4.56	3.61 (1.436) <sup>t</sup>	-0.69 + (4.55)t	0.9368	0.9942	
Leaf area per plant (m <sup>2</sup> )	134.21	5.21	0.29 (2.342) <sup>t</sup>	-6.54 + (5.21)t	0.8495	0.9797	
Petiole length (cm)	25.72	6.97	13.52 (1.257) <sup>t</sup>	8.92 + (6.97)t	0.8497	0.9520	
<b><u>ABB</u></b>							
Plant height (cm)	49.62	47.31	30.95 (1.496) <sup>t</sup>	-7.65 + (47.31)t	0.8664	0.9588	
Plant girth (cm)	37.25	10.34	11.81 (1.373) <sup>t</sup>	4.90 + (10.34)t	0.8619	0.9573	
Leaves per plant	42.59	5.07	4.30 (1.426) <sup>t</sup>	-0.15 + (5.07)t	0.9120	0.9974	
Leaf area per plant (m <sup>2</sup> )	108.45	5.96	0.53 (2.085) <sup>t</sup>	-8.31 + (5.96)t	0.9178	0.9778	
Petiole length (cm)	32.86	8.20	11.43 (1.329) <sup>t</sup>	5.94 + (8.20)t	0.8976	0.9809	

Table 17. (Contd.)

	1	2	3	4	5	6	7
<b>AAAA</b>							
Plant height (cm)	28.03	33.98	30.95 (1.496) <sup>t</sup>	-7.65 + (43.31)t	0.8664	0.9588	
Plant girth (cm)	24.48	7.96	11.81 (1.373) <sup>t</sup>	<del>10.96</del> + (10.34)t	0.8619	0.9573	
Leaves per plant	38.36	3.71	4.30 (1.426) <sup>t</sup>	-0.15 + (5.07)t	0.9120	0.9974	
Leaf area per plant (m <sup>2</sup> )	144.12	4.91	0.53 (2.085) <sup>t</sup>	-8.31 + (5.96)t	0.9178	0.9728	
Petiole length (cm)	27.15	8.36	11.49 (1.329) <sup>t</sup>	5.94 + (8.20)t	0.8976	0.9809	
<b>ABBB</b>							
Plant height (cm)	51.46	37.93	23.83 (1.515) <sup>t</sup>	-4.00 + (37.93)t	0.8270	0.9126	
Plant girth (cm)	28.20	8.41	14.99 (1.282) <sup>t</sup>	9.62 + (8.71)t	0.9657	0.9069	
Leaves per plant	49.76	4.74	3.04 (1.498) <sup>t</sup>	-1.18 + (4.74)t	0.8925	0.9888	
Leaf area per plant (m <sup>2</sup> )	150.00	4.72	0.21 (2.500) <sup>t</sup>	-5.08 + (4.72)t	0.7960	0.9512	
Petiole length (cm)	38.10	7.94	8.20 (1.381) <sup>t</sup>	1.46 + (7.94)t	0.9249	0.9817	

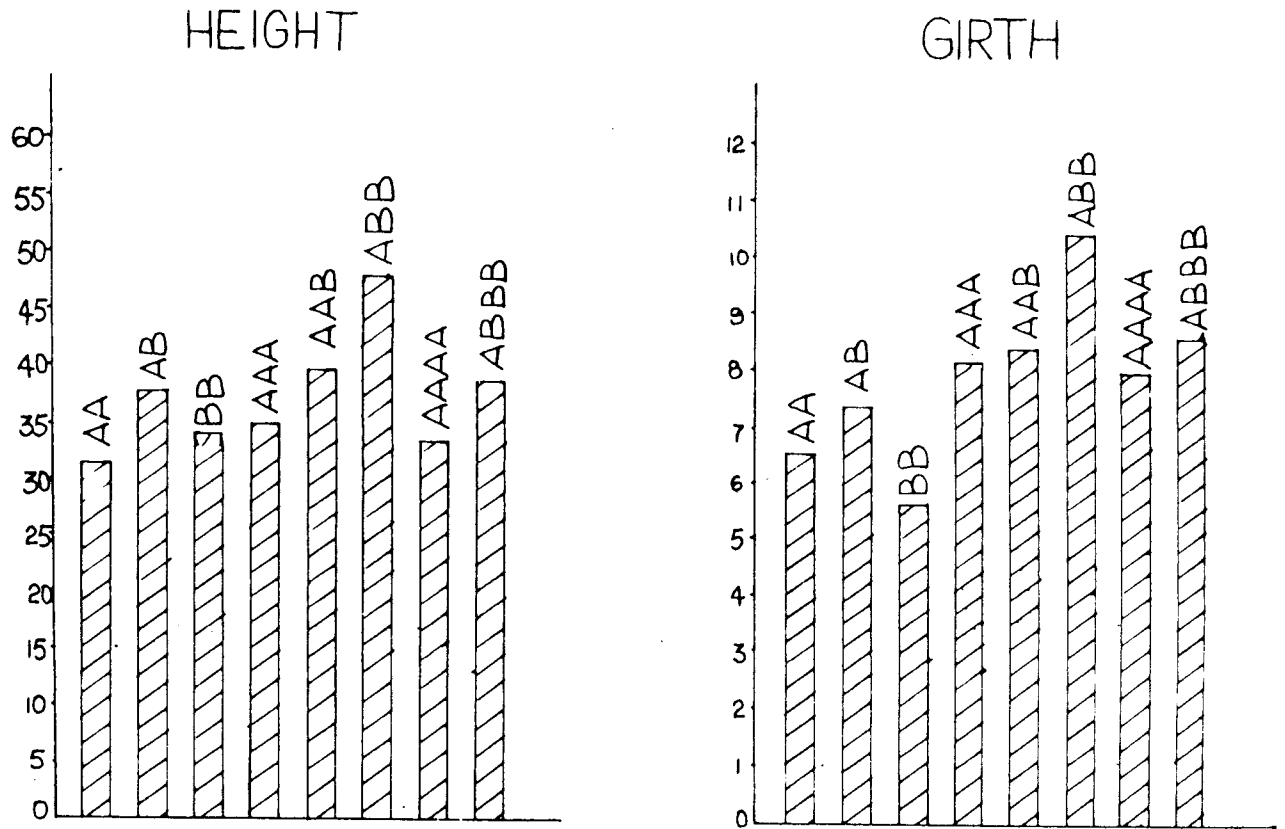


Table 18 Ranking of genomic groups for growth rates

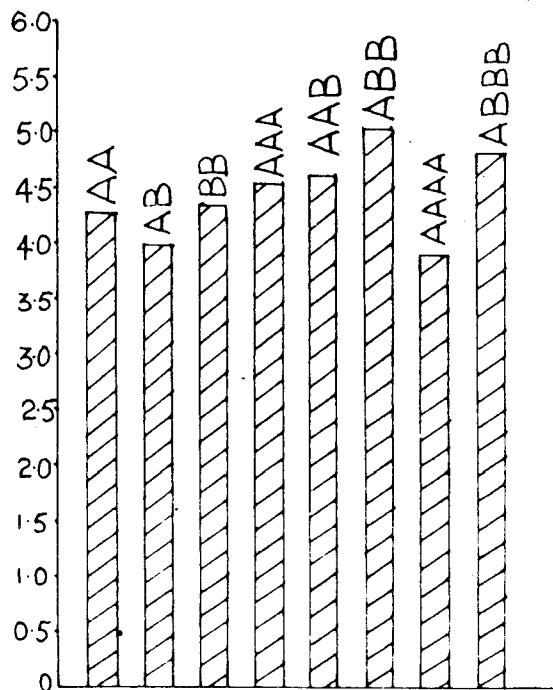
Genomic groups	Ranks assigned to genomic groups for growth rates					Rank Total
	Plant height	Plant girth	Leaves per plant	Leaf area per plant	Petiole length	
AA	8	7	6	8	7	36
AB	4	6	7	4	4	35
BB	7	8	5	7	8	35
AAA	5	4	4	2	6	21
AAB	2	2	3	3	5	15
ABB	1	1	1	1	2	6
AAAA	6	5	8	5	1	25
ABBB	3	3	2	6	3	17

FIG 2

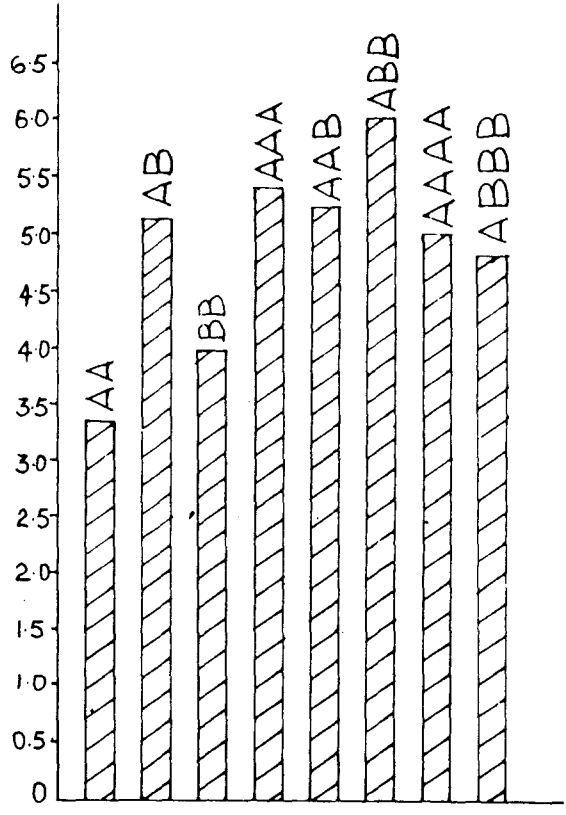
# LINEAR GROWTH RATES OF GENOMIC GROUPS



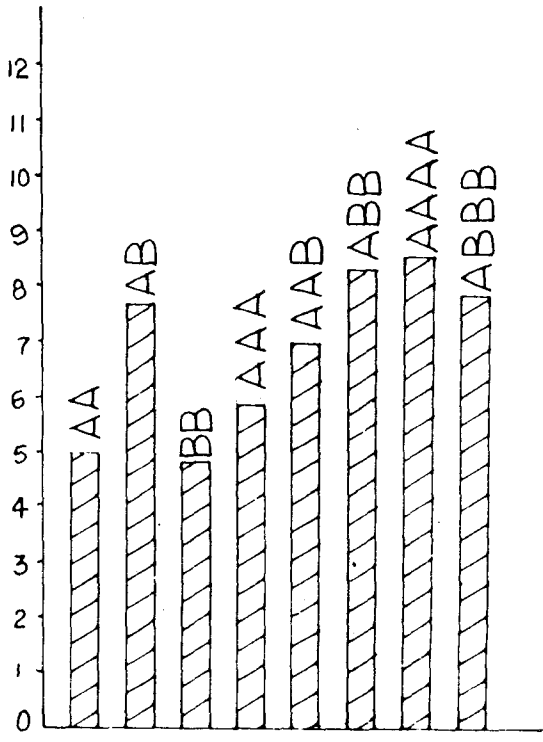
## NUMBER OF LEAVES



# LEAF AREA PER PLANT



# LENGTH OF PETIOLE



The triploids had higher growth rates than the diploids and the tetraploids. The genomic group ABB had the highest growth rates in all the characters except for petiole length. The genomic group AA recorded the lowest growth rates in plant height and leaf area per plant while the group BB recorded the lowest growth rates in plant girth and length of petiole. Within each ploidy level, the genomic groups having both Musa acuminata and Musa balbisiana genomes (AB, AAB, ABB and ABBB) had higher growth rates than Musa acuminata (AA, AAA and AAAA) or Musa balbisiana (BB) groups.

The growth rates, prediction equation and coefficients of determination for cultivars under the different genomic groups are presented in Table 19. The cultivars under each genomic group were ranked based on the growth rates (Table 20).

The cultivar 'Chingan' was the most vigorous one in the genomic group AA, while 'Namarai' was the least vigorous cultivar as indicated by the growth rates (Table 20). In the genomic group AB, 'Vanneettu Mannan' was the most vigorous cultivar while the least vigorous one was 'Padali moongil'. In the group AAA 'Galanamalu' and 'Red banana' were more vigorous than the other cultivars. 'Wather' was the least vigorous cultivar in AAA. In the group AAB 'Charapadaththi' ranked first in vigour while 'Thiruvananthapuram' and 'Kullan' were the least vigorous.

Table 19. Growth rates, prediction equation and coefficients of determination for plant characters of 62 cultivars of banana

Cultivar	Character	Growth rate		Prediction equation		Coefficient of determination (r <sup>2</sup> )	
		Relative	Linear	Exponential	Linear	Exponential	Linear
1	2	3	4	5	6	7	8
<b>AA</b>							
Namarai	Plant height (cm)	31.20	19.68	32.23 (1.312) <sup>t</sup>	24.46 + (19.68)t	0.7857	0.8608
	Plant girth (cm)	24.40	4.89	9.87 (1.274) <sup>t</sup>	8.08 + (4.89)t	0.7781	0.8731
	Leaves per plant	46.10	4.08	2.94 (1.461) <sup>t</sup>	0.90 + (4.08)t	0.9260	0.9996
	Leaf area per plant (m <sup>2</sup> )	131.10	2.45	0.14 (2.311) <sup>t</sup>	-3.48 + (2.45)t	0.9353	0.9736
	Petiole length (cm)	23.74	4.89	12.08 (1.237) <sup>t</sup>	10.16 + (4.89)t	0.8179	0.9268
Chinga	Plant height (cm)	61.40	39.39	16.63 (1.614) <sup>t</sup>	-18.50 + (39.39)t	0.8497	0.9467
	Plant girth (cm)	41.10	7.07	6.74 (1.411) <sup>t</sup>	1.69 + (7.07)t	0.8595	0.9604
	Leaves per plant	46.50	4.59	3.16 (1.465) <sup>t</sup>	-1.52 + (4.59)t	0.9495	0.9960
	Leaf area per plant (m <sup>2</sup> )	240.96	4.02	0.03 (3.409) <sup>t</sup>	-7.17 + (4.02)t	0.8258	0.9158
	Petiole length (cm)	42.23	6.22	5.68 (1.422) <sup>t</sup>	1.38 + (6.22)t	0.8398	0.9291
Tongat	Plant height (cm)	48.20	36.54	15.54 (1.482) <sup>t</sup>	6.99 + (36.54)t	0.8537	0.9018
	Plant girth (cm)	35.70	7.48	5.85 (1.357) <sup>t</sup>	7.85 + (7.48)t	0.8484	0.9717
	Leaves per plant	38.20	4.31	2.14 (1.382) <sup>t</sup>	1.04 + (4.31)t	0.9496	0.9858
	Leaf area per plant (m <sup>2</sup> )	183.40	3.48	0.03 (2.834) <sup>t</sup>	-5.18 + (3.48)t	0.8358	0.9351
	Petiole length (cm)	25.80	4.25	4.78 (1.258) <sup>t</sup>	7.18 + (4.25)t	0.8588	0.9554
Eraichi-vazhai	Plant height (cm)	35.10	32.76	33.56 (1.351) <sup>t</sup>	6.92 + (32.76)t	0.9155	0.9958
	Plant girth (cm)	36.90	9.51	13.04 (1.349) <sup>t</sup>	8.88 + (9.10)t	0.7850	0.8656
	Leaves per plant	37.80	4.21	4.46 (1.378) <sup>t</sup>	1.01 + (4.20)t	0.9203	0.9984
	Leaf area per plant (m <sup>2</sup> )	131.30	3.91	0.23 (2.313) <sup>t</sup>	-4.91 + (3.90)t	0.8493	0.9628
	Petiole length (cm)	21.06	3.57	10.28 (1.211) <sup>t</sup>	8.71 + (3.57)t	0.8752	0.9355
Sarna-chenka-dali	Plant height (cm)	39.70	35.36	37.35 (1.397) <sup>t</sup>	17.30 + (35.36)t	0.8160	0.9035
	Plant girth (cm)	34.60	7.61	10.16 (1.346) <sup>t</sup>	6.00 + (7.61)t	0.8314	0.9332
	Leaves per plant	42.00	3.90	3.44 (1.420) <sup>t</sup>	0.20 + (3.90)t	0.9082	0.9781
	Leaf area per plant (m <sup>2</sup> )	258.43	4.03	0.02 (3.584) <sup>t</sup>	-7.42 + (4.03)t	0.9522	0.8229
	Petiole length (cm)	15.85	4.97	20.08 (1.159) <sup>t</sup>	18.62 + (4.97)t	0.9330	0.9690
<b>AB</b>							
Krishna vazhai	Plant height (cm)	42.20	42.08	38.25 (1.422) <sup>t</sup>	7.93 + (42.08)t	0.8656	0.9510
	Plant girth (cm)	28.40	8.81	16.11 (1.284) <sup>t</sup>	13.51 + (8.81)t	0.6615	0.7487
	Leaves per plant	36.90	3.46	4.55 (1.359) <sup>t</sup>	2.05 + (3.46)t	0.9057	0.9807
	Leaf area per plant (m <sup>2</sup> )	107.50	4.00	0.40 (2.076) <sup>t</sup>	-4.49 + (4.00)t	0.8645	0.9793
	Petiole length (cm)	20.53	4.33	12.58 (1.205) <sup>t</sup>	10.29 + (4.33)t	0.9308	0.9783
Vannan	Plant height (cm)	50.80	46.38	35.05 (1.508) <sup>t</sup>	1.08 + (46.38)t	0.8930	0.9553
	Plant girth (cm)	37.60	9.45	13.08 (1.376) <sup>t</sup>	9.45 + (9.45)t	0.7735	0.8136
	Leaves per plant	45.10	3.65	3.31 (1.451) <sup>t</sup>	0.55 + (3.65)t	0.9380	0.9980
	Leaf area per plant (m <sup>2</sup> )	166.30	4.36	0.21 (2.663) <sup>t</sup>	-5.20 + (4.36)t	0.8864	0.4803
	Petiole length (cm)	21.61	4.61	13.18 (1.217) <sup>t</sup>	10.14 + (4.65)t	0.9025	0.9031
Viru-pakahi	Plant height (cm)	41.80	41.53	37.10 (1.418) <sup>t</sup>	2.45 + (41.53)t	0.8989	0.9847
	Plant girth (cm)	29.90	7.59	13.36 (1.299) <sup>t</sup>	10.48 + (7.58)t	0.7742	0.8586
	Leaves per plant	32.90	3.03	4.02 (1.329) <sup>t</sup>	1.55 + (3.04)t	0.9303	0.9805
	Leaf area per plant (m <sup>2</sup> )	126.30	3.80	0.24 (2.263) <sup>t</sup>	-5.30 + (3.80)t	0.8727	0.9628
	Petiole length (cm)	29.99	7.51	12.29 (1.299) <sup>t</sup>	7.77 + (7.51)t	0.8562	0.9432
Sirumalai	Plant height (cm)	52.30	47.43	32.90 (1.523) <sup>t</sup>	-6.03 + (47.43)t	0.9378	0.9964
	Plant girth (cm)	43.70	10.28	10.30 (1.437) <sup>t</sup>	3.83 + (10.28)t	0.8870	0.9679
	Leaves per plant	51.50	4.23	2.99 (1.515) <sup>t</sup>	0.48 + (0.18)t	0.9403	0.9990
	Leaf area per plant (m <sup>2</sup> )	172.00	4.32	0.19 (2.720) <sup>t</sup>	-5.28 + (4.32)t	0.8847	0.9771
	Petiole length (cm)	26.53	4.77	11.02 (1.265) <sup>t</sup>	9.38 + (4.77)t	0.8100	0.9067
Agniswar	Plant height (cm)	51.20	50.48	38.79 (1.512) <sup>t</sup>	5.83 + (50.47)t	0.8508	0.8978
	Plant girth (cm)	38.00	8.35	11.19 (1.380) <sup>t</sup>	7.80 + (8.35)t	0.7946	0.8449
	Leaves per plant	58.20	6.40	3.72 (1.582) <sup>t</sup>	-1.35 + (6.40)t	0.8997	0.9604
	Leaf area per plant (m <sup>2</sup> )	189.20	6.36	0.23 (2.892) <sup>t</sup>	-6.96 + (6.35)t	0.8462	0.9567
	Petiole length (cm)	23.31	5.05	14.74 (1.233) <sup>t</sup>	13.95 + (5.95)t	0.7184	0.7989
Adakka kunnan	Plant height (cm)	32.30	34.32	43.08 (1.328) <sup>t</sup>	15.11 + (34.31)t	0.8840	0.9716
	Plant girth (cm)	28.60	8.19	13.30 (1.286) <sup>t</sup>	8.77 + (8.19)t	0.8080	0.9080
	Leaves per plant	39.40	4.65	4.64 (1.394) <sup>t</sup>	0.39 + (4.65)t	0.9040	0.9843
	Leaf area per plant (m <sup>2</sup> )	153.50	5.76	0.24 (2.535) <sup>t</sup>	-8.31 + (5.71)t	0.8512	0.9724
	Petiole length (cm)	32.10	9.02	11.14 (1.321) <sup>t</sup>	3.10 + (9.10)t	0.9109	0.9954
Valiya kunnan	Plant height (cm)	37.40	34.37	33.58 (1.374) <sup>t</sup>	7.00 + (34.30)t	0.8380	0.9528
	Plant girth (cm)	33.00	8.52	7.68 (1.330) <sup>t</sup>	4.61 + (8.52)t	0.3870	0.9561
	Leaves per plant	39.70	4.30	3.55 (1.397) <sup>t</sup>	-0.71 + (4.30)t	0.9040	0.9964
	Leaf area per plant (m <sup>2</sup> )	161.20	3.18	0.13 (2.162) <sup>t</sup>	-6.05 + (3.18)t	0.8604	0.9752
	Petiole length (cm)	29.20	7.25	13.35 (1.292) <sup>t</sup>	10.46 + (7.25)t	0.8214	0.9524

(Contd.)

Table 19. (Contd.)

1	2	3	4	5	6	7	8
Thaen kunnan	Plant height (cm)	37.60	34.02	30.48 (1.376) <sup>t</sup>	-5.00 + (34.02) <sup>t</sup>	0.9214	0.9902
	Plant girth (cm)	25.60	5.19	11.76 (1.256) <sup>t</sup>	7.57 + (6.19) <sup>t</sup>	0.8718	0.9746
	Leaves per plant	35.20	5.15	5.61 (1.252) <sup>t</sup>	1.57 + (5.15) <sup>t</sup>	0.8614	0.9722
	Leaf area per plant(m <sup>2</sup> )	121.30	6.22	0.28 (2.213) <sup>t</sup>	-9.59 + (6.22) <sup>t</sup>	0.8499	0.9637
	Petiole length (cm)	17.41	3.97	14.36 (1.174) <sup>t</sup>	13.07 + (3.97) <sup>t</sup>	0.7869	0.9034
Padali moongil	Plant height (cm)	33.90	32.21	34.85 (1.339) <sup>t</sup>	2.00 + (32.21) <sup>t</sup>	0.9384	0.9958
	Plant girth (cm)	24.70	5.86	10.19 (1.247) <sup>t</sup>	9.28 + (5.86) <sup>t</sup>	0.8263	0.9293
	Leaves per plant	38.80	4.22	3.46 (1.388) <sup>t</sup>	-1.29 + (4.21) <sup>t</sup>	0.9508	0.9920
	Leaf area per plant(m <sup>2</sup> )	116.20	3.18	0.13 (2.162) <sup>t</sup>	-6.05 + (3.18) <sup>t</sup>	0.9364	0.8610
	Petiole length (cm)	23.57	6.81	13.99 (1.236) <sup>t</sup>	-7.63 + (6.81) <sup>t</sup>	0.8424	0.9557
Ney poovan	Plant height (cm)	52.00	58.18	43.58 (1.520) <sup>t</sup>	1.03 + (58.75) <sup>t</sup>	0.8978	0.9698
	Plant girth (cm)	46.10	11.25	10.38 (1.461) <sup>t</sup>	3.35 + (11.25) <sup>t</sup>	0.8709	0.9384
	Leaves per plant	50.20	5.55	4.13 (1.502) <sup>t</sup>	0.40 + (5.55) <sup>t</sup>	0.9444	0.9960
	Leaf area per plant(m <sup>2</sup> )	159.20	4.95	0.29 (2.592) <sup>t</sup>	-5.41 + (4.95) <sup>t</sup>	0.8606	0.9845
	Petiole length (cm)	41.40	9.48	16.69 (1.314) <sup>t</sup>	12.73 + (9.48) <sup>t</sup>	0.8414	0.9380
Kostha bontha	Plant height (cm)	39.40	47.42	41.51 (1.394) <sup>t</sup>	2.28 + (47.42) <sup>t</sup>	0.8479	0.9690
	Plant girth (cm)	27.40	9.00	16.50 (1.217) <sup>t</sup>	12.68 + (9.00) <sup>t</sup>	0.7735	0.8859
	Leaves per plant	43.40	5.56	3.96 (1.434) <sup>t</sup>	-1.14 + (5.56) <sup>t</sup>	0.8653	0.9791
	Leaf area per plant(m <sup>2</sup> )	91.65	5.49	0.74 (1.917) <sup>t</sup>	-3.61 + (5.49) <sup>t</sup>	0.7247	0.8976
	Petiole length (cm)	26.30	7.49	16.53 (1.263) <sup>t</sup>	14.66 + (7.49) <sup>t</sup>	0.7441	0.8223
BB Klavashai	Plant height (cm)	25.00	32.85	19.58 (1.250) <sup>t</sup>	-8.35 + (32.85) <sup>t</sup>	0.8172	0.9883
	Plant girth (cm)	16.50	5.44	9.66 (1.165) <sup>t</sup>	5.81 + (5.44) <sup>t</sup>	0.8935	0.9315
	Leaves per plant	23.80	4.33	3.03 (1.238) <sup>t</sup>	-0.58 + (4.33) <sup>t</sup>	0.8415	0.8915
	Leaf area per plant(m <sup>2</sup> )	59.00	4.36	0.76 (1.590) <sup>t</sup>	-3.81 + (3.93) <sup>t</sup>	0.8718	0.8816
	Petiole length (cm)	15.10	3.93	9.34 (1.151) <sup>t</sup>	6.39 + (4.36) <sup>t</sup>	0.8215	0.9519
AAA Gros Michel	Plant height (cm)	36.80	37.14	34.76 (1.368) <sup>t</sup>	-3.57 + (37.14) <sup>t</sup>	0.9266	0.9878
	Plant girth (cm)	2.60	7.17	13.37 (1.360) <sup>t</sup>	8.57 + (7.17) <sup>t</sup>	0.8740	0.9769
	Leaves per plant	38.70	4.29	3.69 (1.387) <sup>t</sup>	0.57 + (4.29) <sup>t</sup>	0.9153	0.9908
	Leaf area per plant(m <sup>2</sup> )	127.24	6.24	0.23 (2.272) <sup>t</sup>	10.11 + (6.24) <sup>t</sup>	0.8627	0.9403
	Petiole length (cm)	24.28	5.37	11.59 (1.243) <sup>t</sup>	8.94 + (5.37) <sup>t</sup>	0.8169	0.9132
High- gate	Plant height (cm)	54.70	35.09	17.74 (1.547) <sup>t</sup>	-18.15 + (35.09) <sup>t</sup>	0.9101	0.9771
	Plant girth (cm)	43.30	10.16	8.32 (1.433) <sup>t</sup>	-0.63 + (10.16) <sup>t</sup>	0.9151	0.9880
	Leaves per plant	47.40	4.83	3.10 (1.474) <sup>t</sup>	-2.16 + (4.83) <sup>t</sup>	0.9663	0.9860
	Leaf area per plant(m <sup>2</sup> )	138.95	6.31	0.91 (2.389) <sup>t</sup>	-41.73 + (6.32) <sup>t</sup>	0.8223	0.9423
	Petiole length (cm)	28.62	4.42	7.31 (1.286) <sup>t</sup>	4.99 + (4.42) <sup>t</sup>	0.8121	0.9121
Pedda pachcha	Plant height (cm)	60.40	31.64	13.75 (1.604) <sup>t</sup>	-15.00 + (31.64) <sup>t</sup>	0.8666	0.9452
	Plant girth (cm)	34.20	7.11	9.92 (1.342) <sup>t</sup>	6.67 + (7.11) <sup>t</sup>	0.7971	0.8904
	Leaves per plant	44.60	3.69	2.61 (1.446) <sup>t</sup>	-1.47 + (3.69) <sup>t</sup>	0.9685	0.9698
	Leaf area per plant(m <sup>2</sup> )	112.23	3.46	0.23 (2.122) <sup>t</sup>	-5.53 + (3.46) <sup>t</sup>	0.7705	0.9224
	Petiole length (cm)	45.31	8.11	6.58 (1.453) <sup>t</sup>	1.10 + (8.11) <sup>t</sup>	0.8325	0.9220
Basrai	Plant height (cm)	39.70	20.73	16.64 (1.397) <sup>t</sup>	-5.46 + (20.73) <sup>t</sup>	0.9268	0.9928
	Plant girth (cm)	24.70	6.00	12.47 (1.247) <sup>t</sup>	9.14 + (6.00) <sup>t</sup>	0.8409	0.9461
	Leaves per plant	37.00	4.60	4.35 (1.370) <sup>t</sup>	-0.14 + (4.60) <sup>t</sup>	0.9141	0.9986
	Leaf area per plant(m <sup>2</sup> )	93.06	3.57	0.29 (1.931) <sup>t</sup>	6.13 + (3.57) <sup>t</sup>	0.7907	0.9308
	Petiole length (cm)	26.53	3.09	7.36 (1.265) <sup>t</sup>	7.16 + (3.09) <sup>t</sup>	0.7785	0.8787
Harichal	Plant height (cm)	59.40	33.54	14.75 (1.594) <sup>t</sup>	-16.25 + (31.33) <sup>t</sup>	0.8355	0.9588
	Plant girth (cm)	33.50	7.22	2.81 (1.335) <sup>t</sup>	5.89 + (7.22) <sup>t</sup>	0.7658	0.8955
	Leaves per plant	45.60	3.82	5.85 (1.456) <sup>t</sup>	-1.48 + (3.82) <sup>t</sup>	0.9213	0.9984
	Leaf area per plant(m <sup>2</sup> )	3.42	0.25	2.20 (1.344) <sup>t</sup>	-4.48 + (3.42) <sup>t</sup>	0.8552	0.9455
	Petiole length (cm)	38.56	3.92	9.58 (1.385) <sup>t</sup>	1.80 + (3.92) <sup>t</sup>	0.8453	0.9729
Sapumal anamalu	Plant height (cm)	49.60	43.18	21.32 (1.496) <sup>t</sup>	-31.43 + (43.18) <sup>t</sup>	0.9274	0.9855
	Plant girth (cm)	35.00	8.48	8.94 (1.350) <sup>t</sup>	1.00 + (8.48) <sup>t</sup>	0.9017	0.9874
	Leaves per plant	37.00	4.58	4.20 (1.370) <sup>t</sup>	-0.29 + (4.58) <sup>t</sup>	0.9210	0.9972
	Leaf area per plant(m <sup>2</sup> )	130.99	5.94	0.19 (2.309) <sup>t</sup>	-10.48 + (5.94) <sup>t</sup>	0.8955	0.9170
	Petiole length (cm)	34.62	5.35	6.74 (1.346) <sup>t</sup>	1.87 + (5.35) <sup>t</sup>	0.8845	0.9528
Manoran- jithm	Plant height (cm)	45.90	38.35	22.17 (1.459) <sup>t</sup>	-24.57 + (38.35) <sup>t</sup>	0.9376	0.9857
	Plant girth (cm)	29.50	6.76	9.58 (1.295) <sup>t</sup>	3.50 + (6.76) <sup>t</sup>	0.9044	0.9647
	Leaves per plant	43.30	4.96	3.33 (1.433) <sup>t</sup>	-2.14 + (4.96) <sup>t</sup>	0.9233	0.9930
	Leaf area per plant(m <sup>2</sup> )	135.50	5.95	0.16 (2.355) <sup>t</sup>	-10.93 + (5.95) <sup>t</sup>	0.9095	0.9212
	Petiole length (cm)	27.46	5.22	7.90 (1.275) <sup>t</sup>	-3.34 + (5.22) <sup>t</sup>	0.8545	0.9855
Galana- malu	Plant height (cm)	38.90	40.87	37.19 (1.389) <sup>t</sup>	7.00 + (40.87) <sup>t</sup>	0.8422	0.9604
	Plant girth (cm)	33.50	10.07	12.77 (1.335) <sup>t</sup>	7.36 + (10.07) <sup>t</sup>	0.7884	0.9178
	Leaves per plant	37.50	4.05	3.57 (1.375) <sup>t</sup>	-0.86 + (4.05) <sup>t</sup>	0.9440	0.9940
	Leaf area per plant(m <sup>2</sup> )	320.73	6.83	0.05 (4.207) <sup>t</sup>	-9.73 + (6.84) <sup>t</sup>	0.9181	0.9508
	Petiole length (cm)	30.62	8.10	11.44 (1.306) <sup>t</sup>	5.77 + (8.10) <sup>t</sup>	0.9492	0.9584
Red banana	Plant height (cm)	33.20	37.22	40.42 (1.332) <sup>t</sup>	12.31 + (37.22) <sup>t</sup>	0.8152	0.9550
	Plant girth (cm)	24.50	8.11	15.80 (1.245) <sup>t</sup>	11.41 + (8.11) <sup>t</sup>	0.8062	0.9322
	Leaves per plant	34.80	4.66	4.59 (1.348) <sup>t</sup>	0.68 + (4.66) <sup>t</sup>	0.8317	0.9681
	Leaf area per plant(m <sup>2</sup> )	97.68	9.20	0.62 (1.977) <sup>t</sup>	-12.24 + (9.20) <sup>t</sup>	0.7776	0.9642
	Petiole length (cm)	21.59	5.31	14.79 (1.216) <sup>t</sup>	14.00 + (5.31) <sup>t</sup>	0.7083	0.8100
Wather	Plant height (cm)	29.00	26.96	42.07 (1.290) <sup>t</sup>	0.41 + (26.96) <sup>t</sup>	0.8210	0.6740
	Plant girth (cm)	26.00	6.19	13.14 (1.260) <sup>t</sup>	10.20 + (6.19) <sup>t</sup>	0.8495	0.9430
	Leaves per plant	49.00	4.34	2.66 (1.490) <sup>t</sup>	-1.97 + (4.34) <sup>t</sup>	0.9549	0.9914
	Leaf area per plant(m <sup>2</sup> )	149.00	3.37	1.11 (2.490) <sup>t</sup>	-5.53 + (3.37) <sup>t</sup>	0.9333	0.9420
	Petiole length (cm)	19.10	3.46	11.42 (1.191) <sup>t</sup>	10.04 + (3.46) <sup>t</sup>	0.8599	0.7917

(Contd.)

Table 19. (Contd.)

1	2	3	4	5	6	7	8
Karim kadali	Plant height (cm)	48.10	34.46	24.33 (1.481) <sup>t</sup>	-2.42 + (34.46) <sup>t</sup>	0.8612	0.9444
	Plant girth (cm)	34.20	7.33	9.98 (1.342) <sup>t</sup>	6.02 + (7.33) <sup>t</sup>	0.8319	0.9214
	Leaves per plant	44.40	4.28	3.32 (1.444) <sup>t</sup>	-0.60 + (4.27) <sup>t</sup>	0.9291	0.9904
	Leaf area per plant(m <sup>2</sup> )	150.00	3.90	0.15 (2.500) <sup>t</sup>	-5.31 + (3.89) <sup>t</sup>	0.8608	0.9791
AAB	Petiole length (cm)	24.85	3.86	9.01 (1.249) <sup>t</sup>	7.60 + (3.86) <sup>t</sup>	0.7973	0.9004
	Plant height (cm)	44.30	32.97	25.22 (1.443) <sup>t</sup>	-6.46 + (32.97) <sup>t</sup>	0.9324	0.9860
	Plant girth (cm)	29.50	6.91	12.16 (1.295) <sup>t</sup>	9.05 + (6.91) <sup>t</sup>	0.8077	0.8849
	Leaves per plant	44.50	4.07	3.07 (1.445) <sup>t</sup>	-0.92 + (4.07) <sup>t</sup>	0.9491	0.9952
Thiruvananthapuram	Leaf area per plant(m <sup>2</sup> )	153.80	4.29	0.15 (2.538) <sup>t</sup>	-5.95 + (4.29) <sup>t</sup>	0.8593	0.9779
	Petiole length (cm)	24.57	5.09	12.48 (1.245) <sup>t</sup>	11.29 + (5.09) <sup>t</sup>	0.7448	0.8154
	Plant height (cm)	43.30	37.80	23.36 (1.433) <sup>t</sup>	-26.50 + (37.80) <sup>t</sup>	0.9688	0.9541
	Plant girth (cm)	26.90	7.16	13.18 (1.269) <sup>t</sup>	9.50 + (7.16) <sup>t</sup>	0.8192	0.9103
China	Leaves per plant	38.10	4.92	4.39 (1.381) <sup>t</sup>	-0.28 + (4.91) <sup>t</sup>	0.8942	0.9779
	Leaf area per plant(m <sup>2</sup> )	102.70	4.71	0.38 (2.027) <sup>t</sup>	-6.18 + (4.71) <sup>t</sup>	0.8381	0.9884
	Petiole length(cm)	26.42	5.51	11.65 (1.264) <sup>t</sup>	-9.15 + (5.51) <sup>t</sup>	0.8308	0.9378
	Plant height (cm)	29.70	36.14	58.76 (1.297) <sup>t</sup>	46.86 + (36.14) <sup>t</sup>	0.7430	0.8464
Rasthali	Plant girth (cm)	26.00	8.38	17.04 (1.260) <sup>t</sup>	14.57 + (8.39) <sup>t</sup>	0.7436	0.8497
	Leaves per plant	44.00	5.22	3.76 (1.440) <sup>t</sup>	-0.43 + (5.22) <sup>t</sup>	0.8294	0.9559
	Leaf area per plant(m <sup>2</sup> )	100.00	5.55	0.54 (2.000) <sup>t</sup>	-5.38 + (5.55) <sup>t</sup>	0.7602	0.9614
	Petiole length (cm)	19.61	6.33	20.78 (1.196) <sup>t</sup>	18.76 + (6.325) <sup>t</sup>	0.8026	0.9063
Dudhsagar	Plant height (cm)	53.10	43.88	22.28 (1.531) <sup>t</sup>	-22.25 + (43.88) <sup>t</sup>	0.9297	0.9847
	Plant girth (cm)	30.70	7.72	11.57 (1.307) <sup>t</sup>	5.68 + (7.72) <sup>t</sup>	0.9122	0.9659
	Leaves per plant	52.20	4.85	2.79 (1.522) <sup>t</sup>	-1.77 + (4.85) <sup>t</sup>	0.8995	0.9807
	Leaf area per plant(m <sup>2</sup> )	174.80	7.33	0.08 (2.748) <sup>t</sup>	-10.85 + (7.33) <sup>t</sup>	0.8673	0.9577
Sugandhi	Petiole length (cm)	22.65	9.06	9.55 (1.237) <sup>t</sup>	2.50 + (9.06) <sup>t</sup>	0.9497	0.9523
	Plant height (cm)	34.72	43.28	53.90 (1.247) <sup>t</sup>	25.12 + (43.28) <sup>t</sup>	0.8554	0.9320
	Plant girth (cm)	30.00	9.14	15.70 (1.300) <sup>t</sup>	1.17 + (9.14) <sup>t</sup>	0.8019	0.8789
	Leaves per plant	50.80	5.43	3.38 (1.508) <sup>t</sup>	-1.26 + (5.43) <sup>t</sup>	0.8778	0.9657
Palayan-kodan	Leaf area per plant(m <sup>2</sup> )	143.30	8.91	0.40 (2.433) <sup>t</sup>	-10.15 + (8.41) <sup>t</sup>	0.8297	0.9685
	Petiole length (cm)	29.98	6.32	14.44 (1.240) <sup>t</sup>	-10.61 + (6.32) <sup>t</sup>	0.9239	0.9882
	Plant height (cm)	48.70	39.49	27.93 (1.487) <sup>t</sup>	0.90 + (39.43) <sup>t</sup>	0.8199	0.9065
	Plant girth (cm)	34.70	8.39	11.15 (1.347) <sup>t</sup>	6.50 + (8.39) <sup>t</sup>	0.8308	0.9326
Pacha chingan	Leaves per plant	49.40	4.71	3.11 (1.494) <sup>t</sup>	-0.83 + (4.71) <sup>t</sup>	0.8099	0.9162
	Leaf area per plant(m <sup>2</sup> )	167.00	7.17	0.19 (2.677) <sup>t</sup>	-10.43 + (7.17) <sup>t</sup>	0.8742	0.9622
	Petiole length (cm)	28.26	6.53	12.49 (1.283) <sup>t</sup>	9.90 + (6.53) <sup>t</sup>	0.7978	0.9004
	Plant height (cm)	38.95	46.18	45.52 (1.388) <sup>t</sup>	20.55 + (46.18) <sup>t</sup>	0.8819	0.9418
Mannan	Plant girth (cm)	33.10	10.75	15.42 (1.331) <sup>t</sup>	8.15 + (10.75) <sup>t</sup>	0.8321	0.8949
	Leaves per plant	42.10	3.75	5.18 (1.421) <sup>t</sup>	-1.12 + (2.75) <sup>t</sup>	0.9264	0.9952
	Leaf area per plant(m <sup>2</sup> )	135.80	4.45	0.58 (2.358) <sup>t</sup>	-5.18 + (4.45) <sup>t</sup>	0.7506	0.9117
	Petiole length (cm)	22.12	5.48	11.58 (1.221) <sup>t</sup>	11.18 + (5.48) <sup>t</sup>	0.8234	0.9885
Malakali	Plant height (cm)	39.60	39.85	47.68 (1.396) <sup>t</sup>	23.35 + (39.85) <sup>t</sup>	0.8709	0.9504
	Plant girth (cm)	32.10	6.91	15.38 (1.321) <sup>t</sup>	9.05 + (6.91) <sup>t</sup>	0.8221	0.8849
	Leaves per plant	40.30	4.07	4.09 (1.403) <sup>t</sup>	-0.92 + (4.07) <sup>t</sup>	0.9164	0.9952
	Leaf area per plant(m <sup>2</sup> )	134.70	4.29	0.44 (2.347) <sup>t</sup>	-5.96 + (4.29) <sup>t</sup>	0.8234	0.9779
Pacha nadan	Petiole length (cm)	23.65	4.68	12.48 (1.237) <sup>t</sup>	12.18 + (4.67) <sup>t</sup>	0.7500	0.8357
	Plant height (cm)	63.90	49.10	24.59 (1.639) <sup>t</sup>	-11.45 + (49.10) <sup>t</sup>	0.8544	0.9035
	Plant girth (cm)	42.10	10.25	11.26 (1.421) <sup>t</sup>	5.75 + (10.25) <sup>t</sup>	0.8447	0.9084
	Leaves per plant	40.20	4.43	4.69 (1.402) <sup>t</sup>	1.68 + (4.43) <sup>t</sup>	0.9526	0.9974
Mendra padaththi	Leaf area per plant(m <sup>2</sup> )	166.10	4.92	0.23 (2.661) <sup>t</sup>	-6.37 + (4.92) <sup>t</sup>	0.9124	0.9549
	Petiole length (cm)	31.40	5.53	8.53 (1.314) <sup>t</sup>	4.28 + (5.53) <sup>t</sup>	0.9409	0.9649
	Plant height (cm)	55.43	42.48	27.02 (1.554) <sup>t</sup>	-5.78 + (42.48) <sup>t</sup>	0.8965	0.9549
	Plant girth (cm)	45.40	11.40	10.86 (1.454) <sup>t</sup>	4.10 + (11.40) <sup>t</sup>	0.8575	0.9153
Chara padaththi	Leaves per plant	42.90	3.58	3.53 (1.429) <sup>t</sup>	0.88 + (3.58) <sup>t</sup>	0.9419	0.9980
	Leaf area per plant(m <sup>2</sup> )	155.00	3.59	0.22 (2.550) <sup>t</sup>	-4.00 + (3.58) <sup>t</sup>	0.8690	0.9888
	Petiole length (cm)	26.71	5.01	14.51 (1.267) <sup>t</sup>	-8.88 + (5.00) <sup>t</sup>	0.8889	0.9515
	Plant height (cm)	39.50	40.88	46.96 (1.395) <sup>t</sup>	19.03 + (40.87) <sup>t</sup>	0.9320	0.9962
Kullan	Plant girth (cm)	41.50	11.00	12.54 (1.415) <sup>t</sup>	7.05 + (11.00) <sup>t</sup>	0.8276	0.8830
	Leaves per plant	46.50	3.63	3.06 (1.465) <sup>t</sup>	0.13 + (3.63) <sup>t</sup>	0.9489	0.9964
	Leaf area per plant(m <sup>2</sup> )	150.30	4.47	0.26 (2.503) <sup>t</sup>	-5.82 + (4.47) <sup>t</sup>	0.9063	0.9128
	Petiole length (cm)	30.05	7.38	14.51 (1.301) <sup>t</sup>	12.28 + (7.38) <sup>t</sup>	0.7760	0.8505
Kullian	Plant height (cm)	69.50	50.65	19.52 (1.695) <sup>t</sup>	-30.15 + (50.65) <sup>t</sup>	0.9444	0.9765
	Plant girth (cm)	43.20	10.23	10.78 (1.432) <sup>t</sup>	1.49 + (10.3) <sup>t</sup>	0.8101	0.8512
	Leaves per plant	47.00	5.33	4.38 (1.470) <sup>t</sup>	-0.02 + (5.33) <sup>t</sup>	0.9608	0.9948
	Leaf area per plant(m <sup>2</sup> )	195.20	6.61	0.19 (2.952) <sup>t</sup>	-8.89 + (6.61) <sup>t</sup>	0.9772	0.9596
Chinali	Petiole length (cm)	1.41	9.38	9.77 (1.412) <sup>t</sup>	2.68 + (9.38) <sup>t</sup>	0.9456	0.9898
	Plant height (cm)	40.10	26.07	25.99 (1.401) <sup>t</sup>	7.50 + (26.07) <sup>t</sup>	0.8653	0.9639
	Plant girth (cm)	25.70	7.34	16.30 (1.257) <sup>t</sup>	16.30 + (7.34) <sup>t</sup>	0.7982	0.9021
	Leaves per plant	46.10	4.50	3.38 (1.461) <sup>t</sup>	-0.33 + (4.50) <sup>t</sup>	0.8844	0.9864
Chinali	Leaf area per plant(m <sup>2</sup> )	146.00	4.40	0.20 (2.460) <sup>t</sup>	-5.38 + (4.40) <sup>t</sup>	0.8296	0.9584
	Petiole length (cm)	18.77	2.76	4.45 (1.188) <sup>t</sup>	8.37 + (2.76) <sup>t</sup>	0.8634	0.9446
	Plant height (cm)	56.80	41.30	15.25 (1.568) <sup>t</sup>	-35.86 + (41.30) <sup>t</sup>	0.9065	0.9780
	Plant girth (cm)	32.80	8.92	10.66 (1.328) <sup>t</sup>	2.93 + (8.92) <sup>t</sup>	0.8887	0.9677
Chinali	Leaves per plant	38.30	3.81	3.08 (1.383) <sup>t</sup>	-1.64 + (3.83) <sup>t</sup>	0.9726	0.9738
	Leaf area per plant (m <sup>2</sup> )	130.99	2.46	0.16 (2.309) <sup>t</sup>	-10.31 + (5.46) <sup>t</sup>	0.9655	0.9668
	Petiole length (cm)	40.06	8.81	7.41 (1.401) <sup>t</sup>	-0.21 + (8.81) <sup>t</sup>	0.8551	0.9596

(Contd.)

Table 19. (Contd.)

1	2	3	4	5	6	7	8
<b>ABE</b>							
Karpooravally	Plant height (cm)	38.80	42.95	23.28 (1.388) <sup>t</sup>	-0.46 + (42.95) <sup>t</sup>	0.8690	0.9651
	Plant girth (cm)	28.00	8.42	14.06 (1.280) <sup>t</sup>	8.89 + (8.42) <sup>t</sup>	0.8369	0.9380
	Leaves per plant	41.80	4.72	3.55 (1.418) <sup>t</sup>	-1.04 + (4.72) <sup>t</sup>	0.8921	0.9791
	Leaf area per plant (m <sup>2</sup> )	118.80	4.96	0.26 (2.188) <sup>t</sup>	-6.79 + (4.97) <sup>t</sup>	0.8207	0.9767
	Petiole length (cm)	30.86	7.57	12.13 (1.309) <sup>t</sup>	8.00 + (7.57) <sup>t</sup>	0.8517	0.9421
Chirapunchi	Plant height (cm)	44.00	53.11	35.92 (1.440) <sup>t</sup>	-17.43 + (53.11) <sup>t</sup>	0.8943	0.9781
	Plant girth (cm)	37.80	12.63	12.64 (1.378) <sup>t</sup>	4.86 + (12.63) <sup>t</sup>	0.7926	0.9118
	Leaves per plant	37.70	5.79	5.20 (1.377) <sup>t</sup>	-0.61 + (5.79) <sup>t</sup>	0.9183	0.9862
	Leaf area per plant (m <sup>2</sup> )	114.20	8.18	0.45 (2.142) <sup>t</sup>	-12.06 + (8.18) <sup>t</sup>	0.8471	0.9696
	Petiole length (cm)	25.26	8.04	16.53 (1.253) <sup>t</sup>	10.92 + (8.04) <sup>t</sup>	0.9610	0.9862
Paykunnan	Plant height (cm)	34.70	45.46	50.71 (1.347) <sup>t</sup>	14.61 + (45.46) <sup>t</sup>	0.8669	0.9724
	Plant girth (cm)	27.60	9.11	15.85 (1.276) <sup>t</sup>	10.71 + (9.11) <sup>t</sup>	0.8216	0.9278
	Leaves per plant	62.70	5.60	1.72 (1.627) <sup>t</sup>	-4.64 + (5.60) <sup>t</sup>	0.8560	0.9829
	Leaf area per plant (m <sup>2</sup> )	135.80	5.78	0.19 (2.358) <sup>t</sup>	-8.16 + (5.75) <sup>t</sup>	0.7974	0.9712
	Petiole length (cm)	30.11	7.91	13.09 (1.301) <sup>t</sup>	8.70 + (7.91) <sup>t</sup>	0.8495	0.9264
Walha	Plant height (cm)	59.00	50.64	23.70 (1.590) <sup>t</sup>	-18.50 + (50.64) <sup>t</sup>	0.8414	0.9372
	Plant girth (cm)	46.80	12.41	9.21 (1.468) <sup>t</sup>	-0.47 + (12.41) <sup>t</sup>	0.8679	0.9582
	Leaves per plant	46.70	5.55	3.83 (1.467) <sup>t</sup>	-1.72 + (5.55) <sup>t</sup>	0.9467	0.9976
	Leaf area per plant (m <sup>2</sup> )	177.82	6.75	0.15 (2.775) <sup>t</sup>	-10.11 + (6.75) <sup>t</sup>	0.8785	0.9631
	Petiole length (cm)	44.31	7.91	1.30 (1.443) <sup>t</sup>	-8.70 + (7.91) <sup>t</sup>	0.8495	0.9264
Aahybatheesa	Plant height (cm)	64.60	58.51	23.08 (1.646) <sup>t</sup>	-35.02 + (58.51) <sup>t</sup>	0.8783	0.9698
	Plant girth (cm)	42.20	10.42	9.55 (1.422) <sup>t</sup>	2.44 + (10.42) <sup>t</sup>	0.8433	0.9278
	Leaves per plant	45.60	5.12	3.74 (1.456) <sup>t</sup>	-1.13 + (5.12) <sup>t</sup>	0.9335	0.9988
	Leaf area per plant (m <sup>2</sup> )	185.30	5.74	0.11 (2.853) <sup>t</sup>	-8.91 + (5.74) <sup>t</sup>	0.8813	0.9497
	Petiole length (cm)	44.15	10.66	8.85 (1.442) <sup>t</sup>	-0.15 + (10.66) <sup>t</sup>	0.8874	0.9851
Meyvannan	Plant height (cm)	51.40	40.00	21.05 (1.514) <sup>t</sup>	-26.50 + (40.00) <sup>t</sup>	0.9569	0.9532
	Plant girth (cm)	40.50	12.10	11.29 (1.405) <sup>t</sup>	0.90 + (12.10) <sup>t</sup>	0.9243	0.9857
	Leaves per plant	40.10	5.55	5.07 (1.401) <sup>t</sup>	0.24 + (5.55) <sup>t</sup>	0.9536	0.9936
	Leaf area per plant (m <sup>2</sup> )	130.20	6.08	0.34 (2.302) <sup>t</sup>	-8.49 + (6.08) <sup>t</sup>	0.8761	0.9600
	Petiole length (cm)	38.61	8.71	8.56 (1.386) <sup>t</sup>	0.82 + (8.71) <sup>t</sup>	0.9419	0.9579
Alukehal	Plant height (cm)	53.30	42.48	28.02 (1.533) <sup>t</sup>	-8.28 + (42.48) <sup>t</sup>	0.9454	0.9960
	Plant girth (cm)	36.50	9.05	11.91 (1.365) <sup>t</sup>	6.04 + (9.05) <sup>t</sup>	0.9178	0.9859
	Leaves per plant	48.70	5.73	4.34 (1.487) <sup>t</sup>	-0.68 + (5.73) <sup>t</sup>	0.9728	0.9958
	Leaf area per plant (m <sup>2</sup> )	173.20	6.14	0.25 (2.732) <sup>t</sup>	-8.03 + (6.13) <sup>t</sup>	0.9149	0.9569
	Petiole length (cm)	36.99	7.40	9.39 (1.369) <sup>t</sup>	4.35 + (7.40) <sup>t</sup>	0.9231	0.9787
Kapok	Plant height (cm)	39.50	52.70	42.87 (1.395) <sup>t</sup>	-12.57 + (52.70) <sup>t</sup>	0.9132	0.9868
	Plant girth (cm)	27.60	9.45	15.91 (1.276) <sup>t</sup>	9.57 + (9.45) <sup>t</sup>	0.8658	0.9736
	Leaves per plant	34.40	3.76	4.04 (1.344) <sup>t</sup>	0.46 + (3.76) <sup>t</sup>	0.8970	0.9791
	Leaf area per plant (m <sup>2</sup> )	99.50	6.21	0.52 (1.995) <sup>t</sup>	-8.91 + (6.21) <sup>t</sup>	0.8444	0.9740
	Petiole length (cm)	23.51	7.49	16.47 (1.235) <sup>t</sup>	11.46 + (7.49) <sup>t</sup>	0.8763	0.9708
Jurmoneykunthali	Plant height (cm)	50.10	54.31	28.47 (1.501) <sup>t</sup>	-25.29 + (54.31) <sup>t</sup>	0.8573	0.9775
	Plant girth (cm)	32.10	10.35	13.17 (1.321) <sup>t</sup>	4.95 + (10.35) <sup>t</sup>	0.8825	0.9829
	Leaves per plant	45.20	5.86	3.78 (1.452) <sup>t</sup>	-2.00 + (5.86) <sup>t</sup>	0.8810	0.8810
	Leaf area per plant (m <sup>2</sup> )	140.00	7.76	0.23 (2.400) <sup>t</sup>	-11.44 + (7.76) <sup>t</sup>	0.8427	0.8427
	Petiole length (cm)	28.74	7.99	12.13 (1.287) <sup>t</sup>	5.59 + (7.99) <sup>t</sup>	0.9033	0.9033
Peyan	Plant height (cm)	44.10	50.88	35.74 (1.441) <sup>t</sup>	-7.71 + (50.88) <sup>t</sup>	0.8486	0.9471
	Plant girth (cm)	12.72	8.14	15.64 (1.272) <sup>t</sup>	13.89 + (8.14) <sup>t</sup>	0.8923	0.8087
	Leaves per plant	44.60	5.42	3.56 (1.446) <sup>t</sup>	-1.93 + (5.42) <sup>t</sup>	0.8923	0.9815
	Leaf area per plant (m <sup>2</sup> )	127.30	6.61	0.28 (2.273) <sup>t</sup>	-8.57 + (6.61) <sup>t</sup>	0.8136	0.9520
	Petiole length (cm)	24.25	6.96	15.04 (1.243) <sup>t</sup>	11.74 + (6.96) <sup>t</sup>	0.8100	0.8766
Pachabonthebatheesa	Plant height (cm)	38.40	39.82	44.68 (1.384) <sup>t</sup>	16.75 + (39.82) <sup>t</sup>	0.7172	0.8857
	Plant girth (cm)	28.60	7.76	14.00 (1.286) <sup>t</sup>	9.93 + (7.57) <sup>t</sup>	0.8372	0.9306
	Leaves per plant	43.90	6.25	4.91 (1.439) <sup>t</sup>	-1.00 + (6.25) <sup>t</sup>	0.9421	0.9940
	Leaf area per plant (m <sup>2</sup> )	134.20	5.37	0.32 (2.342) <sup>t</sup>	-5.81 + (5.36) <sup>t</sup>	0.8138	0.9681
	Petiole length (cm)	30.59	7.35	11.92 (1.306) <sup>t</sup>	7.98 + (7.35) <sup>t</sup>	0.8248	0.9082
Muthia	Plant height (cm)	77.20	44.78	11.02 (1.772) <sup>t</sup>	11.02 + (44.78) <sup>t</sup>	0.8503	0.9520
	Plant girth (cm)	43.20	9.40	7.92 (1.432) <sup>t</sup>	0.10 + (9.40) <sup>t</sup>	0.8966	0.9837
	Leaves per plant	52.90	4.96	2.75 (1.529) <sup>t</sup>	-2.00 + (4.96) <sup>t</sup>	0.9040	0.9831
	Leaf area per plant (m <sup>2</sup> )	184.24	5.17	0.08 (2.843) <sup>t</sup>	-9.32 + (5.17) <sup>t</sup>	0.9328	0.9428
	Petiole length (cm)	43.45	6.89	5.51 (1.435) <sup>t</sup>	-0.99 + (6.89) <sup>t</sup>	0.9208	0.9686
Kari bonthe	Plant height (cm)	59.20	61.70	35.31 (1.592) <sup>t</sup>	-10.80 + (61.70) <sup>t</sup>	0.8750	0.9291
	Plant girth (cm)	43.20	10.35	10.93 (1.432) <sup>t</sup>	5.55 + (10.35) <sup>t</sup>	0.8312	0.8943
	Leaves per plant	44.60	4.42	4.01 (1.446) <sup>t</sup>	0.52 + (4.42) <sup>t</sup>	0.9565	0.9990
	Leaf area per plant (m <sup>2</sup> )	177.30	4.72	0.20 (2.773) <sup>t</sup>	-5.19 + (4.71) <sup>t</sup>	0.8556	0.9643
	Petiole length (cm)	40.28	9.96	11.30 (1.403) <sup>t</sup>	4.89 + (9.96) <sup>t</sup>	0.9103	0.9860
Malai monthan	Plant height (cm)	62.20	52.35	27.58 (1.622) <sup>t</sup>	-9.55 + (55.35) <sup>t</sup>	0.8446	0.8759
	Plant girth (cm)	43.50	10.00	10.53 (1.435) <sup>t</sup>	5.65 + (10.00) <sup>t</sup>	0.8071	0.8301
	Leaves per plant	44.60	4.25	3.82 (1.446) <sup>t</sup>	0.50 + (4.25) <sup>t</sup>	0.9512	0.9952
	Leaf area per plant (m <sup>2</sup> )	226.30	4.57	0.09 (3.363) <sup>t</sup>	-5.87 + (4.57) <sup>t</sup>	0.8847	0.9686
	Petiole length (cm)	48.80	11.00	8.57 (1.488) <sup>t</sup>	-0.35 + (11.00) <sup>t</sup>	0.9469	0.9990

(Contd.)



Table 19. (Contd.)

	1	2	3	4	5	6	7	8
Bluggoe	Plant height (cm)		62.10	56.05	29.27 (1.621) <sup>t</sup>	-12.75+(56.05)t	0.8643	0.9097
	Plant girth (cm)		43.20	10.30	10.57 (1.432) <sup>t</sup>	4.20+(10.30)t	0.8812	0.9612
	Leaves per plant		56.00	6.10	3.85 (1.560) <sup>t</sup>	-0.75+(6.10)t	0.8932	0.9614
	Leaf area per plant(m <sup>2</sup> )		223.07	6.35	0.14 (3.230) <sup>t</sup>	-7.11+(6.35)t	0.8425	0.9328
	Petiole length (cm)		31.16	8.08	13.81 (1.311) <sup>t</sup>	9.38+(8.08)t	0.8966	0.9231
Chetti	Plant height (cm)		61.40	48.63	19.82 (1.614) <sup>t</sup>	-29.20+(48.63)t	0.8915	0.9797
	Plant girth (cm)		34.80	8.49	11.34 (1.348) <sup>t</sup>	6.95+(8.49)t	0.8132	0.9000
	Leaves per plant		37.00	4.17	4.49 (1.370) <sup>t</sup>	-0.85+(4.17)t	0.9440	0.9942
	Leaf area per plant(m <sup>2</sup> )		169.70	4.42	0.11 (2.697) <sup>t</sup>	-6.71+(4.42)t	0.8894	0.9580
	Petiole length (cm)		31.58	7.87	10.46 (1.316) <sup>t</sup>	6.42+(6.87)t	0.8532	0.9509
Kallu monthan	Plant height (cm)		47.70	46.68	33.82 (1.477) <sup>t</sup>	-0.08+(46.68)t	0.8369	0.9172
	Plant girth (cm)		37.40	10.66	12.60 (1.374) <sup>t</sup>	6.95+(10.66)t	0.8096	0.8949
	Leaves per plant		42.70	5.56	4.88 (1.427) <sup>t</sup>	0.57+(5.56)t	0.8638	0.9667
	Leaf area per plant(m <sup>2</sup> )		158.00	6.30	0.22 (2.580) <sup>t</sup>	-7.68+(6.30)t	0.8246	0.9692
	Petiole length (cm)		34.68	8.55	11.64 (1.346) <sup>t</sup>	7.66+(8.55)t	0.7966	0.8834
Hybrid Sawai	Plant height (cm)		51.46	37.93	23.83 (1.515) <sup>t</sup>	-4.00 + (37.93)t	0.8270	0.9126
	Plant girth (cm)		28.20	8.41	14.99 (1.282) <sup>t</sup>	9.62 + (8.41)t	0.9657	0.9069
	Leaves per plant		49.76	4.74	3.04 (1.498) <sup>t</sup>	-1.18 + (4.74)t	0.8925	0.9888
	Leaf area per plant(m <sup>2</sup> )		150.00	4.72	0.21 (2.500) <sup>t</sup>	-5.08 + (4.72)t	0.7960	0.9512
	Petiole length (cm)		38.10	7.94	8.20 (1.381) <sup>t</sup>	1.46 + (7.94)t	0.9249	0.9817
Bodles Altafort	Plant height (cm)		28.03	33.98	30.95 (1.496) <sup>t</sup>	-7.65 + (43.31)t	0.8664	0.9588
	Plant girth (cm)		24.48	7.96	11.81 (1.373) <sup>t</sup>	-4.90 + (10.34)t	0.8619	0.9573
	Leaves per plant		38.36	3.71	4.30 (1.426) <sup>t</sup>	-0.15 + (5.07)t	0.9120	0.9974
	Leaf area per plant(m <sup>2</sup> )		144.12	4.21	0.53 (2.085) <sup>t</sup>	-8.31 + (5.96)t	0.9178	0.9728
	Petiole length (cm)		27.15	8.36	11.49 (1.329) <sup>t</sup>	5.94 + (8.20)t	0.8976	0.9809

Table 20. Ranking of banana cultivars for growth rates

Cultivar	Ranks assigned to cultivars					Rank total
	Plant height	Plant girth	Leaves per plant	Leaf area per plant	Petiole length	
1	2	3	4	5	6	7
<b>AA</b>						
Namarai	5	5	4	5	3	22
Chingan	1	4	1	2	1	9
Tongat	2	3	2	4	4	15
Eraichivashai	4	1	3	3	5	14
Sanna chenkadali	3	2	5	1	2	13
<b>AB</b>						
Krishna vazhai	7	6	11	9	11	44
Vannan	6	4	10	7	10	37
Virupakshi	8	10	12	10	4	44
Sirumalai	4	3	8	8	9	32
Agniswar	3	8	1	2	8	22
Adakka kunnan	10	9	6	4	3	32
Valiya kunnan	9	7	7	11	6	40
Thaen kunnan	12	11	5	3	12	43
Padali moongil	11	12	9	11	7	50
Ney poovan	2	2	4	6	2	16
Kostha bontha	5	5	3	5	5	23
Venneettu mannan	1	1	2	1	1	6
<b>AAA</b>						
Gros Michel	5	7	7	4	3	26
Highgate	6	1	2	3	7	19
Pedda pachcha	9	8	11	9	1	38
Basrai	11	11	4	8	11	45
Harichal	8	6	10	10	8	42
Sapumal anamalu	1	3	5	6	4	19
Manoranjitha	3	9	1	5	6	24
Galanamalu	2	2	9	2	2	17

(Contd.)

Table 20. (Contd.)

1	2	3	4	5	6	7
Red banana	4	4	3	1	5	17
Wather	10	10	6	11	10	47
Karim kadali	7	5	8	7	9	36
<b>AAB</b>						
Thiruvananthapuram	13	13	9	12	11	58
China	11	12	4	9	8	44
Rasthali	12	9	3	5	6	35
Dudhsagar	4	10	5	2	2	23
Sugandhi	5	6	1	1	7	20
Palayankodan	10	8	6	3	5	32
Pacha chingan	3	3	11	10	10	37
Mannan	9	13	9	12	13	56
Malakali	2	4	7	7	8	28
Pacha naden	6	1	13	13	12	45
Nendra padaththi	8	2	12	9	4	35
Ghara padaththi	1	5	2	4	1	13
Kullan	14	11	8	11	14	58
Chinali	7	7	10	6	3	33
<b>ABB</b>						
Karpooravally	14	14	12	14	10	64
Chirapunchi	5	1	4	1	7	18
Pey kunnan	13	11	6	10	9	49
Walha	9	2	8	3	9	31
Ashy batheesa	2	5	10	11	2	30
Ney varman	16	3	8	9	4	40
Alukehel	15	12	5	8	12	52
Kapok	6	9	16	7	11	49
Jurmoney kunthali	4	6	3	2	8	23
Peyan	8	15	9	4	14	48
Pacha bontha bathees	17	16	1	12	13	59
Muthia	12	10	11	13	15	61
Kari bontha	1	6	13	15	3	38
Malai montha	7	8	14	16	1	46
Bluggoe	3	7	2	5	6	23
Chetti	10	13	15	17	16	71
Kallu monthan	11	4	7	6	5	33

In the group ABB 'Chirapunchi' was the most vigorous cultivar while 'Chetti' was the least vigorous one, as shown by the total ranks for their growth rates.

## 8. Estimation of genetic variability

The genotypic and phenotypic coefficients of variation, heritability in broad sense, genetic advance and genetic gain for 26 characters of banana are presented in Table 21.

Characters-leaf area per plant (0.9998), petiole length (0.9995) pulp/peel ratio on volume basis (0.9983) weight of fruit (0.9960) and volume of fruit (0.9932) showed higher heritability values combined with high genotypic coefficients of variation, except in leaf area per plant in which the genotypic coefficient of variation was 31.69.

Among the 26 characters, petiole length recorded the highest value for genetic gain (171.23) combined with high heritability. Weight of fruit (86.21), volume of fruit (85.51), pulp/peel ratio on volume basis (77.56) and leaf area per plant (64.64) also showed high genetic gain combined with high heritability values.

## 9. Multivariate analysis

### 9.1. $D^2$ Analysis

The significance of Lambda Statistic indicated the overall significant difference among the cultivars with regard to the 22 selected characters.

Table 21. Mean, range, genotypic and phenotypic coefficients of variation (gcv and pcv), heritability in the broad sense ( $h^2$ ), genetic advance and genetic gain for 26 characters of 62 cultivars of banana

Character	Mean	Range	gcv	pcv	$h^2$	Genetic advance	Genetic gain
1	2	3	4	5	6	7	8
Plant height (cm)	243.54 ± 3.24	128.00 - 451.50	22.59	22.68	0.9931	26.59	10.91
Plant girth (cm)	56.65 ± 4.27	36.25 - 85.25	23.05	25.39	0.8237	24.41	43.09
Leaves per plant	27.99 ± 0.39	18.25 - 60.00	23.14	23.22	0.9930	13.30	47.52
Leaf area per plant (m <sup>2</sup> )	25.99 ± 0.10	12.00 - 51.24	31.69	31.69	0.9998	16.80	64.64
Petiole length (cm)	46.02 ± 0.43	25.25 - 67.75	83.15	83.16	0.9995	78.80	171.23
Planting to flowering interval (days)	201.68 ± 1.57	162.50 - 432.50	19.36	19.39	0.9968	79.97	39.65
Flowering to harvest interval (days)	97.92 ± 1.25	63.00 - 137.00	20.77	20.85	0.9925	41.74	42.63
Bunch weight (kg)	8.26 ± 0.26	2.50 - 15.25	41.65	41.89	0.9883	7.05	85.35
Hand weight (g)	1105.00 ± 97.22	70.75 - 2725.00	40.84	42.70	0.9151	281.22	25.45
Number of hands	7.92 ± 0.57	3.50 - 16.50	38.36	39.70	0.9333	6.37	80.43
Number of fingers	104.01 ± 5.33	19.50 - 231.50	49.19	49.73	0.9787	104.27	100.25
Pediceal length (cm)	2.96 ± 0.10	1.28 - 5.55	36.70	37.01	0.9833	2.22	75.00
Finger length (cm)	13.45 ± 0.28	8.88 - 19.75	19.85	20.06	0.9794	5.44	40.45
Finger girth (cm)	10.81 ± 0.39	7.13 - 14.88	15.71	16.16	0.8820	3.17	29.32
Finger weight (g)	86.14 ± 1.62	30.25 - 195.66	41.94	42.02	0.9960	74.26	86.21
Finger volume (cc)	87.33 ± 2.27	25.50 - 206.50	44.39	44.54	0.9932	74.68	85.51

(Contd.)

Table 21. (Contd.)

	1	2	3	4	5	6	7	8
Per cent pulp weight		65.18 ± 0.46	49.88 - 87.75	9.98	10.05	0.9861	11.02	20.41
Pulp/peel ratio on weight basis		2.10 ± 0.10	0.79 - 7.17	51.97	52.40	0.9835	2.23	106.19
Per cent pulp volume		61.66 ± 0.36	46.76 - 81.50	8.18	8.23	0.9874	9.07	16.75
Pulp/peel ratio on volume basis		2.05 ± 0.01	1.21 - 4.41	37.61	37.64	0.9983	1.59	77.56
TSS (%)		32.71 ± 0.30	15.50 - 29.00	4.77	4.90	0.9467	3.48	9.55
Total sugars (%)		20.02 ± 0.42	5.60 - 22.78	15.11	15.28	0.9699	6.82	30.68
Reducing sugars (%)		12.77 ± 0.44	4.27 - 18.72	16.72	17.28	0.9365	6.76	33.32
Non reducing sugars (%)		1.89 ± 0.53	0.50 - 4.95	23.09	25.02	0.8522	3.39	43.97
Acidity (%)		0.33 ± 0.14	0.14 - 0.54	17.05	18.13	0.8841	1.07	33.02
Sugar/acidratio		46.78 ± 2.66	17.76 - 89.41	32.80	33.76	0.9431	30.70	65.63

### 9.1.1. $D^2$ values

Considering 62 cultivars, 2 at a time  $1891 \binom{62}{C_2}$  squares of difference ( $D^2$  values) were obtained. The  $D^2$  values are presented in Table 22. For the presentation of the data in a simple and concise form serial numbers 1 to 62 were assigned to the cultivars.

The tabulated value of chi-square for 22 degrees of freedom being, was lower than the calculated values of  $D^2$  in all cases, which showed that all the  $D^2$  values were significant. The minimum genetic distance (226.74) was between cultivars 'Pacha chingan' (AAB) and 'Mannan' (AAB) (No.35 and No.37) and the maximum genetic distance (38402.74) was between the cultivars 'Elavashai' (BB) and 'Harichal' (AAA) (No.6 and No.22) (Table 22).

### 9.1.2. Contribution of characters towards divergence

The character pulp/peel ratio on volume basis (34.06%) followed by weight of fruit (20.57%), total sugars (19.46%) and length of petiole (7.93%) contributed the maximum towards divergence (Table 23). These four characters along with the volume of fruit (4.81%), pulp/peel ratio on weight basis (3.54%), Height of the plant (2.75%) girth of the plant (1.43%), planting to flowering interval (2.27%) contributed to 96.82 per cent of the total divergence. The contribution of other characters were either negligible or zero.

Table 22 D<sup>2</sup> values for 62 cultivars of banana considering 22 characters simultaneously

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
1	0	7713.05	2536.55	1472.67	3983.29	21362.32	2788.43	4126.15	3726.07	4215.63	3578.80	5675.10	5816.52	5788.70	7399.06	4103.91
2		0	9446.40	5719.40	3175.76	23381.40	3463.22	8670.30	7356.19	3598.54	9451.14	3162.29	5246.42	2279.45	5871.93	2955.31
3			0	3732.13	4073.27	22216.60	3299.35	775.28	1448.63	2515.21	762.08	5432.04	7362.47	6192.55	6465.88	6692.40
4				0	3031.09	20239.78	1903.49	4319.50	4447.89	3542.96	4085.67	3739.21	4685.80	4002.72	7612.93	2597.06
5					0	19981.75	1788.85	3701.39	4360.37	1543.50	3941.78	4065.39	5454.29	3310.34	5902.23	2939.81
6						0	16722.79	24588.08	18769.79	23458.48	23303.51	16446.41	9451.14	14340.87	16197.22	14627.09
7							0	3107.11	2532.47	1734.99	3182.30	1979.76	2829.47	2283.51	3615.72	1451.57
8								0	1379.49	1752.59	390.50	5045.26	8077.94	6293.56	6627.45	7123.12
9									0	1018.58	1094.90	2734.87	4279.33	3889.16	4242.04	5421.30
10										0	1018.12	2916.90	5885.31	3542.39	5668.77	4745.56
11											0	5194.61	7612.99	6471.80	6437.79	6844.84
12												0	1791.81	831.42	3168.86	2449.37
13													0	3961.56	2223.40	2223.40
14														0	2802.09	1813.16
15															0	3889.55
16																0

(Contd.)



	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
1	6326.94	9996.11	9778.19	4165.63	1369.27	6832.29	7090.67	9420.11	2516.98	5515.26	7999.87	2631.63	2768.99	5832.10	7661.53	4096.85
2	7649.09	7633.82	9619.51	8819.02	6798.14	16096.34	8572.16	7793.48	5710.11	8366.58	11034.50	6850.57	6628.89	9172.97	3377.09	5902.36
3	5288.37	8030.27	16975.12	2953.06	3170.90	11197.79	4184.73	8632.48	1919.34	3817.30	13717.38	2016.00	1193.68	1841.96	6680.66	2157.85
4	4419.91	7355.31	16848.83	4328.99	1549.04	15481.48	5505.99	8333.23	2862.68	4441.66	15349.95	2478.50	2886.03	5649.07	5279.59	3783.05
5	5052.97	6820.83	10452.96	3908.24	2102.65	11168.06	4318.82	3848.50	1266.78	2974.11	9190.80	1935.14	1840.65	3695.36	4100.67	3031.84
6	10047.36	10254.55	23429.48	29304.80	21122.99	38402.74	20553.06	22963.37	23032.11	23578.37	23696.13	14206.94	23737.19	26349.25	17301.16	18392.50
7	2964.17	5063.18	12040.07	4553.17	2466.92	13182.61	4248.18	5216.62	2339.83	4512.39	10865.06	1441.98	2333.54	4367.12	3018.61	2160.24
8	5075.18	7380.86	15386.56	2805.21	4080.87	9247.03	3292.65	4448.39	1895.98	3216.22	11977.24	2290.84	975.67	993.65	5957.46	2165.30
9	3103.61	4460.31	14175.53	4877.80	4948.06	12792.07	4175.35	5785.76	3422.65	5227.50	12218.89	2372.86	2798.53	2960.25	4577.74	1926.21
10	5334.66	6522.46	12315.16	3848.59	3862.90	10880.31	4380.47	4158.89	2162.27	4247.24	10687.46	2786.39	1832.12	2759.82	4102.27	2414.78
11	4958.22	7578.32	16901.89	3211.57	4070.24	11061.57	4209.76	5516.81	2309.87	4050.86	13431.89	2212.88	1375.96	1679.30	6882.73	2909.40
12	2322.04	2290.69	9391.53	6636.13	5658.39	13528.69	4686.73	5827.47	4966.50	6003.90	9528.46	3820.52	5127.43	5804.47	1243.72	2920.56
13	1780.28	2251.65	4175.62	1445.12	6269.53	20109.57	7258.75	9366.98	7131.12	8458.06	2873.33	3937.02	7599.31	9581.82	3046.10	4347.90
14	2386.72	2412.59	8212.18	1563.33	5210.60	14705.24	5221.79	6127.73	4808.48	5811.72	8881.98	3640.05	5302.99	6695.33	1230.21	3046.89
15	4564.42	1643.94	9182.33	7406.46	7191.53	13256.04	5994.15	6028.09	5357.62	7625.56	8999.87	4762.48	5710.49	6672.69	3723.04	5009.93
16	3815.47	5764.32	13538.70	7684.51	3820.88	18742.42	7220.67	8466.76	4431.39	7088.13	13773.80	3373.73	5085.04	8541.93	4128.75	5233.41

(Contd.)

	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
1	2236.94	3394.93	5343.26	5946.14	4497.78	6728.81	7788.79	6252.21	6099.22	3976.64	3390.98	4180.06	9074.56	5836.38	8236.29	7515.27
2	7307.94	7743.13	9070.18	1919.82	9137.04	8801.87	1588.95	7889.29	6248.41	7302.77	7464.03	6210.58	11616.55	9574.03	12865.39	13133.06
3	2908.44	1267.27	2937.18	8723.31	2131.88	3497.82	8552.95	3332.74	4331.21	1197.78	976.44	4186.16	8391.60	4574.88	4458.83	4232.71
4	1608.36	3210.72	4618.88	4197.92	4069.65	6360.28	4896.79	5128.15	4661.14	4328.98	3571.38	2642.64	6899.19	4296.48	8089.08	6537.62
5	3251.52	2812.84	3690.94	1934.78	3939.26	4534.58	3210.92	3984.07	3277.48	3004.53	2275.04	3893.38	8021.42	5747.02	7130.51	8013.37
6	12345.65	20329.29	20696.89	22512.71	20342.88	16237.76	22958.41	15765.16	13932.00	20170.56	22823.53	11690.64	8905.91	11846.07	16662.10	21315.97
7	1468.71	2433.37	3432.31	2819.11	3226.92	4318.37	2881.33	3050.64	2714.92	2346.07	2607.73	1881.08	5972.70	3496.45	5947.68	6963.99
8	3633.58	1228.73	1790.03	8265.06	1519.77	3200.08	7548.57	2368.43	3668.50	688.22	531.72	4269.16	8365.52	4578.88	4500.83	3950.38
9	2664.61	2083.94	2760.13	7913.92	2127.18	2670.19	6467.85	2095.83	2940.53	646.82	1517.79	2457.69	5780.51	2842.37	3700.08	3773.96
10	4035.04	2549.14	3238.07	3486.07	3081.28	4604.18	3059.95	3593.54	4034.68	1648.62	1464.65	4073.36	8904.37	5465.06	6702.99	6845.67
11	3135.67	1385.33	1978.47	8349.78	1544.59	3515.89	8263.85	2667.55	4024.40	620.26	458.40	4042.64	8027.33	4248.06	4627.90	4197.51
12	3180.41	3961.79	5585.07	5402.97	5151.02	3952.25	2177.28	3204.89	2411.67	3460.27	4613.11	1498.09	5039.45	2963.97	5775.46	5341.12
13	2363.72	6155.83	6928.16	6005.11	6400.80	5125.75	4704.36	4487.25	3033.21	5469.34	7033.33	1346.14	2994.72	2777.48	6355.64	7462.47
14	3179.12	4584.00	6098.98	4184.76	5750.27	4059.85	1761.91	3498.19	2118.26	4321.66	5229.62	1821.59	4695.44	3739.45	6345.29	6682.89
15	5003.59	4750.64	7326.76	8415.05	7091.18	4320.45	5612.15	4215.96	3206.92	4160.63	5668.15	4082.33	1200.73	5769.89	6567.96	8471.92
16	2515.03	5622.49	7114.67	2674.31	6915.18	7223.83	2902.05	5852.14	4006.46	5704.73	5913.76	2479.75	1631.79	1041.22	9665.57	9809.62

(Contd.)

	49	50	51	52	53	54	55	56	57	58	59	60	61	62
1	5242.00	7532.26	7897.91	4483.47	6298.46	1480.08	2211.25	6748.17	1392.95	6534.76	8036.26	7074.29	6501.27	3326.93
2	10928.18	11110.29	9220.17	13019.92	8668.36	6859.00	16449.30	13559.07	12991.38	11858.67	10323.31	9172.32	8790.05	9367.79
3	2850.51	3377.38	3539.81	4376.29	2302.46	6936.79	5290.96	4675.26	5603.42	2241.37	4456.17	5864.36	9011.87	1443.30
4	5362.73	7048.77	6577.73	10299.97	5395.73	10761.49	13053.82	11162.02	10232.50	6956.19	6587.81	5250.54	12341.73	3725.06
5	6013.81	5670.70	5660.21	7406.78	4093.30	6205.70	10632.72	8304.04	8678.60	6415.20	7321.62	6194.91	7058.11	4110.89
6	11608.82	23253.31	23201.92	26472.13	22413.86	31395.08	29389.87	29245.54	14319.34	18943.00	19283.89	9116.28	27313.79	16524.09
7	3609.02	5166.05	4933.56	7503.94	3811.25	7343.57	10177.79	8520.98	6872.09	4648.68	5714.38	4013.97	8863.31	2198.96
8	3446.39	2910.99	2584.61	3390.04	1574.80	5324.25	4291.77	3871.77	4933.25	2136.09	3909.23	6062.07	7755.41	2086.11
9	1935.95	4080.73	3259.19	4973.72	2524.55	5990.55	5214.42	5153.09	3220.32	1937.66	3117.66	3628.17	8469.18	1422.14
10	5206.66	4846.61	4184.89	5951.98	2945.99	4578.94	7911.54	6262.80	6830.37	4697.75	5707.89	6325.57	7165.77	3620.58
11	3173.72	3590.49	3443.34	4527.65	2141.10	6647.01	4915.21	4656.29	4986.11	2339.77	4569.43	5757.82	9587.42	1644.44
12	3893.86	5913.44	3971.00	7629.79	4065.92	5709.51	9223.51	7842.72	5066.72	4964.48	3292.69	2780.87	7223.78	3720.14
13	3621.52	8898.09	7639.55	1723.76	7255.25	1241.45	3996.22	2804.80	6260.00	6782.24	5807.93	1875.99	1656.33	4558.19
14	4622.59	6972.03	5222.08	8915.10	5034.16	6469.74	11374.64	9571.35	6282.27	6341.66	4771.33	2940.37	7351.81	4420.79
15	1869.00	6525.92	5708.28	7701.10	5435.57	5697.71	8449.75	7228.88	6196.26	5485.03	6593.45	5491.86	7694.94	4633.14
16	1989.81	9679.72	8582.67	12633.71	7625.14	10376.85	15570.41	12973.13	10323.00	8814.35	8364.77	4561.74	12239.37	5768.56

(Contd.)

	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
17	0	939.59	10818.34	8071.27	5638.83	15064.98	3984.36	6592.30	5623.11	5235.91	9667.40	2254.18	5470.44	5849.49	2972.94	2758.82
18		0	8923.92	11073.59	9192.44	15997.43	5226.16	7263.75	8394.11	7373.49	8772.99	4726.14	8312.39	7868.24	2534.77	4100.72
19			0	12835.22	14555.35	8177.63	6660.78	5498.68	12486.55	9793.76	933.51	12193.52	13648.70	11141.69	5407.50	9399.59
20				0	2330.48	1413.92	2612.59	2505.06	1537.01	1672.74	10059.28	3626.43	1502.99	1587.98	6213.44	3992.98
21					0	1026.78	4140.49	1654.03	1396.72	2320.78	12550.75	1693.89	1909.82	4005.68	5999.34	3178.12
22						0	4127.65	3584.98	8601.34	1580.93	4812.42	11265.02	8480.48	4831.23	9691.15	9091.35
23							0	1359.74	3273.13	1163.75	4267.44	2618.08	3148.22	1604.49	3042.96	1908.08
24								0	3542.32	2431.46	2244.85	3995.67	3754.86	2219.49	4071.24	3543.15
25									0	1797.88	9165.50	1573.46	283.48	1761.28	4880.60	2591.55
26										0	7155.22	2418.17	1974.63	1536.02	4479.37	2748.16
27											0	9772.87	10814.70	7750.24	5652.36	7583.54
28												0	1572.01	2886.83	4229.73	1782.41
29													0	1235.20	5245.78	2410.08
30														0	5227.81	2098.16
31															0	2608.07
32																0

(Contd.)

	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
17	1477.74	3670.02	3822.94	8017.00	3523.49	2438.96	6202.54	1486.87	1057.80	3409.53	4519.20	453.67	978.81	884.32	3237.26	3645.50
18	4069.92	5935.22	6061.64	9768.22	5920.49	3249.51	6132.68	2579.04	1960.42	5156.29	6918.74	1693.27	1789.24	1866.76	4488.43	4844.24
19	14687.46	10926.70	13585.15	13851.66	14160.40	7584.01	8946.67	8782.93	7853.07	11831.01	13076.11	11573.82	13246.70	12359.34	10253.93	14502.10
20	5411.43	1619.76	4415.34	8407.69	3893.33	4409.00	7931.62	4687.71	5204.90	2860.84	1963.27	6084.39	11368.79	6859.99	6103.93	5695.52
21	2292.89	2371.27	4229.65	4540.31	3738.62	5208.96	6465.97	4856.69	4454.78	3760.06	2713.12	3838.49	7765.00	5025.25	6352.11	6654.45
22	15376.19	6703.25	10361.79	18545.60	10754.02	1249.61	14517.43	8511.73	10011.37	8883.00	8460.37	14454.15	18867.06	13912.78	9093.97	10556.93
23	4473.00	1475.83	3142.24	9312.21	3046.33	1340.87	7081.18	1379.30	2139.62	2424.06	2697.27	3678.56	5758.09	3197.07	2151.27	3309.31
24	6971.43	2815.49	4950.79	8720.56	5066.79	2826.51	6757.86	3148.08	3707.21	3404.47	3657.56	6134.11	9372.43	6229.09	4379.87	6587.49
25	3041.14	1195.92	3074.37	5049.11	2992.87	3474.41	5627.07	3385.62	3199.60	1911.21	1142.81	4199.81	9145.50	5685.53	5983.45	5827.39
26	4292.20	1626.77	3219.69	7870.48	3173.25	2655.54	7165.48	2577.21	2709.06	3055.13	2276.14	4316.55	6979.55	4389.65	3929.84	3655.68
27	12875.38	8069.33	10628.55	14120.57	11239.91	5533.72	9882.51	6485.72	6599.73	9332.37	10106.30	10635.46	12156.94	10570.97	7604.69	11596.37
28	793.71	1184.43	2071.63	5397.73	1852.70	2318.33	6207.29	1602.15	8026.29	1623.37	1580.22	1626.68	4192.09	2135.92	3622.49	4459.72
29	2980.19	917.01	2287.48	5754.52	2108.78	3412.52	6109.19	2980.05	3306.09	1375.09	641.18	4190.20	9017.13	5334.85	5607.13	5398.68
30	4966.00	839.59	2388.38	9306.97	2234.55	2186.67	7779.68	2215.34	3306.01	1208.44	834.35	5223.98	8982.03	5142.61	3328.73	3485.16
31	4370.63	3802.25	5721.55	6186.15	5636.17	2796.75	2304.06	2770.64	1798.56	4146.21	5254.99	2510.73	5386.20	3897.38	5027.48	5581.98
32	2567.30	1418.02	2506.21	6417.44	2173.82	1758.61	4886.22	1585.90	2047.86	1608.01	1988.57	2552.80	5030.34	2792.58	2408.88	3574.20

(Contd.)

	49	50	51	52	53	54	55	56	57	58	59	60	61	62
17	1652.59	5488.82	4253.84	7283.80	4067.97	9616.22	9277.74	8887.77	2919.32	3716.12	2774.84	387.41	9222.34	2569.40
18	3175.78	7137.19	5008.78	8314.22	3363.98	9197.48	10096.13	9828.93	2625.47	5261.62	2932.23	970.72	8366.91	4656.60
19	13701.03	9229.98	9154.47	9369.12	9386.36	7213.87	13008.67	11194.50	10811.10	12538.18	11434.52	12474.37	3235.37	12413.01
20	6523.23	2865.46	3586.36	4118.58	2595.40	4820.76	5676.62	3829.14	9166.30	4689.79	6315.66	9282.72	1061.00	3235.87
21	6266.42	5092.56	6194.64	7873.20	4531.75	9352.54	11054.53	8703.10	10343.86	5899.53	7378.22	6569.21	1624.29	3045.58
22	13418.45	4076.85	5398.75	3368.19	5180.35	4885.04	5239.43	3997.95	11469.14	8492.44	9985.86	16780.99	3069.33	9871.63
23	3526.14	1977.69	1532.01	1753.98	1076.92	4388.35	4050.09	3030.62	3870.35	2290.89	2947.93	4917.49	2867.18	2347.92
24	5867.84	2113.68	2834.37	2267.84	2136.92	3073.57	4714.57	2914.27	5409.40	4031.15	5534.16	7595.49	1793.81	4336.88
25	4969.93	3790.29	3894.20	5030.68	2626.97	4956.69	7005.61	5314.90	7960.45	4358.37	5825.43	6810.59	6473.84	2655.60
26	4980.04	2292.64	2766.24	3374.12	1866.32	5381.64	6078.68	4261.41	6840.52	3960.66	4280.41	6063.13	4660.76	2947.77
27	11347.87	6001.32	6624.85	6847.06	6503.35	6155.75	9194.85	7653.25	8428.13	9269.06	9387.57	11352.33	2172.94	9852.55
28	1806.83	3574.78	4017.64	5435.38	2670.56	7899.95	7669.92	6597.47	4778.22	2853.87	4401.71	2912.96	8013.18	1316.03
29	4468.41	3304.74	3347.58	4427.76	2127.98	5101.25	6210.33	4847.47	7208.53	3673.46	5466.39	6695.80	7065.50	2376.44
30	4367.47	1181.71	1446.03	1321.06	1576.12	3463.85	2702.90	1877.33	4929.58	1998.30	3606.26	6927.35	4340.05	2144.74
31	4918.55	4639.17	2994.06	6034.62	3437.38	4232.93	8558.17	7084.92	5122.75	5188.31	3375.42	3700.33	3993.93	4381.19
32	2591.54	2206.71	2225.38	3365.63	1516.93	5430.02	5962.79	5154.82	4087.55	2033.45	2695.80	3681.68	5052.08	1694.80

(Contd.)

33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
33	0	2260.44	3076.91	5821.95	2627.74	3343.50	6366.68	2502.07	2128.64	2660.86	2910.21	804.62	3103.78	1598.46	4294.01	4571.33
34		0	2054.12	7576.46	1789.88	1418.45	6573.28	1449.35	2109.29	830.85	702.91	2893.50	6536.16	3217.38	2717.61	3025.26
35			0	7242.56	226.74	2810.63	7931.13	1895.35	2929.62	1572.76	1546.40	3608.70	5762.13	3433.08	3836.59	4541.74
36				0	7389.15	10011.67	2321.76	8497.79	7196.01	7218.44	6546.76	6368.28	11023.92	9353.34	12996.71	14370.68
37					0	2669.13	7655.81	1891.69	2976.28	1272.11	1321.41	3132.40	5329.14	2920.57	3422.38	3985.67
38						0	7620.45	718.94	1018.90	1584.57	2455.05	2670.99	4249.51	2472.27	1245.52	2404.38
39							0	6383.59	5108.13	6322.69	6584.22	4996.85	9666.91	7749.30	10742.86	10868.64
40								0	1674.58	1322.17	2052.79	1796.89	3196.66	1492.75	1824.72	2421.34
41									0	2148.94	2904.67	1198.11	2786.73	1655.41	2516.36	3045.16
42										0	423.97	2794.51	6188.43	3094.73	2814.78	3539.21
43											0	3650.72	7510.08	4101.74	3934.28	4067.25
44												0	1714.99	620.05	3719.28	3541.17
45													0	971.04	3857.38	4675.01
46														0	2290.53	2410.62
47															0	2297.76
48																0

(Contd.)

	49	50	51	52	53	54	55	56	57	58	59	60	61	62
33	1773.13	5277.41	6063.70	7979.81	4062.84	10467.59	10125.18	9235.16	5490.48	3839.07	4513.83	1935.83	11060.90	1604.25
34	2491.75	1286.86	1660.48	2496.30	1714.03	4777.19	3937.21	3219.44	4193.27	1549.09	3030.86	4531.19	5368.00	1739.08
35	3524.44	3513.19	3631.15	4734.54	2491.79	7687.44	6608.85	6486.12	4919.33	3163.78	4710.38	4978.58	8483.72	2458.83
36	10815.79	11620.11	11208.54	14670.68	9458.46	10957.28	19165.93	15926.03	14840.91	12501.87	12941.22	9588.91	12621.66	8949.64
37	2917.06	3315.84	3408.21	4654.85	2334.49	7727.27	6340.29	6102.97	4650.37	2733.04	4308.17	4538.22	8681.76	1833.45
38	2073.77	1713.41	1382.62	2266.39	1242.25	4575.09	3432.51	3387.35	1747.84	1424.92	1943.79	3079.92	3785.44	1230.57
39	9423.01	9198.14	7203.06	11173.86	6828.48	6219.15	14614.87	11845.93	10585.04	10097.26	8323.60	7452.51	805.66	8040.53
40	1691.73	2254.31	1608.77	3064.03	1267.82	5323.53	4439.55	4314.14	1852.01	1577.88	1954.14	2241.66	5427.52	1505.71
41	2143.85	3328.42	2236.50	4412.76	2128.59	5384.20	6257.57	5469.88	2876.80	2786.35	2311.75	1683.36	5431.07	2042.19
42	2214.45	2263.92	2087.75	3033.66	1185.10	4431.33	3806.96	3442.70	3174.81	1436.20	3270.55	4281.08	6196.89	1951.20
43	3440.53	2885.26	2712.40	3511.47	1318.18	5006.92	4834.84	3967.77	5095.35	2412.11	4326.93	5585.39	6888.02	1414.36
44	1567.79	5175.55	4081.85	7351.64	3737.27	8703.40	9196.12	8264.24	3820.25	3688.95	2826.38	679.32	1042.45	1981.55
45	2830.62	7854.55	6927.75	10144.51	6708.02	14995.78	12647.05	12271.16	4258.70	5815.96	4527.38	850.87	12453.47	4433.03
46	985.15	4363.78	3826.79	6282.21	3428.11	10011.88	8009.28	7554.48	2649.23	2707.46	2236.19	564.24	9456.68	1839.02
47	1830.16	1535.42	2282.51	2459.68	1862.60	1797.61	4102.67	4036.00	1986.29	1028.42	2464.19	3372.44	6119.93	1547.65
48	2882.55	3224.25	2009.38	3856.66	2299.23	1762.26	4227.45	4280.20	3266.72	2050.52	720.92	3401.59	7991.01	2280.72

(Contd.)



	49	50	51	52	53	54	55	56	57	58	59	60	61	62
49	0	3504.70	3598.77	4895.89	2890.27	9241.25	5875.72	5780.41	1825.79	1294.41	2543.63	1395.65	9182.97	1051.01
50		0	1142.88	652.03	508.02	4656.19	2468.04	1773.94	3797.66	1166.57	3081.16	6165.77	3704.97	1944.57
51			0	1364.83	502.95	2972.37	2326.83	1908.68	2961.74	1551.00	1430.92	4882.39	3609.12	2283.63
52				0	999.05	3735.89	1154.68	821.86	3726.03	1641.16	3409.85	8008.29	2968.14	3456.34
53					0	3457.16	2421.60	1760.55	3019.55	1030.65	1983.44	4704.84	3833.44	1442.47
54						0	4180.94	2854.06	1208.32	4092.27	5935.77	10814.94	2174.89	6750.88
55							0	647.39	3859.24	2254.17	3999.30	9700.25	5217.18	4380.01
56								0	4683.46	2405.00	4012.43	9209.46	3759.36	4039.63
57									0	1723.35	2128.83	2778.57	4694.37	2896.79
58										0	1854.45	3879.36	6268.84	1015.43
59											0	2825.03	5199.70	2521.02
60												0	10366.74	2856.30
61													0	7145.04
62														0

\* Cultivars

1. Namarai
2. Sanna chenkadali
3. Chingan
4. Tongat
5. Eraichivazhai
6. Elavazhai
7. Agniswar
8. Krishna vazhai
9. Virupakshi
10. Sirumalai
11. Vannan
12. Ney poovan
13. Adakka kunnan
14. Valiya kunnan
15. Padali moongil
16. Thaen kunnan
17. Kosta bontha
18. Venneettu mannan
19. Galanamalu
20. Pedda pachcha
21. Basrai
22. Harichal
23. Gros Michel
24. Sapumal anamalu
25. Wather
26. Highgate
27. Red banana
28. Manoranjithm
29. Karim kadali
30. Malakali
31. Dudhsagar
32. Chara padaththi
33. China
34. Thiruvananthapuram
35. Mannan
36. Kullan
37. Pacha chingan
38. Chinali
39. Palayankodan
40. Sugandhi
41. Rasthali
42. Nendra padaththi
43. Pacha nadan
44. Karpooravally
45. Chirapunchi
46. Pey kunnan
47. Ney vannan
48. Walha
49. Peyan
50. Alukehel
51. Pacha bontha bathees
52. Bluggoe
53. Muthia
54. Malai monthan
55. Kari bontha
56. Chetti
57. Kapok
58. Kallu monthan
59. Ashy batheesa
60. Jurmoney kunthali
61. Bodles Altafort
62. Hybrid Sawai

Table 23. Contribution of characters towards divergence

Character	Per cent contribution
Plant height (cm)	2.75
Plant girth (cm)	1.43
Leaves per plant	0
Leaf area per plant (m <sup>2</sup> )	0
Petiole length (cm)	7.93
Planting to flowering interval (days)	2.27
Flowering to harvest interval (days)	0.58
Bunch weight (kg)	0.42
Hand weight (g)	0.79
Number of hands	0.05
Number of fingers	0.11
Pedicel length (cm)	0.16
Finger length (cm)	0.37
Finger weight (g)	20.57
Finger volume (cc)	4.81
Pulp/peel ratio on volume basis	34.06
Pulp/peel ratio on weight basis	3.54
TSS (%)	0
Total sugars (%)	19.46
Non reducing sugars (%)	0.37
Acidity (%)	0
Sugar/acid ratio	0.32

### 9.1.3. Cluster formation

Using the  $D^2$  values, the 62 cultivars were grouped into 8 clusters as detailed below.

#### Cluster I (19 cultivars)

'Pacha chingan'; 'Mannan'; 'Nendra padaththi';  
'Krishna vazhai'; 'Vannan'; 'Thiruvananthapuram';  
'Manoranjithm'; 'Sugandhi'; 'Kari~~m~~ kadali'; 'Virupakshi';  
'Chingan'; 'Charapadaththi'; 'Malakali'; 'Pacha nadan';  
'China'; 'Chinali'; 'Agniswar'; 'Wather' and 'Sirumalai'.

#### Cluster II (14 cultivars)

'Kostha bontha'; 'Jumoney kunthali'; 'Karpooravally';  
'Pey kunnan'; 'Venneettu mannan'; 'Chirapunchi'; 'Rasthali';  
'Payan'; 'Adakka kunnan'; 'Ney poovan'; 'Valiya kunnan';  
'Dudh<sup>^</sup>sagar'; 'Thaen kunnan' and 'Padali moongil'.

#### Cluster III (13 cultivars)

'Muthia'; 'Pacha bontha bathees'; 'Alukehel';  
'Bluggoe'; 'Kallu monthan'; 'Chetti'; 'Ney poovan';  
'Walha'; 'Malai monthan'; 'Kari bontha'; 'Hybrid Sawai';  
'Kapok' and 'Ashy batheesa'.

#### Cluster IV (3 cultivars)

'Palayankodan'; 'Kullan' and 'Sanna chenkadali'.

#### Cluster V (2 cultivars)

'Galanamalu' and 'Red banana'.

Cluster VI (7 cultivars)

'Boales Altafort'; 'Harichal'; 'Gros Michel';  
'Sapumal anamalu'; 'Highgate'; 'Pedda pachcha' and 'Basrai'.

Cluster VII (3 cultivars)

'Namarai'; 'Tongat' and 'Eraichivazhai'.

Cluster VIII (1 cultivar)

Elavazhai (Musa balbisiana)

9.1.4. Intra and intercluster  $D^2$  and D values

The intra and intercluster  $D^2$  values and D values were calculated (Tables 24 and 25) which showed that the intracluster  $D^2$  values were lesser than the intercluster  $D^2$  values of that cluster with other clusters. So the clusters can be considered to be more or less homogeneous within themselves and heterogeneous among themselves. The maximum average intracluster distance was in cluster 5 (9303.51) and the minimum in cluster 4 (1610.18).

The maximum intercluster distance was between cluster 6 and cluster 8 (26177.03) and the minimum between cluster 1 and 7 (3612.24).

## 9.2. Canonical analysis

The first two canonical roots  $\lambda_1$  and  $\lambda_2$ , and their relative contribution towards divergence are given

Table 24. Average intra and inter-cluster  $D^2$  values

Cluster No.	1	2	3	4	5	6	7	8
1	2035.30	4761.77	3974.05	6848.26	11085.21	4821.27	3612.24	23167.36
2		2521.72	5721.90	6389.94	9702.20	7623.05	5474.99	12557.59
3			2568.10	11442.95	9439.56	4868.88	8986.31	22493.85
4				1610.18	11242.57	9201.28	4264.41	22277.81
5					9303.51	6622.79	11603.43	23562.81
6						2324.95	6107.48	26177.03
7							2829.02	20527.95
8								0

Table 25. Average intra and inter-cluster distance (D values)

Cluster No.	1	2	3	4	5	6	7	8
1	45.11	69.01	63.04	82.75	105.29	69.44	60.11	152.21
2		50.22	75.64	79.94	98.50	87.31	73.99	112.06
3			50.68	105.56	97.16	69.78	94.80	149.98
4				40.13	106.03	95.92	65.30	149.26
5					30.55	81.38	107.72	153.50
6						48.22	78.15	161.79
7							53.19	143.28
8								0

in Table 26. The first principal component contribute to 78.41 per cent of the total variability. The first two components together contributed to 99.82 per cent of the total variability.

The eigen vectors for the 22 characters are given in Table 27. The highest numerical value was recorded by the pulp/peel ratio on volume basis followed by weight of finger and total sugars.

The values of the eigen vectors corresponding to the mean values of the characters ( $Z_1$  and  $Z_2$ ) were worked out for different cultivars and are given in Table 28. A scatter diagram showing the position of the 62 cultivars of banana on the basis of the mean values of the canonical variates ( $Z_1$  and  $Z_2$ ) is shown in Fig.3. The 62 cultivars were grouped into eight clusters which were similar to those formed by the  $D^2$  analysis.





**Table 26. Canonical roots and their contribution towards divergence**

Canonical root	$\lambda_1$	$\lambda_2$	Others
Contribution towards divergence	235610.90	64337.50	551.12
Per cent contribution	78.41	21.41	0.18

Table 27 Eigen vectors for 22 characters of banana

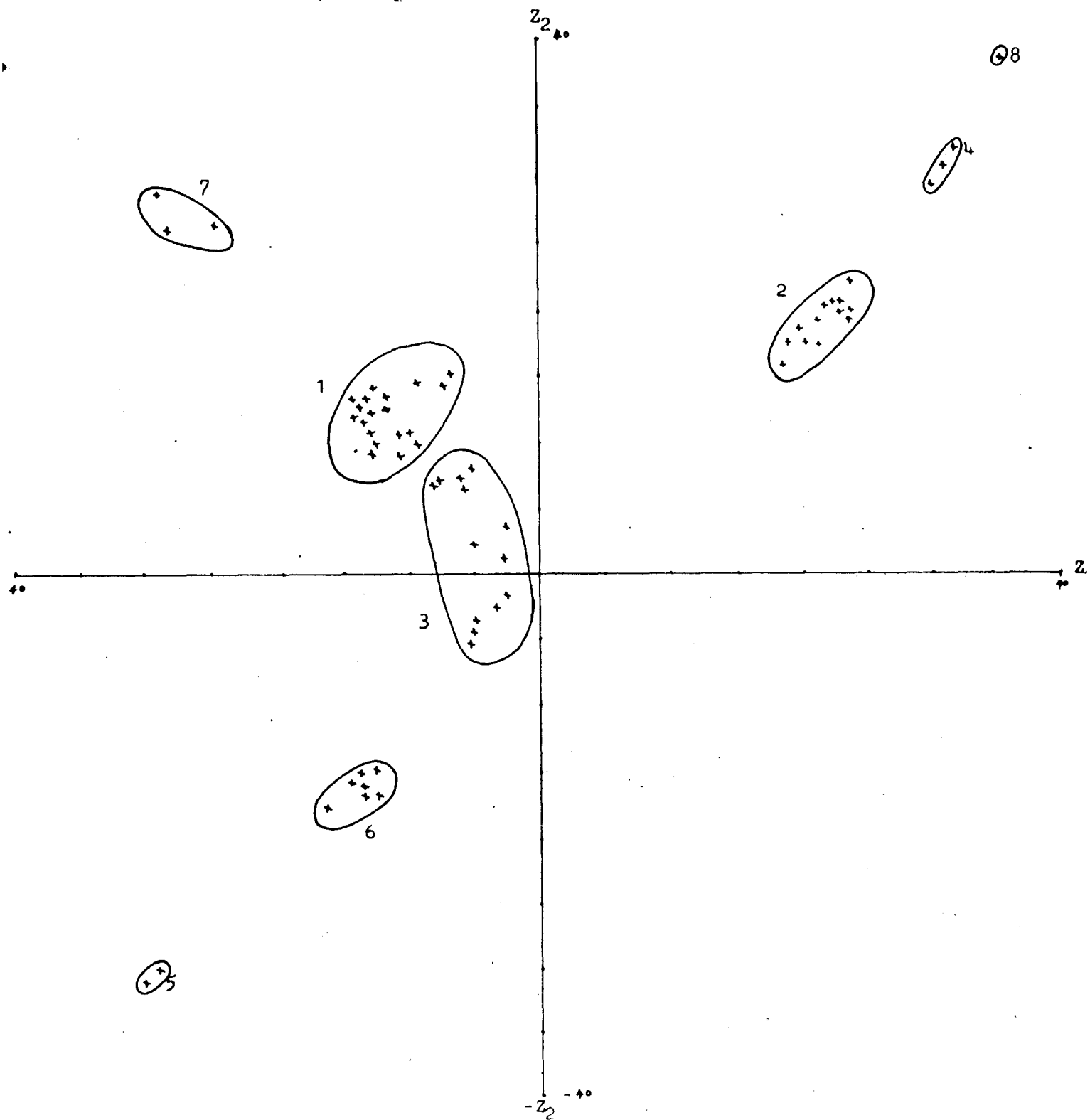
Character	Vector I	Vector II
Plant height (cm)	0.0251	-0.0138
Plant girth (cm)	-0.0132	-0.0015
Leaves per plant	-0.0014	0.0132
Leaf area per plant (m <sup>2</sup> )	-0.0026	-0.0014
Petiole length (cm)	-0.0628	0.0528
Planting to flowering interval (days)	-0.0218	-0.0114
Flowering to harvest interval (days)	-0.0052	0.0132
Bunch weight (kg)	-0.0019	-0.0044
Hand weight (g)	0.0132	0.0124
Number of hands	-0.0007	0.0014
Number of fingers	-0.0012	-0.0013
Pedicel length (cm)	0.0046	-0.0041
Finger length (cm)	0.0037	0.0035
Finger weight (g)	0.0778	-0.0614
Finger volume (cc)	0.0495	-0.0394
Pulp/peel ratio on volume basis	-0.2252	0.2138
Pulp/peel ratio on weight basis	-0.0364	-0.0148
TSS (%)	0.0048	-0.0018
Total sugars (%)	0.0769	0.0789
Non reducing sugars (%)	0.0035	0.0031
Acidity (%)	0.0015	0.0014
Sugar/acid ratio	-0.0028	-0.0026

Table 28.  $Z_1$  and  $Z_2$  values for 62 cultivars\* of banana

Sl.No.	$Z_1$	$Z_2$	Sl.No.	$Z_1$	$Z_2$
1	-28.21	26.18	32	-14.02	13.12
2	30.51	29.18	33	- 9.18	14.28
3	- 9.96	11.11	34	-13.44	10.32
4	-26.22	26.00	35	-14.38	13.21
5	-30.02	29.48	36	33.35	32.48
6	39.92	39.18	37	-14.62	13.41
7	- 7.51	14.20	38	-14.00	13.96
8	-12.91	11.50	39	-31.18	31.49
9	-14.06	12.01	40	-14.56	12.12
10	-14.48	12.50	41	19.58	19.78
11	-11.45	9.80	42	-13.10	12.57
12	22.51	20.58	43	-14.21	9.50
13	22.31	20.51	44	22.26	21.15
14	22.52	21.26	45	-19.48	20.10
15	23.02	22.08	46	18.79	19.81
16	22.58	21.28	47	- 5.65	5.38
17	21.20	19.50	48	- 3.18	3.54
18	22.19	20.18	49	18.80	19.10
19	-30.19	29.18	50	- 4.75	5.23
20	-14.50	-14.00	51	- 5.56	-4.16
21	-15.58	-14.56	52	- 2.72	1.35
22	-16.18	-15.54	53	- 8.17	5.16
23	-15.59	-14.38	54	- 5.73	-5.63
24	-15.61	-14.96	55	- 4.79	-5.31
25	- 9.50	10.30	56	- 0.57	-3.68
26	-15.04	-14.94	57	3.18	-2.20
27	-31.10	-30.08	58	- 6.03	5.82
28	-10.18	10.52	59	- 5.00	2.50
29	-13.39	13.26	60	18.24	17.80
30	- 7.18	15.00	61	-17.50	-17.50
31	20.12	19.88	62	- 8.18	7.00

\* Cultivars are serially numbered as in Table 22.

Fig.3. Scatter diagram showing the positions of 62 cultivars of banana on the basis of the mean values of the canonical variates ( $Z_1$  and  $Z_2$ ).



## *Discussion*

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## DISCUSSION

Based on morphological description, chromosome number and taxonomic scoring, 64 cultivars were identified, eliminating synonyms. The quantitative, quality and pollen characters were recorded and analysed statistically to estimate the extent of variation as influenced by polyploidy and the genomic constitution. Linear growth curves were fitted for cultivars and different genomic groups. Rate of growth was determined considering characters plant height, plant girth, leaf number, leaf area per plant and petiole length. The coefficients of variation, heritability (in broad sense), genetic advance and genetic gain were estimated for the observed characters. The genetic diversity among the cultivars were estimated using Mahalanobis  $D^2$  statistic and the cultivars were grouped into 8 clusters. The groups formed by the  $D^2$  analysis were further confirmed by canonical analysis. The contribution of various characters towards divergence was also estimated.

### 1. Variation in quantitative, quality and pollen characters

Studies on the quantitative, quality and pollen characters of 62 cultivars of banana revealed wide and significant variation among them. The ploidy level and the genomic constitution of cultivars were found to influence the characters at varying degrees.

The morphological characters - plant height, plant girth, leaves per plant, total leaf area per plant and petiole length were influenced more by the genomic constitution than by the ploidy level. The presence of 'B' genome in the constitution of the cultivar increased the magnitude of these characters. Musa balbisiana recorded maximum values and Musa acuminata (AA/AAA), the minimum for the above morphological characters. Within the triploids the maximum values were recorded by the genomic group ABB. Within each ploidy level, except tetraploids, plant height, plant girth, leaf area per plant and petiole length increased with the increase in 'B' genome in the genomic constitution. Within tetraploids, 'Bodles Altafort' (AAAA) recorded higher values than 'Hybrid Sawai' (ABBB), for plant height, leaf area per plant and petiole length. 'Hybrid Sawai' is a synthetic tetraploid banana intermediate in characteristics between the parents 'Ney vannan' (ABB) and Musa balbisiana (BB) (Raman et.al., 1970). Its behaviour could not be taken as that of a typical tetraploid of ABBB group.

When the rates of growth for plant height, plant girth, leaves per plant, leaf area per plant and petiole length were compared, it was found that the triploids had higher growth rates than the diploids and the tetraploids. The presence of 'B' genome in the cultivars of hybrid

origin, increased the growth rates. Similar results were reported by Nambisan and Rao (1980a).

The duration from planting to flower and flowering to harvest was the maximum in Musa balbisiana. The influence of 'B' genome to increase the crop duration was not evident in genomic groups of AAB to ABBB. The data indicated that the duration is not basically controlled by the genome constitution and polyploidy in banana. Summerville (1944) opined that the environmental factors may influence the duration to a greater or lesser degree than the other factors.

The triploids recorded higher values than the diploids for bunch weight and hand weight. This holds good within Musa acuminata groups and in groups of hybrid origin. This is evident from the prevalence of the above characters in commercial triploid cultivars since human selection might have preferred these characters of the triploids. An enhancement of the commercial attributes over the diploids was reported in the triploids and the tetraploids (Simmonds, 1966; De Langhe, 1969). Simmonds (1976) reported that the breeding of the triploids was all the more important in the hybridization of banana. Among the triploids, triploids of hybrid origin (ABB and AAB) were found better than pure Musa acuminata triploids (AAA) for bunch characters suggesting that a combination of 'A' and 'B' genomes contribute to bunch characters.



In finger characters, the triploids and the tetraploids recorded higher values than the diploids conforming to the earlier reports (Simmonds, 1966 and De Langhe, 1969). Triploids are more vigorous than diploids and hence their fruits grow larger than the diploids (Simmonds, 1976). There was an increase in the commercial characters of the finger in pure Musa acuminata groups (AAA and AAAA) over Musa balbisiana (BB) and the groups of hybrid origin (AB, AAB, ABB and ABBB).

The Musa acuminata groups (AA, AAA and AAAA) recorded lower values for pedicel length compared to other groups. When the Musa acuminata genome was substituted by the Musa balbisiana genome in cultivars of hybrid origin there was a corresponding increase in pedicel length. The short pedicel is a characteristic feature of Musa acuminata (Simmonds and Shepherd, 1955). The quantitative expression of this character in genomic groups substantiates its selection as a character in the taxonomic scoring method. It may also be noted that in pure Musa acuminata groups, the pedicel length decreased with the increase in 'A' genome upto triploidy.

The quality characters were influenced more by the genomic constitution than by the ploidy level. The genomic groups of hybrid origin (AB, AAB, ABB and ABBB) had higher content of total sugars, reducing sugars, non reducing sugars, and acidity than the Musa acuminata groups (AA,

AAA and AAAA). The group AAA had the highest value for sugar acid ratio. Though the hybrid cultivars, especially of the genomic group ABB, has a higher sugar content, the disappearance of acidity at ripening proceeds at a lower rate and they have a lower sugar/acid ratio which contributes to their inferior fruit quality (Simmonds, 1966). The studies substantiated the need for inclusion of 'B' genome in the banana hybridization programme which enhances plant vigour and improves the bunch characters and fruit quality.

The studies on pollen size, viability and production point out the possibility of utilising the knowledge in banana classification. Significant variations were observed in pollen characters among the cultivars, different ploidy levels and genomic groups. Out of the 62 cultivars studied, 22 were male sterile. All the cultivars of the genomic group AB did not produce viable pollen grains.

Cultivars 'Pacha chingan', 'Mannan', 'Malakali', 'Pacha nadan', 'Nendra padaththi', 'Chara padaththi' and 'Kullan' belonging to the genomic group AAB, 'Walha', 'Ashy batheesa' and 'Jurmoney kunthali' belonging to the genomic group ABB did not produce viable pollen grains. The non polleniferous cultivars belonged to two groups, one having well developed anther lobes and the other with black thread like anther lobes. The non polleniferous character of some of the cultivars of AB group like

'Adakka kunnan', 'Krishna vazhai' and 'Sirumalai' were reported by Alexander (1976).

The cultivars 'Virupakshi' and 'Krishna vazhai' which were found to be non polleniferous were reported to produce pollen grains in the hills (Sathiamoorthy and Rao, 1980). 'Virupakshi' and 'Krishna vazhai' are bud sports of 'Vannan', a non pollen producing cultivar and their cultivation in the plains is reported to revert them to 'Vannan' (Jacob, 1952).

In the present study it was also observed that the cultivars belonging to the ABB group, 'Jurmoney kunthali', 'Walha' and 'Ashy batheesa' did not produce pollen. In 'Jurmoney kunthali' the anther lobes were black and thread like. 'Walha' and 'Ashy batheesa' produced a very few number of male flowers with one or two well developed stamens which also did not contain any pollen grains.

The pollen size increased with ploidy level, the diploids having the smallest and the polyploids the largest. Within the diploids the genomic group AA had larger pollen than BB. Within the triploids and the tetraploids the pollen size increased with increase in the level of 'A' genome. In the case of triploids, the genomic group AAA had larger sized pollen grains than AAB or ABB, and in tetraploids 'AAAA' had larger pollen grains than ABBB. It was demonstrated that in autopolyploid series cell volume

varied directly with the increase in the chromosome number (Jorgensen, 1928; Muntzing, 1928, Lindstrom and Humphery, 1933). The genomic constitution and the level of ploidy seemed to exert a combined influence on pollen size which, therefore, appears to be a useful character to determine the ploidy and the contribution of Musa acuminata or Musa balbisiana genome to the constitution of a cultivar.

Pollen viability was the highest in the tetraploids followed by the diploids and the triploids. In cultivars of hybrid origin, it was lesser than in pure Musa acuminata or Musa balbisiana (BB) cultivars. Meiotic abnormalities in hybrid cultivars result in the production of more of sterile pollen (Simmonds, 1962). The variations in pollen stainability in cultivars are mainly attributed to genetic causes which operate to bring about either a degradation of pollen mother cells or the microspores at different stages of development. Chromosomal irregularities also contribute to the sterility met with, but relatively they seem to be of lesser importance.

Pollen production was the highest in the tetraploids followed by the diploids and the triploids. Among the diploids, the genomic group BB, among the triploids the group ABB and within the tetraploids the group ABBB produced the largest number of pollen grains per anther. The higher

pollen productivity of the genomic groups BB and ABBB were earlier observed by Sathiamoorthy and Rao (1980). Though the pollen productivity was higher in the triploid genomic group ABB, the viability was the least in this group.

The lower pollen productivity of the triploids, compared to the diploids and the tetraploids is due to meiotic abnormalities (Dodds, 1943; Simmonds, 1962). In banana, parthenocarpy and sterility arose as gene mutations in edible fertile diploids and the resultant types were taken into cultivation. Man selected and propagated those producing the fewest seeds and in the course of time parthenocarpy was completely established and vegetative propagation became obligatory (Dodds, 1943). At the same time the structural changes in the somatic chromosomes occurred and they were maintained. Nearly complete male sterility was added to meiotic anomalies, which were also controlled by morphological and physiological factors (Dodds, 1943; Simmonds, 1962; De Langhe, 1969).

There are reports that in the male flowers of edible banana types a few or no pollen grains are formed (Simmonds, 1966; De Langhe, 1969). In banana breeding, wild diploid clones and a few edible diploids are used as male parents. The use of wild parents in banana breeding programme in early years produced a few undesirable results, like horizontal bunches and seed fertility of the

progenies which they inherited from the wild male parent (Simmonds, 1966). In recent years several cultivated diploids and triploids have also been utilised as male parents (Sathiamoorthy and Rao, 1980, Anon, 1982). The utility of these cultivars depends on the viability and quantity of pollen produced. In the present investigation many cultivars belonging to the genomic groups AA, AAA, AAB, ABB, AAAA and ABBB were found to produce viable pollen grains indicating their potentiality as male parents. Many cultivars of the AAA group like 'Basrai' could not be used in the hybridization programme as female parent due to high female sterility (Simmonds, 1962, 1966).

The present study pointed out the possibility of inclusion of the highly desirable Cavendish gene in the banana breeding programme as male parent. The other desirable polleniferous cultivars can also be used as male parents even though they are female sterile.

## 2. Coefficients of variation, heritability, genetic advance and genetic gain for morphological characters

More than the observed variation, a knowledge on the extent and nature of the genetic variability is all the more important for the improvement of any crop. The values estimated for phenotypic and genotypic coefficients of variation for 26 characters were high suggesting the

high degree of variability in the cultivars which can be exploited for crop improvement programme.

According to Gandhi et.al. (1964) the magnitude of the genotypic coefficient of variation alone will not help the breeder to determine the amount of variation that is heritable. Heritability estimates will give an index of that portion of the variation transmissible to the progeny. According to Burton (1952) the genotypic coefficient of variation together with the heritability estimates would give a true picture of the amount of progress to be expected by selection. Characters like petiole length, pulp/peel ratio on volume basis, weight and volume of fruit showed very high heritability coupled with high genotypic coefficients of variation. These characters can be improved by selection since high heritability indicates the effectiveness with which selection of genotypes can be based on phenotypic performance (Johnson et.al., 1955). The maximum genetic advance was obtained for petiole length, followed by pulp/peel ratio on volume basis and finger weight.

The present study revealed that the cultivars 'Sanna chenkadali' (4.41), 'Galanamalu' (3.80), 'Palayankodan' (3.98), 'Kullan' (3.98) have higher pulp/peel ratio than the other cultivars. The cultivars belonging to the AAA group like 'Red banana' (195.60 g), 'Galanamalu' (193.50 g), 'Harichal' (188.02 g) were superior to other cultivars with

regards to the weight of fruit. Regarding the volume of fruit cultivars 'Malai monthan' (206.80 cc), 'Pacha bontha bathees' (205.50 cc), 'Harichal' (184.00 cc) and 'Chetti' (162.50<sup>cc</sup>), were superior to other cultivars. 'Rasthali' (132.00 cc), 'Red banana' (131.00 cc) and 'Galanamalu' (120.50 cc) also recorded higher values in volume of finger. Musa balbisiana (51.24 m<sup>2</sup>) and cultivars of ABB group viz., 'Chirapunchi' (46.84 m<sup>2</sup>) and 'Jurmoney kunthali' (39.24 m<sup>2</sup>) recorded higher values in leaf area per plant than other cultivars. These cultivars were also superior in bunch weight, hand weight, number of fingers, length of finger except 'Kullan'. Cultivars 'Red banana', 'Galanamalu', 'Harichal' and 'Rasthali' are superior quality bananas and their role in the banana hybridization programme had been emphasised by earlier workers (Jacob, 1952; Nair, 1962). 'Malai monthan', 'Pacha bontha bathees' and 'Chetti' are excellent culinary bananas and would prove useful in banana breeding programme as suggested earlier by Nair (1962) and Ramen (1976).

### 3. Taxonomic scoring and chromosome studies

The taxonomic scoring method suggested by Simmonds and Shepherd (1955) is widely accepted as a useful tool to identify the genomic status of banana cultivars. This system was found to be inappropriate in a few of the South Indian cultivars like 'Eraichivazhai' (AA), 'Sanna chenkadali' (AA),



'Agniswar' (AB), 'Krishna vazhai' (AB), 'Vannan (AB),  
'Virupakshi' (AB), 'Sirumalai' (AB), 'Kostha bontha' (AB)  
and 'Venneettu mannan' (AB), 'Karpooravally' (ABB),  
'Chirapunchi' (ABB) and 'Pey kunnan' (ABB). The genomic  
formulae suggested by Simmonds (1966) to the cultivars  
'Adakka kunnan' (AB), 'Thaen kunnan' (AB) and 'Padali moongil'  
(AB) were also found to be inappropriate.

The cultivars 'Eraichivazhai' and 'Sanna chenkadali'  
scored 26 and 28 respectively which were in the range of  
AAB cultivar. These cultivars had high length/breadth ratio  
of bracts unlike a cultivar belonging to the AA group. The  
outside bract colour was brownish purple. Both these  
characters are characteristics of Musa balbisiana. For all the  
other characters they resembled Musa acuminata. Raman et al.  
(1968, 1970) showed an introgression of the gene complex  
of Musa balbisiana in South Indian varieties. The metroglyph  
analysis showed that cultivars at present considered to  
have AA genome showed a wide dispersion over the diagram and  
exhibited expression of characteristics of those intermediate  
between Musa acuminata and Musa balbisiana. This feature  
is considered as a factor which has favoured their success  
both under the dry and humid conditions and also their  
susceptibility, to diseases. The general observations in  
the cultivar 'Sanna chenkadali' are that it is comparatively  
free from diseases, especially the bunchy top disease, and  
tolerant to drought compared to the other cultivars belonging  
to the AA group.

Cultivars 'Krishna vazhai', 'Vannan', 'Virupakshi', 'Sirumalai' and 'Agniswar' were diploids and belonged to the AB group, though the genomic formulae suggested by Simmonds (1966) to 'Krishna vazhai', 'Vannan', 'Virupakshi' and 'Sirumalai' were AAB. Raman et.al. (1970) reported that cultivars 'Sirumalai' and 'Vannan' were diploids and exhibited expression of characters of those intermediate between Musa acuminata<sup>a</sup> and Musa balbisiana and nature of pairing of the chromosomes also indicated their hybrid nature.

The cultivars grouped under 'kunnan' by Jacob (1952) viz., 'Adakka kunnan', 'Valiya kunnan' and 'Thaen kunnan' were found to be diploids confirming the earlier reports (Jacob, 1966 and Raman et.al., 1970). Simmonds (1966) included them under three different genomic groups namely, AB (Kunnan), AAB (Adakka kunnan) and ABB (Thaen kunnan). The cultivar 'Padali moongil' belonging to the 'Kunnan' group was found to be an allodiploid (AB) though Simmonds (1966) had included it under the AAB group.

The cultivars 'Kostha bontha' and 'Venneettu mannan' had a high expression of Musa balbisiana characters and high score. They were grouped to the genomic group 'ABB' by Simmonds (1966). Counting of the somatic chromosomes revealed the diploid nature of these cultivars and they were grouped under the genomic group 'AB' in the present study. The orientation of the bunch would help in the identification

of the ploidy level of these cultivars. All the cultivars belonging to the AB group had bunches oriented at an angle  $60^{\circ}$  -  $90^{\circ}$  to the pseudostem, while in all the triploid cultivars the bunches were oriented at less than  $30^{\circ}$  to the pseudostem. These cultivars did not produce viable pollen grains. It may be noted that the morphological criteria used by Jacob (1952) are indicative of the high ploidy level of these cultivars since he included these cultivars under the 'Kunnam' group.

The cultivars 'Karpooravally', 'Chirapunchi' and 'Pey kunnam' had lower scores (56) than the typical ABB cultivars. These three cultivars were found to be triploids and considering the predominance of Musa balbisiana characteristics in the morphology of the plants, they were given the genomic formula ABB. 'Karpooravally' and 'Pey kunnam' are female fertile and the fruits contain a number of black seeds. In fruit shape and quality, they, especially 'Karpooravally' resembled 'Palayankodan' and could be used as dessert banana. Jacob (1952) included 'Pey kunnam' under the 'Kunnam' group and Simmonds (1966), under the genomic group ABB. These cultivars were grouped into the second cluster which also included the other cultivars of the 'Kunnam' group of Jacob (1952).

The studies on morphological characters, taxonomic scoring and chromosome numbers of South Indian cultivars

revealed that the cultivars within each genomic group were highly variable. The cultivar 'Sanna chenkadali' which was supposed to have AA genome only, had characters of Musa balbisiana. Diploid clones occurred more frequently than those suggested by Simmonds (1966). Cultivars 'Krishna vazhai', 'Vannan', 'Virupakshi', 'Sirumalai', 'Agniswar', 'Padali moongil', 'Kostha bontha' and 'Venneettu mannan' were added to the AB group in the present study. In genomic groups AAB and ABB, cultivars exhibited expression of characters of Musa acuminata and Musa balbisiana to varying degrees. The genomic groups AB, AAB and ABB are more common in the cultivated bananas of India. These variations in Indian bananas are possible because of their centre of origin in India (Simmonds, 1966).

Cheesman (1948a) reported that the number of cultivars showing characters of Musa acuminata and Musa balbisiana are relatively small. The group representing the cultivars of hybrid origin was classified as Musa x sapientum and was the largest group. Examining the grouping with regard to the Indian cultivars, it has to be mentioned that the cultivars representing hybrid origin is of the largest group and that cultivars like 'Gros Michel', which have all the characters of Musa acuminata are rather rare. Wide variability was reported in the Musa balbisiana of South India and this variability in the 'B' genome may be responsible for introducing wide variation even in

South Indian cultivars of hybrid origin involving 'B' genome (Raman et.al., 1968). In cultivars, especially of South Indian origin the genomic formulae assigned by Simmonds (1966) are inappropriate and not useful in some of the cultivars as stated in Table 29.

#### 4. Estimation of genetic divergence

Information on genetic divergence is of great importance in many of the crop improvement programmes. The cultivars on the whole when considered on the basis of 22 selected characters simultaneously were significantly different. The estimates on relative contribution of each character towards divergence showed that pulp/peel ratio contributed maximum (34.06%) towards divergence followed by fruit weight (20.57%) and total sugars (19.46%). All the 22 characters showed high heritability values and hence could be utilised for selection with advantage.

Using  $D^2$  values eight clusters were formed. The intercluster distance was greater than the intracluster distance showing that the clusters are more or less homogeneous within themselves and heterogeneous among themselves. The canonical analysis of the data confirmed the groups formed by  $D^2$  analysis. The cultivars 'Pacha chingan' and 'Mannan' with the minimum genetic distance belonged to the same genomic group AAB while 'Elavazhai' and 'Harical' with the maximum genetic distance

Table 29. Modifications in the genomic groups suggested by Simmonds (1966).

Cultivar	Genomic group suggested by Simmonds (1966)	Genomic group suggested in the present studies
Krishnavazhai	AAB	AB
Vannan	AAB	AB
Virupakshi	AAB	AB
Sirumalai	AAB	AB
Agniswar	AAA	AB
Padali moongil	AAB	AB
Kostha bontha	AAB	AB
Venneettu mannan	ABB	AB

belonged to the genomic groups BB and AAA respectively.

The first cluster included 19 cultivars belonging to the genomic groups AAB, AB, AA and AAA. Some of the clusters contained diploids and triploids. Cultivars 'Pacha chingan', 'Mannan', 'Nendra padatathi', 'Chara padath<sup>th</sup>i', 'Malakali' and cultivars 'Krishna vazhai', 'Vannan', 'Virupakshi' and 'Agniswar' though belonged to genomic groups AAB and AB had morphological characters of similar magnitude. In taxonomic scoring also they had more or less similar scores. None of these cultivars produced pollen grains. The inclusion of cultivars belonging to AA and AAA group may be because of the reason given by Raman et.al. (1970) viz., in cultivars belonging to Musa acuminata groups, there is introgression of the Musa balbisiana genome. Similarly cultivars belonging to AAB group showing varying degrees of expression of the Musa balbisiana characteristics are also included in the group.

The second cluster included 14 cultivars belonging to AB, AAB and ABB groups. It included diploids of the genomic group AB, 'Adakka kunnan', 'Valiya kunnan', 'Ney poovan', 'Kō<sup>s</sup>tha bontha' and 'Venneettu mannan', along with 'Karpooravally', 'Chirapunchi' and 'Pey kunnan' which scored almost similar to AB cultivars but belonged to different genomic groups because of the difference in ploidy level.

The third cluster included 13 cultivars all of which were typical ABB cultivars but for 'Hybrid Sawai' which though belonged to ABBB group was a hybrid tetraploid intermediate in characteristics between the parents 'Ney vanna' (ABB) and Musa balbisiana (BB) (Raman, 1976).

The fourth cluster included 3 cultivars 'Palayankodan' and 'Kullan' belonging to the AAB group and 'Sanna chenkadali' (AA). 'Sanna chenkadali' though belonged to the AA group was found to exhibit some of the characters of Musa balbisiana and had a high score (28), typical of AAB cultivar.

The fifth cluster included two cultivars only, 'Galanamalu' (AAA) and 'Red banana' (AAA), the former being a bud sport of the latter. The sixth cluster contained cultivars all belonging to Musa acuminata groups (AAAA and AAA). It is noteworthy that this group included none of the Indian cultivars of Musa acuminata group. The seventh cluster had three cultivars - 'Namarai', 'Tongat' and 'Erapichivazhai' all belonging to the AA group. The eighth cluster included only one - 'Elavazhai' (Musa balbisiana-BB).

Of the eight clusters formed, Cluster III and VI included cultivars which had a predominance of the characters of Musa balbisiana and cultivars which had a predominance of the characters of Musa acuminata, respectively. Cluster No.VIII included only Musa balbisiana (BB) and cluster V included 'Galanamalu' and 'Red banana' which



belonged to the genomic group AAA. In the case of clusters which included cultivars belonging to genomic groups AAB, AB and ABB there was no uniformity in distribution. This may be because these clusters included mainly cultivars of Indian origin which included cultivars showing different degrees of expression of the characters of Musa acuminata and Musa balbisiana. In the case of these cultivars, Simmonds and Shepherds (1955) taxonomic scoring system seems to be inappropriate since the cultivars included within a genomic group are highly variable and genetically divergent.

The present studies on cytological and morphological aspects of banana cultivars revealed that the cultivars could be grouped into 3 groups, viz., cultivars showing predominant characters of Musa acuminata cultivars representing a mixture of characteristics of Musa acuminata and Musa balbisiana and cultivars showing predominant characters of Musa balbisiana. The second group is the largest group and the cultivars included are highly variable genetically.

The present study also indicated the possibility of improving the banana cultivars by selection to meet

the location specific requirements. The results also indicated that several desirable cultivars had viable pollen which could be utilised for the hybridization programme. The classification based on genetic divergence suggested the groups from which the parents could be conveniently selected for exploiting the wide variability to improve the crop.

# *Summary*

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## SUMMARY

Cytotaxonomical studies on 100 cultivars of banana were conducted at the College of Horticulture, Kerala Agricultural University, Vellanikkara during 1981-83. Based on the morphological characters, taxonomic scoring and chromosome numbers, <sup>identical</sup> ~~synonymous~~ cultivars were identified. Out of the 100, there were only 64 distinct cultivars.

The cultivars were assigned to eight genomic groups on the basis of taxonomic scoring and ploidy level. The cultivars 'Agniswar' included under the genomic group AAA, 'Krishna vazhai', 'Vannan', 'Virupakshi', 'Sirumalai' and 'Padali moongil' under the genomic group AAB and 'Kostha bontha' and 'Venneettu mannan' under the genomic group ABB, by Simmonds (1966) were identified to be diploids of the genomic constitution 'AB'.

Studies on the quantitative, quality and pollen characters of 62 cultivars of banana revealed a significant variation among them. The genomic constitution and the ploidy of the cultivars influenced the characters.

The growth parameters like plant height, plant girth, leaves per plant, leaf area per plant and petiole

length were influenced by the genomic constitution of the cultivars. The presence of 'B' genome in the genomic constitution increased the magnitude of these characters. In all the characters, the highest values were recorded by Musa balbisiana (BB) followed by the genomic group ABB and the lowest by Musa acuminata groups.

Musa balbisiana took the longest duration from planting to flower (433 days) and from flowering to harvest (128 days). The planting to flower interval was the shortest in the genomic group AAB (192 days) while the flowering to harvest interval was the shortest in the group AA (88 days).

The triploids recorded higher values than the diploids for bunch characters, bunch weight, hand weight, number of hands and fingers. Within the diploids the genomic group AB and within the triploids the genomic groups ABB and AAB recorded higher values than Musa acuminata groups (AA and AAA) and Musa balbisiana (BB).

Musa balbisiana (BB) and genomic groups ABB and ABBB had longer pedicels than Musa acuminata groups (AA, AAA and AAAA). The genomic groups AB and ABB were intermediate for pedicel length between these two above groups.

The triploids and the tetraploid genomic group AAAA recorded significantly higher values than the diploids

for finger characters-length, girth, volume, weight, percentage of pulp weight and pulp/peel ratio. The Musa acuminata groups, AAA and AAAA recorded higher values than Musa balbisiana (BB), ABB and ABBB groups.

The quality characters - total soluble solids, sugars, acids and sugar/acid ratio were more influenced by the genomic constitution of the cultivars than the ploidy level. The genomic groups of hybrid origin recorded higher values for these characters except for the sugar/acid ratio of fruits, than the Musa acuminata and Musa balbisiana groups. The genomic group AAA had the highest value (59.64) for sugar/acid ratio.

The studies on pollen viability, size and production revealed the possibility of utilising the cultivars in banana hybridization programme as male parents. None of the cultivars belonging to the genomic group AB produced pollen grains. Also cultivars-'Pacha chingan', 'Mannan', 'Malakali', 'Pacha nadan', 'Nendra padaththi', 'Chara padaththi', and 'Kullan' belonging to the genomic group AAB; and 'Walha', 'Ashy batheesa' and 'Jurmoney kunthali' of the genomic group ABB, did not produce pollen.

Pollen viability was the highest in Musa balbisiana (93.10%), followed by the tetraploids (75.75%). In genomic groups of hybrid origin pollen viability was lesser than in Musa acuminata or Musa balbisiana groups.

Pollen production was the highest in Musa balbisiana (17133.33) followed by the tetraploids (11981.67). Within the triploids, the genomic group ABB (5612.14) and within the tetraploid the genomic group ABBB (12416.67) produced larger number of pollen than the other groups.

The growth pattern of banana cultivars from planting to flower was linear. The rates of growth with respect to plant height, plant girth, leaves per plant and leaf area per plant were influenced by the ploidy level and the genomic constitution of the cultivars. The triploids were more vigorous than the diploids and the tetraploids as evidenced from their higher rates of growth. The genomic groups of hybrid origin recorded higher growth rates than Musa acuminata or Musa balbisiana groups.

The genotypic and phenotypic coefficients of variation, heritability in broad sense, genetic advance and genetic gain were estimated for the observed 26 characters. The characters, petiole length (0.9995) pulp/peel ratio on volume basis (0.9983), finger weight (0.9960) and finger volume (0.9932) showed higher heritability values combined with higher genotypic coefficients of variation. The characters, fruit weight (86.21), fruit volume (85.51), pulp/peel ratio on volume basis (77.56) and leaf area per plant (64.64) recorded higher values for genetic gain than the other characters.

The genetic divergence among the cultivars estimated by the Mahalanobis  $D^2$  analysis revealed that the minimum distance (226.74) was between the cultivars 'Pacha chingan' (AAB) and 'Mannan' (AAB) and the maximum (38402.74) between Harichal (AAA) and Musa balbisiana (BB).

The relative contribution of each character towards divergence was calculated which showed that the pulp/peel ratio on volume basis contributed the maximum towards divergence (34.06%) followed by fruit weight (20.57%) and total sugars (19.46%).

Using the  $D^2$  values eight more or less homogeneous clusters were formed. The intracluster distance was lesser than the intercluster distance, showing that the clusters were homogeneous within themselves and heterogeneous between themselves. The first cluster included 19 cultivars, the second cluster 14 cultivars, the third cluster 13 cultivars, the fourth cluster 3 cultivars, the fifth cluster 2 cultivars, the sixth cluster 7 cultivars and the seventh, 3 cultivars. The eighth cluster included only one, Musa balbisiana. The clusters formed were differing from the genomic groups.

Eight clusters similar to those formed by the  $D^2$  analysis were formed by the canonical analysis of the data. The eigen vectors were calculated for the characters.



The highest numerical values was recorded by pulp/peel ratio on volume basis (-0.2353, 0.2138) followed by finger weight (0.0789, -0.0614) and total sugars (0.0769, 0.0789).

The present study clearly indicated the possibility of improving the banana cultivars by selection. The results also indicated that several cultivars like 'Basrai', 'Rasthali', 'Red banana' and 'Palayankodan' had viable pollen. The clustering based on genetic divergence suggested the groups from which parents could be conveniently selected for exploiting the wide variability for improving the crop.

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\* Originals not seen

# Appendices

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Appendix 1. Analysis of variance for growth parameters of 62 cultivars of banana

Source	df	Mean sum of squares				
		Height (cm)	Girth (cm)	Number of leaves	Leaf area per plant (m <sup>2</sup> )	Length of petiole
Total	123					
Replications	1	29.52	6.33	5.91	0.02	17.66
Genotypes	61	6074.21	206.94**	84.21**	135.65**	293.56**
Diploids Vr.Polyploids	1	921.10	187.58**	11.46**	183.04**	31.01**
Diploids	17	10215.48	295.42**	176.35**	189.39**	390.53**
AA	4	2136.65**	643.85**	9.44**	21.48**	122.48**
AB	11	3470.04**	30.89	73.22**	107.18**	359.40**
BB	-	-	-	-	-	-
Among diploids	2	63473.04**	1126.81**	1077.36**	977.38**	1097.85**
Polyploids	43	4556.80**	172.41**	49.46**	113.30**	261.33**
Triploids	41	4735.92**	180.74**	50.34**	115.95**	267.39**
AAA	10	5305.26**	222.17**	32.58**	117.78**	195.46**
AAB	13	1796.80**	54.32**	43.01**	108.12**	242.78**
ABB	16	3741.71**	223.14**	44.81**	117.98**	84.47**
Among triploids	2	28947.19**	456.15**	231.00**	141.59**	50.39**
Tetraploids	1	756.25**	3.07 NS	14.07**	0.85**	81.00**
Tetraploids Vs.Triploids	1	1013.42**	0.39 NS	49.10**	117.02**	193.12
Error	61	21.03*	36.48	0.29995	0.01	0.73

\*\* Significant at 1% level

NS Not significant

Appendix 2. Analysis of variance for duration of 62 cultivars of banana

Source	df	Mean sum of squares	
		Planting flowering interval (days)	Flowering to harvest interval (days)
Total	123		
Replications	1	15.61	5.04
Genotypes	61	3044.72**	415.31**
Diploids Vr. Polyploids	1	9770.21**	215.40**
Polyploids	17	7155.76**	813.43**
AA	4	188.00**	602.80**
AB	11	1915.94**	838.31**
BB	-	-	-
Among diploids	2	49910.28**	1399.20**
Polyploids	43	1263.02**	262.57**
Triploids	41	1315.88**	274.61**
AAA	10	904.58**	261.48**
AAB	13	1255.77**	358.42**
ABB	16	1633.92**	203.38**
Among triploids	2	1218.81**	865.33**
Tetraploids	1	0.25 NS	25.00
Tetraploids Vr. Triploids	1	358.55**	6.43**
Error	61	4.91	3.12

\*\* Significant at 1% level  
 NS Not significant

Appendix 3. Analysis of variance for bunch characters of 62 cultivars of banana

Source	df	Mean sum of squares			
		Bunch weight (kg)	Hand weight (g)	Number of hands	Number of fingers
Total	123				
Replications	1	3.73	191304.60	0.43	2556.20
Genotypes	61	23.81	426285.88**	19.12**	5292.93**
Diploids Vs. Polyploids	1	98.99	2398153.77**	1.13**	842.87**
Diploids	17	25.09	206548.67**	19.23**	7234.78**
AA	4	15.78	412360.48**	22.38**	10448.25**
AB	11	32.49	166616.44**	19.76**	6776.41**
BB	-	-	-	-	-
Among diploids	2	3.05	14552.37**	10.01**	3328.90**
Polyploids	43	21.99	467301.34**	19.50**	4628.72**
Triploids	41	22.59	465317.48**	22.64**	4775.90**
AAA	10	24.13	766502.05**	4.21**	489.11**
AAB	13	20.78	3407785.71**	12.65**	3639.29**
ABB	16	25.11	242677.05**	39.75**	7552.78**
Among triploids	2	6.44	2061188.81**	16.08**	11382.84**
Tetraploids	1	12.25	864900.00**	0.25 NS	841.10**
Tetraploids Vs. Triploids	1	7.40	151041.04**	18.72**	2381.82**
Error	61	0.14	18902.86	0.66	56.92

\*\* Significant at 1% level  
 NS Not significant

Appendix 4. Analysis of variance for finger characters of 62 cultivars of banana

Source	df	Mean sum of squares								
		Pediceal length (cm)	Finger length (cm)	Finger girth (cm)	Finger weight (g)	Finger volume (cc)	% pulp weight	Pulp/peel ratio on weight b basis	% Pulp volume	Pulp/peel ratio volume basis
Total	123									
Replications	1	0.18	0.69	0.47	0.05	75.88	0.23	0.02	2.27	0.001
Genotypes	61	2.38**	14.41**	5.74**	2615.02**	3015.54**	58.45**	2.40**	39.52**	1.19**
Diploids Vs. Polyploids	1	2.29**	110.45**	71.23**	33055.84**	44137.36**	298.06**	9.96**	232.41**	6.33**
Diploids	17	1.57**	9.23**	3.90**	555.62**	558.85**	72.51**	4.71**	39.25**	1.32**
AA	4	0.41**	11.94**	2.93**	753.37**	741.50**	53.07**	2.81**	69.38**	3.03**
AB	11	1.48**	9.36**	3.62**	511.13**	456.80**	79.94**	5.45**	29.04**	0.79**
BB	-	-	-	-	-	-	-	-	-	-
Among diploids	2	4.40**	3.06**	7.39**	404.80**	754.79**	70.45**	4.46**	35.11**	0.82**
Polyploids	43	1.32**	14.22**	4.94**	2721.27**	3030.48**	47.33**	1.31**	35.14**	1.02**
Triploids	41	2.78**	12.80**	5.16**	2587.03**	3139.41**	48.72**	1.35**	34.45**	0.99**
AAA	10	0.34**	12.43**	5.04**	5064.71**	1897.48**	46.21**	2.10**	27.15**	1.02**
AAB	13	0.21**	8.43**	5.09**	871.42**	1280.24**	24.79**	1.06**	43.46**	1.58**
ABB	16	1.42**	10.47**	5.53**	1286.03**	4906.69**	35.21**	0.53**	19.63**	0.28**
Among triploids	2	42.84**	61.76**	3.34**	11757.99**	419.38**	275.03**	6.03**	116.73**	2.67**
Tetraploids	1	2.40**	85.56**	0.40NS	8775.94**	756.25**	2.21**	0.01 NS	120.01**	2.82**
Tetraploids Vs. Triploids	1	NS	0.85**	0.48NS	2170.76**	838.76**	35.07**	1.02**	7.16**	0.31**
Error	61	0.02	0.15	0.36	5.23	10.29	0.41	0.02	0.25	0.001

\*\* Significant at 1% level  
 NS Not significant

Appendix 5. Analysis of variance for quality characters of 62 cultivars of banana

Source	df	Mean sum of squares					
		Total soluble solids (%)	Total sugars (%)	Reducing sugars (%)	Non reducing sugars (%)	Acidity (%)	Sugar/acid ratio
Total	123						
Replications	1	0.95	0.62	0.16	0.13	0.0002	1.36
Genotypes	61	6.21**	22.93**	23.80**	6.89**	0.65**	484.84**
Diploids Vs. Polyploids	1	36.17**	5.28 NS	4.65**	5.73**	0.52**	57.86**
Diploids	17	9.61**	23.84**	24.18**	9.14**	0.46**	206.43**
AA	4	14.94**	40.65**	28.02**	19.61**	0.99**	276.84**
AB	11	4.64**	3.65**	3.84**	4.68**	0.30**	157.16**
BB	-	-	-	-	-	-	-
Among diploids	2	25.56**	101.32**	128.41**	12.68**	0.45**	336.56**
Polyploids	43	4.16**	22.98**	24.10**	6.03**	0.73**	604.84**
Triploids	41	4.32**	23.61**	24.67**	6.04**	0.75**	630.13**
AAA	10	2.25**	14.71**	17.84**	6.39**	0.55**	1101.94**
AAB	13	1.52**	17.23**	19.85**	5.73**	0.14**	167.53**
ABB	16	3.69**	19.28**	18.82**	6.12**	0.61**	457.05**
Among triploids	2	37.88**	144.23**	137.01**	5.67**	0.27**	2662.70**
Tetraploids	1	NS	12.89**	10.89**	11.42**	0.28**	37.21NS
Tetraploids Vs. Triploids	1	1.64**	7.09**	14.16**	0.01**	0.53**	135.58**
Error	61	0.17	0.35	0.78	0.55	0.04	14.11

\*\* Significant at 1% level

NS Not significant

Appendix 6. Analysis of variance for pollen characters of 40 banana cultivars

Source	df	Mean sum of squares		
		Pollen viability (%)	Pollen size (micron)	Pollen production per anther
Total	119			
Genotypes	39	44.99**	3317.59**	0.1537**
Diploids Vs. Polyploids	1	1754.51**	16050.29**	0.11**
Diploids	5	428.79**	643.79**	0.24**
AA	4	224.31**	612.65**	0.15**
BB	-	-	-	-
Among diploids	1	1246.72**	768.34**	0.82**
Polyploids	33	336.93**	3336.87**	0.144**
Triploids	31	297.20**	3315.24**	0.12**
AAA	10	561.56**	805.62**	0.03**
AAB	6	28.36**	623.55**	0.13**
ABB	18	88.88**	5271.14**	0.14**
Among Triploids	2	1136.30**	11225.05**	0.475**
Tetraploids	1	3443.40**	748.17**	0.001 NS
Tetraploids Vs. Triploids	1	1560.99**	6596.20**	0.999**
Error	80	0.528	22.21	0.0026

\*\* Significant at 1% level

NS Not significant

Appendix 7. Intercorrelations among different characters\* in banana

1	2	3	4	5	6	7	8	9	10	11	12	13	
1	1	-0.0753	0.6280	0.6721	0.6745	0.6548	0.40009	0.4644	0.0259	0.2311	0.3759	0.4731	0.0491
2		1	-0.03522	-0.6202	-0.0684	0.02122	-0.2935	-0.0139	-0.0779	-0.0569	-0.1010	0.0162	-0.0156
3			1	0.7128	0.4384	0.7407	0.66320	0.2838	-0.0915	0.1148	0.2611	0.3098	0.0539
4				1	0.5017	0.5995	0.5593	0.5258	0.4171	0.1332	0.3399	0.1691	0.0709
5					1	0.4229	0.3571	0.4067	0.0999	0.2216	0.3414	0.5545	0.1231
6						1	0.5279	0.2042	-0.0178	-0.0102	0.0852	0.1055	-0.0849
7							1	0.4505	0.0508	0.15086	0.3748	0.1244	0.1051
8								1	0.3682	0.4357	0.7157	0.0745	0.2971
9									1	-0.0837	-0.0271	-0.5091	0.5249
10										1	0.5388	0.2944	0.1684
11											1	0.2230	-0.4763
12												1	0.1893
13													1

(Contd.)

	14	15	16	17	18	19	20	21	22	23	24	25	26
1	0.7823	-0.0819	-0.0229	-0.0495	-0.0162	-0.1231	-0.1225	0.4083	0.2582	0.2628	0.0938	0.0590	0.1228
2	-0.0869	-0.0997	-0.2620	-0.0631	-0.1538	-0.0103	-0.0944	0.08743	0.1473	0.0863	0.2874	0.1651	-0.0521
3	0.04168	-0.0120	0.0143	0.0194	0.4545	-0.0865	-0.1065	0.2259	0.01311	-0.0137	0.2365	-0.0902	0.1113
4	0.1755	0.2214	0.0525	0.1297	0.1206	0.0307	0.0154	0.1942	0.0732	0.0729	0.1137	-0.1340	0.2030
5	0.2465	0.1536	0.0645	0.1230	0.1885	0.0642	0.6964	0.4124	0.2343	0.2921	0.0333	0.0343	0.0748
6	0.0686	-0.0186	-0.1887	0.1976	0.1912	0.0148	-0.0023	0.2214	-0.1087	-0.1519	0.0796	-0.2022	0.1090
7	0.0156	0.1767	0.0891	0.3142	0.3367	0.1481	0.1352	0.1871	-0.1123	-0.1203	0.0554	-0.4029	0.3729
8	0.1705	0.3328	0.2614	0.1504	0.1006	0.1354	0.1208	0.0648	-0.0583	-0.0627	-0.0152	-0.2640	0.2558
9	0.4393	0.6027	0.5762	-0.0091	-0.0483	0.0771	0.0683	-0.2448	-0.0650	-0.0749	-0.0006	-0.0792	0.1270
10	0.1869	-0.0621	-0.0109	-0.1222	-0.0851	-0.0180	-0.0260	0.1264	-0.1798	-0.1698	-0.1074	-0.0816	-0.0943
11	-0.2632	-0.2243	-0.1126	0.0901	0.0089	0.1129	0.0901	0.2079	0.0108	0.0009	0.0262	-0.1190	0.1002
12	0.0410	-0.1492	0.0193	-0.2409	0.0996	-0.2101	-0.1537	0.4749	0.2867	0.2752	0.1788	-0.1292	-0.1464
13	0.4329	0.5059	0.6614	-0.1167	-0.0501	-0.0708	-0.0984	-0.1302	-0.1516	-0.1714	0.0908	0.0727	0.0544

(Contd.)





\* Characters

1. Plant height (cm)
2. Plant girth (cm)
3. Leaves per plant
4. Leaf area per plant ( $m^2$ )
5. Petiole length (cm)
6. Planting to flowering interval (days)
7. Flowering to harvest interval (days)
8. Bunch weight (kg)
9. Hand weight (g)
10. Number of hands
11. Number of fingers
12. Pedicel length (cm)
13. Finger length (cm)
14. Finger girth (cm)
15. Finger weight (g)
16. Finger volume (cc)
17. Per cent pulp weight
18. Pulp/peel ratio on weight basis
19. Per cent pulp volume
20. Pulp/peel ratio on volume basis
21. TSS (%)
22. Total sugars (%)
23. Reducing sugars (%)
24. Non reducing sugars (%)
25. Acidity (%)
26. Sugar/acid ratio

# **CYTOTAXONOMICAL STUDIES ON BANANA CULTIVARS**

By

**P. K. VALSALAKUMARI**

## **ABSTRACT OF THE THESIS**

Submitted in partial fulfilment of  
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1984

**ABSTRACT**

Variability in banana are wide and complex with different degrees of expression of the characters of the parental species, Musa acuminata and Musa balbisiana. Commercial cultivars are many, ranging in levels of productivity and quality characters. Investigations were conducted at the College of Horticulture, Kerala Agricultural University, Vellanikkara, Trichur during 1981-83 on 100 cultivars of banana to study the cytotaxonomical aspects.

Studies on morphological characters, taxonomic scoring and chromosome number revealed that many of the cultivars were identical and ultimately the cultivars were confined to 64 distinct ones. The taxonomic scoring did not indicate the ploidy. Eight cultivars with the scores of triploids, were identified as diploids.

The quantitative, quality and pollen characters showed a significant variation among the cultivars. The characters were influenced by the ploidy and the genomic constitution. The presence of 'B' genome increased plant height and girth, leaves per plant, leaf area per plant and petiole length. Musa balbisiana (BB) recorded the highest values for all the above characters.

The triploids were more vigorous than the diploids and the tetraploids as indicated by their higher growth rates. The triploids were also better than the other groups for bunch and finger characters. Among them, the triploids of hybrid origin were better for bunch characters, while the Musa acuminata triploid group (AAA) was superior to the other groups for finger characters. Longer pedicel was a characteristic feature of Musa balbisiana (BB).

The genomic constitution of the cultivars influenced the contents of total soluble solids, sugars and acids in fruits, more than the ploidy. Musa acuminata group AAA, had the highest sugar/acid ratio.

Studies on pollen viability, size and production in cultivars revealed the possibility of including a few of them as male parents in the banana hybridization programme. Forty of the cultivars studied were ~~non~~ polleniferous. Pollen viability and production were more in pure Musa acuminata and Musa balbisiana groups than in groups of hybrid origin. Musa acuminata cultivars had larger pollen grains than cultivars belonging to the other genomic groups.

Estimates of genotypic and phenotypic coefficients of variation, heritability in the broad sense, genetic advance and genetic gain for the 26 characters indicated the scope for selection among the cultivars. Petiole

length, pulp/peel ratio on volume basis, weight and volume of fruit showed higher heritability values combined with high genetic gain.

Estimation of genetic divergence among the cultivars showed that the cultivars 'Mannan' and 'Pachachingan', belonging to the genomic group AAB, were the closest and a Musa acuminata cultivar, 'Harichal' (AAA) and Musa balbisiana (BB) were the farthest. The 62 cultivars were grouped into eight homogeneous clusters. Similar clustering pattern was obtained in the canonical analysis also.

The study revealed the predominance of the cultivars of the hybrid origin, with different degrees of expression of the characters of the parental species, in the South Indian bananas. The taxonomic scoring system was not always appropriate to find out the ploidy of the cultivars. The study also indicated the scope for selection among the cultivars and the possibility of inclusion of the cultivars with viable pollen as male parents in the hybridization programme.