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Morphological Characterization of Edible Banana Varieties in Kerala (Including Germplasm Collection) and Male Flower Nutritional Analysis of Selected Varieties

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Abstract

Banana (Musa) is a fruit bearing plant belongs to the Musaceae family and mainly cultivated for it's fruit, which is used as a nutritionally rich food item. The banana male bud is also used as a food item due to its high nutritional content. The different banana variety are found which differ in size, shape, appearance, fruit, nutritional value etc. The banana is mainly used as a food item in major part of the world. The value added products can be developed from the fruit. Because of the high protein, fibre, and vitamin content the bananas are widely used The morphological analysis of different variety help us to understand the difference between the 25 varieties in terms of size, shape, appearance and other internal features. The nutritional analysis of the banana male flower includes the proximate composition includes the estimation of dry matter, moister content, estimation of crude protein, estimation of crude fibre, estimation of crude ash and insoluble ash, ether extract and gross energy analysis. From the proximate analysis, we identified that the Palayamkudan male flower contain a huge deposit of crude fibre and crude protein in it. The sample of Nyalipoovan male flower have comparatively low crude fibre content, the gross energy is high in the Nyalipoovan sample.

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Keywords

Anti-oxidant; Crude fibre; Musa; Banana; Crude protein; Gross energy.

Introduction

Banana one of the most popular consumed fruits in the tropical and sub-tropical region (Singh *et al.,* 2017; Bailey *et al.,* 1989; Aurore *et al.,* 2009; Mohapatra *et al.,* 2010), belongs to the Musaceae family have been considered as one of the ancient families within Zingiberales, consisting of large rhizomatous monocarpic herbs with large pseudostem formed by folding leaf sheath (Dahlgren *et al.,* 1985; Sethiya *et al.,* 2019). Musaceae could be easily distinguished form other families of order Zingiberales by the presence of tall pseudostem, long inflorescence, fiver fertile stamens and reduced staminode in male flower (Dahlgren *et al.,* 1985).

Biological evolution and nomenclature

Banana is widely cultivated over 130 countries along the tropics and sub tropics (Mohapatra *et al.,* 2010). Original bananas were seeded and mostly non edible forms. The slow decline in seed fertility, increases in parthenocarpy as well as human selection of characters (pulpiness, fruit colour and taste) may leads to the evolution of edible banana varieties (Uma *et al.,* 2005a; Uma *et al.,* 2005b). Most of the edible bananas present now a days are derived solely from *Musa accuminata* Colla or *Musa balbisiana* Colla or a hybrid between the two wild diploid species. These two diploid ancestral parents contribute to A and B genomes respectively and considered as the Adam and Eve of present day bananas

(Uma *et al.,* 2005a; Uma *et al.,* 2005b; Mohapatra *et al.,* 2010; Simmonds and Shepherd, 1955). The banana plant seems to be originated from India as well as eastern Asian regions (Malaysia and Japan). Polyploidy, hybridization and various combinations of A and B genome has resulted in the development and emergence of broad spectrum of genomic groups; diploid (AA, AB, BB), triploid (AAA, AAB, ABB, BBB) and tetraploid (AAAA, AAAB, ABBB, AABB) varieties of banana.

Various other varieties also co-evolved or exist naturally with theses genomes and have slightly different nomenclatures (Simmonds, 1962; Robinson, 1996). Three common species of Musa (*M. cavendishi*, *M. paradisiaca* and *M. sapientum*) are widely cultivated across the world. *Musa cavendishi* is the pure triploid acuminate (AAA) is also known as desert banana characterized by sweeter and less starchy than *M. paradisiaca*. *Musa sapientum* is known as the true banana could be eaten raw when fully mature. Both *M. paradisiaca* and *M. sapientum* belongs to AAB group characterized by higher starch content compared to pure acuminate group (Mohapatra *et al.,* 2010; Stover and Simmonds, 1987). Cooking bananas falls under ABB and BBB genome with prominent *M. bulbisiana* genes. A great diversity of dessert banana exist due to plant size and various morphological characters. Productivity is high for Cavendish bananas and giant French plantains (>30 t/ha/yr).

Indian production scenario

Banana is the second most important fruit crop in India after mango, good export potential and popular among all classes of people due to its year round availability, affordability, varietal range and nutritional properties. Out of more than 50 varieties of banana cultivated across India, around 20 are commonly grown in various Indian States (Duran *et al.,* 2007).

Musa (Banana)

The bispecific origin of edible banana first mentioned by Kurz (1867) and experimentally proved by Simmonds and Shepherd (1955) by cross the two parent varieties; *M. acuminate* and *M. bulbisiana*. Supported by morphological and cytological evidences, it was assumed that the edible bananas were evolved from the two ancestors in five main stages. The triploids were formed by the fertilization of diploid egg cell with haploid pollen leads to the formation of triploids as a main step in the banana evolution process. The triploids were popular among farmers and breeders due to many beneficial traits especially sturdiness, robustness and pulpiness. Parthenocarpy, sterility, polyploidy and vegetative propagation for perpetuation of useful traits has played a major role in the evolution of current banana varieties (Uma *et al.,* 2005b).

The generic name Musa is rooted in Sanskrit word Moca or may have derived from Arabic world Mauz, Mouz or Mauwz, which is used for banana (De Candolle, 1886; Nayar, 2010; Hakkinen *et al.,* 2013). The Arabic name for banana 'Mauz' is also mentioned in Rheede's 'Hortus Malabaricus'.

The earliest scientific classification of banana was made by the famous taxonomist Linnaeus in 1783. According to his classification, all dessert banana were known as *Musa sapientium*; which is sweet during ripening and consumed fresh. The name *Musa paradisiaca* was assigned to the plantain group which are cooked and consumed while starchy. These two apparent species are not species at all, but considered to be closely related interspecific triploids hybrids of the AAB group. The modern method of classifying edible bananas was devised by Simmonds and Shepherd (1995), most modern edible bananas originally come from two wild species, *Musa acuminate* Colla (A genome) and *Musa balbisiana* Colla (B genome). The classification proposed by Simmonds and Shepherd (1955) based on the relative contribution of the parent character to the constitution of the cultivar and to the ploidy or chromosome number of the cultivar. The original characters used by Simmonds and Shepherd (1955) were amended and updated by many taxonomists (Purseglove, 1972; Stover and Simmonds, 1987; Valmayor *et al.,* 1991). By using 15 separate characters, with strong diagnostic differences between the two ancestors, the contribution of the two species could be clearly distinguished. For each character in which a cultivar agreed completely with wild acuminate, a score of 1 was given, and for each character in which the cultivar agreed with balbisiana, a score of 5 was given. The intermediate expression of the character were assigned as score of 2, 3 or 4, according to intensity.

Concerning ploidy, edible bananas belonging to the section Eumusa have 22, 33 or 44 chromosomes. The basic haploid number is 11, thus cultivars can only be diploid, triploid or tetraploid. Of the 200-300 clones which are thought to exist, more than half are triploids, with the remaining being mostly diploids. Tetraploid clones are very rare. The planted area of triploid bananas

is more than 100 times greater than that of diploids. Triploids are hardier, more vigorous and easier to grow. Morphologically, triploids and tetraploids are larger and more robust than diploids. Also leaf thickness and cell size increases with increasing ploidy.

The scoring technique based on 15 plant characters allows for a range of total score from 15 (pure *Musa acuminate*) to 75 (pure *Musa balbisiana*). Scores in between would be based on the relative contribution of the two species plus the level of ploidy in the interspecific hybrid. Simmonds and Shepherd (1955) and Stover and Simmonds (1987) used the groups and scores to classify a range of edible bananas. Silayoi and Chomchalow (1987) classified 137 accessions in the Thai banana gene bank on the same basis. Recognizing some deficiencies, they later modified the classification.

The main difference between these two classification is the introduction of almost pure balbisiana clones in the Thai grouping, which did not appear in the original classification. Espino and Pimental (1990) used isozyme technology to differentiate clones of pure acuminate, pure balbisiana and their hybrids from one another. They found broad bands of malate dehydrogenease activity which were unique to pure balbisiana, and other bands which indicated an acuminate genome. They concluded that BB and BBB cultivars were unique and distinct from hybrid ABB clones. The cooking plantain Saba (BBB) is very close to pure balbisiana (73 to 75 points).

Valmayor et al. (1991) endorsed the continued adaptation of Simmonds and Shepherd's classification scheme with amendments to accommodate South-east Asian varieties.

All banana taxonomist agree that no single scientific name can be given to all the edible bananas. Musa acuminate could be applied to the pure, seedless diploid (AA) and triploid (AAA) forms of dessert bananas such as Pisang Mas and Grand Nain respectively.

Similarly *Musa balbisiana* could be applied to the pure seedless diploid (BB) and triploid (BBB) forms of cooking bananas such as Abuhon and Saba respectively. However, the many hybrids cannot carry a specific name due to their mixed composition and differences in ploidy. To avoid confusion, it is internally accepted that all banana cultivars should be referred to by genus Musa followed by a code denoting the genome subgroup and ploidy level, followed by subgroup name (if any), followed by the popular name of the cultivar.

Musa AAA (Cavendish subgroup) Grand Nain

Musa (AAB) (plantain subgroup) Horn

Musa BBB Saba

Musa AB Ney Poovan

The significance of somatic mutations in bananas is very great because of the number of clones has gradually increased in this way. Many somatic mutations have remained unrecognized, especially when morphological changes has been small. Some better known somatic mutants have been selected, utilized and names are Extra Dwarf Cavendish from Giant Cavendish; Williams from Giant Cavendish; Highgate from Gros Michel; Cocos from Gros Michel; Dwarf French Plantain from French Plantain; Sliver Bluggoe from Bluggoe and Green Red from Red. The natural rate of somatic mutations are very low with banana propagated conventionally. The levels are significantly increased during propagation by in vitro techniques and considered as somoclonal variations.

Major genomic groups and cultivars in world use

AA group

Sucrier; synonym is Pisang Mas in Malaysia and Indonesia and Bocadillo in South America. This is the most important edible cultivar of diploid acuminate cultivar with small, sweet, thin-skinned, golden yellow fruits. The bunches are small and yield is less than triploids, these varieties are resistant to Panama disease and can withstand wind. Pisang Mas is the most important banana cultivar in Malaysia.

Pisang Ambon Putih is the most important banana cultivar in Indonesia and it also ranks highly in Malaysia. The fruit has good flavour, excellent keeping quality and high yields and highly susceptible to Fusarium wilt disease.

Gros Michel sub group

The main cultivar is Gros Michel. A synonym is Pisang Ambon in Malaysia. The mutants form this variety includes Highgate and Cocos. The cultivar Gros Michel produce tall, vigorous plants bearing heavy, symmetrical bunches with attractive colour and long, slender fruit. Until 1950s, this was considered as the leading cultivar in the world trade after the plantations were decimated by race 1 of Fusarium wilt disease (*Fusarium oxysporoum* cubense-FOC). These plantations were

replaced with the race-1 resistant AAA cultivars Valery and Grand Nain from the Cavendish subgroup,

Cavendish subgroup

This is the most popular subgroup in the world banana trade both for export in the tropics and local trade in the subtropics. There exist a great variation in the pseudostem height between cultivars in this group, Dwarf Cavendish (1.8 to 2.0 m) to Lacatan (4-5), with many cultivars at intermediate height levels.

Dwarf Cavendish type

The main cultivar is Dwarf Cavendish and synonyms of this are Canary Banana, Dwarf Chinese, Basrai in India. It is also known as Governor in the West Indies and Enano in Latin America. This variety is abundant, widespread and the shortest banana grown commercially. This variety is considered to be climatically adapted, stable against subtropical winds and high yielding in Australia, South Africa and Israel.

This variety is susceptible to physiological disorder choke throat and has been replaced by taller Cavendish cultivars (Williams and Grand Nain) which are not susceptible to choke throat, higher yields and better fruit quality. All the sub-tropical countries except Israel, have heavy race 4 of Fusarium wilt disease which attacks Cavendish subgroup cultivars. Due to this reason Williams, Grand Nain and other Giant Cavendish type need to be replaced in heavily infected areas with tolerant mutant AAA selections.

Giant Cavendish type

The main clones of Giant Cavendish are Mons Mari (Queensland), Williams (New South Wales; South Africa), Grand Nain (Central America, Israel, South Africa) and Giant Governor in West Indies. Cultivars of this type are not excessively tall but are called Giant Cavendish to distinguish them from Dwarf Cavendish type. Grand Nain is a major export cultivar in world trade but it can be grown only in areas which are free of Fusarium wilt disease race 4. Since 2005, Williams has started to replace Grand Nain in many tropical export plantations in Central America and West Africa. This is due to more hardy nature of Williams and its more pack-friendly bunch.

Robusta type

The main clones of Robusta are Tall Mons Mari in Australia, Poyo in West Indies and West Africa, Valery in Latin America. These cultivars are generally taller than the Giant Cavendish cultivars. Valery used to be a major export cultivar in world trade is too tall and susceptible to race 4 of Fusarium wilt disease. It has been replaced by Grand Nain and Williams in many exporting areas of Central America because the latter cultivars have the advantages of shorter plants, larger bunches and shorter life cycle.

Lacatan type

The main synonyms are Pisang Masak Hijau in Malaysia, Monte Cristo in Puerto Rico and Giant Fig in the West Indies. This very tall cultivar has limited commercial importance only in Jamaica and the West Indies.

Cultivars, synonyms and mutants in the Cavendish subgroup are confusing. Between Dwarf Cavendish and Lacatan, there is a continuous transition of Cavendish types based mainly on morphological differences. Some types are recognized as distinct cultivars (Dwarf Cavendish and Williams) where as others are recognized as somatic mutations (Grand Nain to Israeli Grand Nain). According to the recorded off-types, the mutation rate was probably in the order of two in one million when using conventional planting material (Stover and Simmonds, 1987). The actual rate could be much higher since many off-types would have been remained undetected or unrecorded.

Red and Green Red subgroup

Neither of these clones is important commercially, but they are well known due to their wide distribution. These are only grown for home consumption and have low harvest index. Red has a red skin from which a mutation for green skin produced the clone Green Red.

Other AAA cultivars

A distinct group of AAA bananas are found in East African Highlands, from the Lujugira subgroup and mainly used for the production of beer of cooking purposes. Commonly known as East African Highland Cooking bananas. The cultivar Ibota and Caipira in Brazil is popularly used as a dessert cultivar with acid flavour and tolerant to many diseases including Sigatoka and nematodes (Lassoudiere, 2007).

AAAA group

Tetraploid of Musa acuminate banana have been produced by breeding AA diploid pollen parents with

AAA triploid female parents which are not totally parthenocarpic and sterile. The traditional female parent used for this breeding process was the mutant of Gros Michel called Highgate. The progeny of a diploid x triploid cross are tetraploids. Some of the AAAA cultivars are IC.2, Bodies Altafort and FHIA SH 3436.

IC.2

This was the first banana to be released from breeding in Trinidad during 1928. Due to severe infestation with Panama disease, it has not been grown commercially since 1954.

Bodies Altafort

This was released from Jamaica in 1962 and is cross between Gros Michel and Pisang Lilin. This variety is tall, prone to lodging in wind and not grown commercially.

FHIA SH 3436

This was released from Honduras in 1982 and is a cross between burrowing nematode resistant diploid SH 3142 and Highgate variety. It has good resistance to black Sigatoka but found susceptible to race 4 of Fusarium wilt decease.

AB group

This group comprises number of diploid hybrids of south Indian origin. The main cultivar is Ney Poovan which is widely distributed and has good commercial domestic markets. Being diploid, the plants are slender and lacking vigour. The fruits are white fleshed with pleasant sweet acid flavour. This variety is highly resistant to Fusarium wilt and leaf spot diseases. An interesting cultivar with similar characteristic in East Africa is called Safet Velchi.

AAB group

This group of triploid hybrids originated in India with a wide range of clones and somatic mutants. The AAB plantains generally have starchy flesh and at maturity they are usually unpalatable unless boiled. Other AAB cultivars have sweet fruit and are used as dessert cultivars.

Plantain subgroup

There are two main types: French plantain type and horn plantain type

French plantain type:

There are nine known forms of French plantain which are grown in different parts of India, Africa and Central America. As a group they are characterized by persistence of male axis and male flowers and bracts.

Horn plantain type:

These are characterized by the early degeneration of the male axis and flower parts. There is wide range of local names given to Horn plantains. They are produced in India, Africa, Central America, the Philippines and the Pacific. In general, plantains are tolerant to Fusarium wilt disease, but are susceptible to black Sigatoka and banana weevil. They are very important sources of staple food for indigenous populations of south India, East, West and Central Africa and Central America. The plantains have become widely diversified due to somatic mutations over years.

AAB dessert bananas

Besides plantains, there is a wide range of important AAB dessert bananas in the tropics

Mysore:

The most important banana clone in India representing 70% of all bananas produced in the country. The plant is large and vigorous, and resistant to Fusarium wilt disease and leaf diseases, and tolerance towards banana weevil, poor soils and drought. However, it is very sensitive to Banana Streak Virus (BSV). The fruit has attractive flavour, yellow colour and has good shelf life with limited distribution outside India.

Prata Ana:

Widely planted in Brazil and used for breeding programmes. It is relatively short plant with sweet fruit and slight acidity. The taste is very popular in Brazil and fetches higher price than Cavendish bananas. It has good resistance to wind and cool conditions, but sensitive to Panama disease which limits its expansion.

Thap Maeo:

A cultivar originating from Thailand, very similar to Mysore but less sensitive to BSV, resistant to black and

yellow Sigatoka and Fusarium wilt disease, and higher tolerance to nematodes (Silva *et al.,* 2014).

Silk:

Some synonyms of this are Apple in Hawaii, Silk Fig in the West Indies, Latundan in The Philippines, Pisang Rastali in Malaysia. Silk is distributed almost as widely in the world as Dwarf Cavendish. Plants are moderately vigorous but do not bear heavily compared to Mysore. It is a popular dessert cultivar in the tropics especially in The Philippines, and has a white, apple flavoured fruit flesh that must only be eaten fully ripe.

Pome:

A synonym of this clone is Lady Finger in Australia and Prata in Brazil. It is a common dessert cultivar I southern India. Plants are vigorous and hardy but not very prolific bearers.

Pisang Raja:

A well-known dessert clone in Malaysia and Indonesia but unknown in Africa and India. Plants are vigorous and resistant Fusarium wilt disease and leaf spot. In Malaysia it is cooked and bunches have only six to nine hands. Maia Maoli: An important clone in Hawaii and the Pacific. It has a compact bunch containing large compact fruits.

ABB group

Due to the predominance of *Musa balbisiana* genes, cultivars of this group are very vigorous and drought resistant. The fruits are green and waxy silver, the pulp is starchy and the plants are resistant to leaf spot. The main centres of origin for this group are southern India and the Philippines

Bluggoe:

This is a starchy cooking banana with large fruits. It has at least 27 synonyms and several named mutants, including dwarf types, and an important source of food in Samoa, the Philippines, southern India and the West Indies. It is immune to common leaf spot, but susceptible to black Sigatoka, race 2 Fusarium wilt disease and Moko disease.

Pisang Awak:

Synonyms of this cultivar include Pisang Klotok in Indonesia, Ducasse in Queensland and Kluai Namwa in Thailand. It is a common cultivar in Thailand where it is eaten fresh or cooked first.

It is also common in north-east India and Malaysia, but not in south India. Pisang Awak is very vigorous and hardy, but it tends to be partially fertile and may produce seedy, inedible fruits if pollinated by wild diploids.

BB group

Although it was thought that the pure seedless diploid clones of *Musa balbisiana* did not exist in nature, morphological and cytological studies carried out in the Philippines clearly indicates the existence of BB cultivars. The most important of them is the early maturing cultivar called Abuhon (Valmayor *et al.,* 2002).

BBB group

There is a wide range of pure balbisiana clones which have been identified in South-east Asia.

Saba:

Synonyms are Pisang Kepok in Indonesia, Pisang Nipah in Malaysia and Kluai Hin Thailand. Saba is the most important banana cultivar in the Philippines, but of lesser importance in other countries of South-east Asia.

It is a cooking banana with medium to large fruits. The pulp is creamy white, and although the flesh become sweet on ripening, fruits are always cooked before consumption. The male bud of Saba is usually removed and eaten as a vegetable.

ABBB, AAAB and AABB group

These three groups are the only natural tetraploids to be found. Pure acuminate or balbisiana tetraploids in nature have not been described, and hybrid tetraploids are certainly not common. Bred tetraploids are now being produced in increasing numbers.

Klue Teparod (ABBB):

This is a robust plant, immune to Fusarium wilt disease and leaf spot. The fruit flesh has an unpleasant spongy texture when raw. In Thailand and Burma, the fruits are cooked to make popular sweetmeats.

Atan (AAAB):

This cultivar resembles AAB triploids in some respects. Leaves are horizontal to drooping which is a typical

weak petiole character of tetraploids. Fruits are short, plump and tart, and the plant is resistant to Fusarium wilt disease.

Kalamagol (AAAB):

This may be the result of a natural cross between Latundan and *Musa balbisiana*, and was found in the Solomon Islands. It has very droopy leaves. Fruits are small and sweet and the plant is resistant to Fusarium wilt disease and leaf spot.

Goldfinger or FHIA 01 (AAAB):

This cultivar is a product of the conventional breeding programme. This variety is reputed to be tolerant to race 4 Fusarium wilt, black Sigatoka and burrowing nematode. It is more tolerant to cold temperatures than Cavendish subgroup cultivars

Objectives

The morphological characterisation and the nutritional analysis of different varieties are yet to be discovered. Based on this background the main objective of the study includes the identification of difference in terms of morphological character and nutritional constituents of selected varieties.

Scope of the study

The study would enlighten the understatement of morphological characters of different varieties and nutritional constituents of male flower of selected varieties as a dietary supplement.

Banana belongs to the family Musaceae; the term banana is derived from an Arabic word banana which means finger (boning, 2006). It is the major food crop, which is grown and consumed in about 100 countries in the tropics and sub tropic region (INIBAP, 2000). According to Simmonds and Shepherd (1995), the most commonly cultivated sweet banana and its plantations belong to Musa, these are the triploid varieties of two wild diploid species.

The genomes of a *M. acuminata* is denoted by AA and *M. balbisiana* is denoted by BB. Musa. The genomes of *Musa acuminata* and *Musa balbisiana* contributes two different traits. These are the largest and widely distributed Musa sp. According to Simmonds and Shepherd (1955), *M. acuminata* (AAA) are parthenocarpy and sterility whereas *M. balbisiana* (BBB) are hardiness, drought tolerance, disease resistance and starchiness (Pillay *et al.,* 2002). Paradisiaca is the hybrid formed from *M. acuminata* and *M. balbisiana* (Espino *et al.,* 1992). Both *M. acuminata* and *M. balbisiana* hybrids forms edible banana which is a mix of wild and cultivated species. According to Daniells et al. (2001), *M. acuminata* is the most widely distributed species of Musa.

There is a prospective market for these fruit and male flower in Kerala as well as outside the state. Analysing the current trend in food science and technology and consumer trend the demand for traditional food items and natural fresh (farm fresh) items has increased drastically in the recent years. It implies that there is a good scope for setting up banana plantation farm in both rural and urban areas. This not only helps the farmer to utilize the perishable raw material but also generate more employment opportunities in rural areas.

Kerala is blessed with a natural wealth of wide variety of banana plants. They are found in almost all part of the state of Kerala. We can produce many value added products from banana flower and banana fruit. Huge number of value added products like cake, ice-cream, salad, juice, wine etc can be prepared from Banana fruit and fibre, vitamin, protein rich supplements can be prepared from Banana flower. Each item have its own virtues in terms of taste, preference, keeping quality etc. A glimpse of the potentiality of the fruit for processing and value addition is as follows; Swad Food private limited is a newly started food processing company in Kerala located at Thrissur district. It is best known for Banana chips Musa is the genus name of banana family of fruit. From the information available; in many areas in Kerala there is a great demand for banana flower because of its high nutritional content. Because of this demand the middle man collect the fruit and send them to other parts of the state and county. The middlemen usually get an average of ₹80-₹120 for flower. In contrast in some areas it's production is high and hence low demand. In many parts like Mumbai, Kolkata, Delhi it's about ₹180-₹280/kg and in Kerala in local market it's about ₹25-₹30 normally and in off season it's about ₹50-₹70.

Recently we can see that the value added products are seen in a wide range in the market includes: juice, wine, cake etc and this must improve in basis of quality and production time. The Government start-up for "Kudambasree" (women empowerment organization local level) had boosted up in the level of products and

quality products from banana flower and fruit. PKD bakers produce banana flower soup and it has a great demand. There is a lot of products like banana chips, juice, soup, wine etc, mainly there are private funding companies for production.

Presently the huge demand for natural and organic products became a trend and now the banana has a huge demand for their flower and fruit. The varieties like Nayalipoovan, Poovan, Etha have huge demand for their flower and fruit. The channel may vary between large, medium and small farmers, large farmers sell their harvest to wholesalers, while medium and small size farmers sell their harvest to local market or to neighbour village (Valvi *et al.,* 2011).

Plant Morphology

In the publications of Simmonds (1959a), Barker and Steward (1962), Purseglove (1972), Morton (1987), Ross (1987), Simmonds and Weatherup (1990), Espino et al (1992), Karamura and Karamura (1995), Rieger (2006), Pillay and Tripathi (2007); detailed morphological description of banana plant is provided. Banana plant is a perennial monocotyledon with a height of about 2-9 m. The Whole part banana can be differentiated into root system, rhizome, pseudostem, stem, leaf, sucker, inflorescence. Plants takes up various nutrients and water from the soil through root system. The underground structure of the rhizome or corm produces the roots. The part above the ground which look like a trunk is called pseudostem (false stem), which is composed of concentric layers of leaf sheath and the part below the ground is called corm (true stem). The meristem of apical bud initially gives rise to leave before it elongates to the pseudostem. Each pseudostem produces inflorescence only once. Leaf is the main photosynthetic part of the plant. According to Barker and Steward (1962), leaves around the Musa gets tightly rolled from the centre of the pseudostem in a clockwise manner. The petiole is formed as the leaf sheath taper on the both sides. The can be erect, intermediate or dropping on the basics of the Musa sp. The lateral shoot that gets arises from the shoot is called sucker which may appear too close to the parent plant. The complex structure that includes the formation of flowers to the fruit is called inflorescence. It includes mainly 2 types of flowers, those appears first are called female flowers in which the ovary produces seedless fruit. The Distal part after the female flowers elongates and produce male flowers in which the pollen less or more fertile. Peduncle supports the inflorescence some of the common characteristics of *Musa acuminata* and *Musa balbisiana* differ each Other.

Musa accuminata

Stools are moderate in which pseudostem attains a height of 3-8 m, is slenderer than of cultivated banana. Presence of brown black blotches marked on pseudostem. Its petiole canal is erect in position, with short hairy peduncle of about 1 cm. Ovules are arranged in 2 regular rows in each of the locules. The shape of the bract is lanceolate, after the opening of the bracts it roll back and its colour varies from reddish-purple to pink purple. Usually one Bract falls daily, prominent scars are present on its bract. Presence of creamy white male flower with rich yellow or orange stigma is an important feature. The approximate length of the fruit varies from 8-13 cm with dull black smooth seeds.

Musa balbisiana

Stools are free in which the pseudostem attains an average height of 6-7 m and is robust in nature. Presence of green or yellowish green blotches often black blotches in its upper part. Its petiole margins are curved inside with long hairy of about 1-2 cm. Ovules are arranged in Four irregular locules. The bracts lift up without rolling them back. The colour of the bract varies from crimson purple to bright crimson purple. Scarcely prominent scars are present on the bract. The colour of the male flower is variably flushed with pink within it, with cream or pale-yellow stigma. The length of the fruit is 7-15 cm long with black seeds. For the growth of the plant it requires nutrients, both macronutrients and micronutrients are essential. Macronutrients are those which are required in large amounts and in large qualities. These include nutrients like nitrogen, phosphorous, potassium magnesium, calcium, and sulphur. The chief promoter for the growth of the plant is nitrogen, which induces the growth of the pseudostem and leaves. For the production of healthy rhizome and a strong root system phosphorus play an important role. Potassium stimulates the early shooting and helps in significantly shortening the time required for fruit maturity. Nutrients that are required in very small quantities are called micronutrients, it includes boron, iron and zinc. The deficiency boron results in the reduction in weight and size of the bunch, which affects the filling of the bunch. Iron deficiency are commonly seen in the plants that are grown in alkaline soils. Plants that are grown on zinc deficient soils are found to be zinc deficient. Symptoms like narrow pointed and chlorite

young leaves etc due to zinc deficiency. According to Méndez et al. (2003), the biochemical composition of the fruit depends on its cultivator, abiotic factors, like climate, method of cultivation and the nature of soil. The fruit contains high level of potassium whereas the level of vitamin A is low. Banana does not exist any toxic properties but it contains high levels of biogenic amines. The Intake of high amount of banana can cause endomyocardial fibrosis (EMF) (Foy and Parratt, 1960)

Taxonomical classification (*Musa acuminata*; banana)

Kingdom: Plantae-- planta, plantes, plants, vegetal

Subkingdom: Tracheobionta

Superdivision: Spermatophyta

Division: Magnoliophyta

Class: Liliopsida

Order: Zingiberidae

Family: Musaceae

Genus: Musa L

Species: *Musa acuminata*

Hypothesis

The current research work is based on the following hypothesis

The morphological character of different varieties varies among one another.

The male flower of banana varieties with high yield and popularity may be nutritionally weak.

Materials and Methods

Study area

Kerala state covers an area of 38,863 km^2 with a population density of 859 per km^2 and spread across 14 districts. The climate is characterized by tropical wet and dry with average annual rainfall amounts to 2,817 ± 406 mm and mean annual temperature is 26.8°C (averages from 1871-2005; Krishnakumar *et al.,* 2009). Maximum rainfall occurs from June to September mainly due to South West Monsoon and temperatures are highest in May and November.

Sample collection and morphological characterization

Twenty five various cultivated banana varieties were identified based on a baseline survey; germplasm accessions from Banana Research Station, Kannara, Kerala and selected for morphological characterization and nutritional analysis from various districts across Kerala State, India. Mature male flowers were collected from different varieties and were thoroughly cleaned using double distilled water. The samples were cut into small pieces and dried in hot air oven at 60ºC for 48 hrs, powdered using a kitchen blender (Prestige Nakshatra plus, Prestige industries Mumbai) and later stored in air tight polyethylene zipper bag for analysis.

Varieties selected

Sanna Chenkadali

The Sanna Chenkadali is one of the most rarely seen variety of banana and its present in the southern part of India. The height is about 2-4m and a mix of green yellow and pink colour. The blotches are present and brown in colour. The upper surface of the leaf colour is a mix of pink and green and the lower side colour is dull green in colour. The leaves are not overlapped. The shape of the leaf blade base are pointed (both sides).

The midrib dorsal colour is red pink. The colour if the cigar leaf is green with some shade of pink the bunch position is at 45° with a curve towards the stalk. The female flower will turn into fruit. The male bud size is intermediate. The bract apex shape is pointed. The young bract slightly overlapped. The fading colour of the bract is discontinued towards the base, the lifting of the bract is one at a time. The immature fruit peel colour is red green and the mature fruit peel colour is red and pulp have a sugary taste.

Red Jaisara

The Red Jaisara is a type of rare variety of banana found in India. Mainly in the southern part like Kerala, Tami Nadu, and Karnataka with normal in size and habitat. The colour of the banana is yellow green mix. The blotches are present. The leaves are not overlapped. The upper and lower leaves are green in colour. The shape of the leaf blade base are both sides pointed. The midrib colour are red pink. The bunch position is hanging at 45°

and curved towards the stalk. The female flower will turn into fruit. The male bud is intermediate in shape. The bract apex shape is pointed. The young bract slightly overlapped. The bract base colour are discontinuing towards the end. The bract will lifts one at a time. The library colour of the compound tepal is cream. The fruit position is slightly curved. The immature fruit peel colour is green and mature fruit peel colour is yellow it is sweet in taste.

Rasa Kadali

The Rasa Kadali is one of the rare variety of banana that is found in the southern part of India and it is rarely seen in banana farms. This variety is intermediate in shape and the colour of Red Jaisara is light green. The leaf upper and lower surface is green in colour and the petiole margins is red in colour. The shape of the leaf blade base is both sides pointed.

The bunch shape is hanging at 45° and with a curve in the bunch axis. The female flower will turn into fruit. The raches position is horizontal. The young bract slightly overlapped. The immature fruit peel colour is green and the mature fruit peel colour is yellow and the pulp is present and tastes very sweet.

Chara Padathy

This is one of the rare variety of banana found in Asia. They are found in the southern part of India. They are normal in size with an average of 2-6 m in height. They are dark green in colour. The leaves are not overlapped. They have blotches and the petiole margins are green in colour. The shape of the leaf blade base are both sides pointed. The cigar leaf are green in colour.

The bunch position is hanging at 45° and dropping downwards. The female flower will turn into fruit. The young bract slightly overlapped. The stigma are light yellow in colour. The immature fruit peel colour is green and the mature fruit peel colour is dull dark green.

Kaligali

This is a variety of banana found in India. They are normal in shape and they are green in colour. The sap colour are watery. The leaves are not overlapped. They have the presence of blotches in it. The leaf upper surface have a shiny green colour and the lower surface have a dull green colour. They are hanging at a 45° with a curve. The male bud are normal in shape and the male flower will fall after the bract. The compound tepal have no pigmentation. The ovary are arched in shape. The immature fruit peel colour is green and the mature fruit peel colour is dull dark green. They have a white pulp in it and they are sweet in taste.

Vannan

The Vannan is a type of variety of banana found in Kerala. They are intermediate in size and the leaves are not overlapped. They are light green in colour. The sap colour is watery. They have small blotches. The upper surface of the leaves are green in colour and the lower surface of the leaves are dull green in colour. The petiole margins are not winged and clasping. They are hanging at 45° with a curve. The female flower will turn into fruit. The bract colour are discontinuing towards the end. The bract will revolute before falling. The immature fruit peel colour is light yellow green and the mature fruit peel colour is yellow. They are soft and sweet in taste.

Petit Naine

These are a famous variety of banana found in the southern part of India especially in Karnataka, Tamil Nadu, and Kerala. Plants are normal in size and the leaves are not overlapped. They are dark green in colour and the sap colour is watery. They have few blotches and the blotches are in black colour. The shape of the leaf blade base are both sides pointed. The cigar leaf is light green in colour. They are hanging downwards with no curve on the axis. The female flower will turn into fruit. The young bract slightly overlapped. The bract base colour discontinuing towards the end. The lifting of the bract is one at a time. The pollen sac are cream in colour. The fruit are curved towards the stalk. The fruit apex shape are bottle neck. The mature fruit are in soft texture and they are very sweet.

Ladies finger

The ladies finger is a variety of banana found in the southern part of Asia especially in Kerala. They are erect in appearance and the leaves are not overlapped. They are generally light green with a pink shade and the sap colour is watery. The margins are curved inwards. Both sides of the leaves are pointed. The midrib dorsal and ventral surface have a light green colour. The cigar leaf is light green in colour. The bunch is hanging at 45° with a curve, the female flower will turn into fruit. The young bract slightly overlapped. The bract colour discontinuing towards the end. The bract lifts two at a time. The male flower will fall after the bract. The fruit are

perpendicular towards the stalk. The immature fruit peel colour are light green and the mature fruit peel colour are tinned green. The pulp is soft and very sweet in taste.

Navaral

This is a type of banana found in Kerala. They are erect in shape and intermediate in size. They are light green in colour. The sap colour is watery and have small blotches. The petiole margins are straight with erect margins. The leaf blade base are both sides pointed. The cigar leaf is light green in colour and the bunch is hanging downwards. The female flower will turn into fruit. The male flower will fall with the bract. The flower has no pigmentation. The fruit are straight in shape. The immature fruit peel colour is green and the mature fruit peel colour is yellowish green mix. The fruit texture is soft and they are sweet in taste.

Malavazha

This variety is a rare type and is seen in southern part of Kerala. They are intermediate in shape and light green in colour. The spa colour us watery. The dorsal and ventral surface of the leaf is green and shiny in appearance. The petiole canal is intermediate. They are winged and clasping. The bunch is hanging downwards and asymmetric in shape. The female flower will turn into fruit. The young bract will slightly overlapped. The bract will lift one at a time. The ovary is arched in shape. The immature fruit peel colour is green and mature fruit peel colour is yellow.

Kalyan Bale

It is a variety of banana found in southern and norther part of India mainly Kerala, Tamil Nadu, Punjab etc. the habitat is intermediates they are light green in colour with few blotches. The leaves are not overlaps. The petiole margin is curved inwards. The shape of the leaf blade base are one side pointed and other side rounded. The bunch position is hanging at 45° with a curve. The bracts are slightly overlapping. The ovary is arched in shape. The mature peel colour is green and immature peel colour is yellow. They are sweet in taste.

Pedda Pacha

They are normal in sizes their colour is medium green. The swap colour is watery. The leaves are green in colour with wide margins. They are hanging vertically in position. The female flower will turn into fruit. The young bract slightly overlaps and bract colour are homogenous. The male flower will falls before the bract. The immature fruit peel colour is light green and mature fruit peel colour is tinned with yellow. They are soft in tender and sweet.

Sikuzani

This varieties are rarely seen in India. They are normally erect in shape. They are medium green in colour. The leaves are not overlapped. The blotches are present on it. The shape of the blade base is one side pointed and other side rounded. The bunch position is hanging at 45° with curve on bunch axis. The female flower will turn into fruit. The young bract slightly overlaps. The male flower falls with bracts. The immature fruit peel colour is light green and mature fruit peel colour is bright yellow. They are sweet in taste.

Pisang Jaribuaya

This is a rare variety of banana rarely seen in Kerala. They are erect in shape and green yellow in colour. The leaves are green in colour and are wide with erect margin. The leaf blade base are rounded on both sides. The bunch position is standing at 45°.The female flower will turn into fruit. The lobe colour of compound tepal are yellow. The pollen sack are light cream yellow in colour. The ovary are arched in shape. The fruits are curved upwards. The immature fruit peel colour are light green and mature fruit peel colour are yellow. They are sweet in taste.

Pacha Nadan

They are intermediate in shape. They are medium green in colour. The petiole margins are winged and not clasping towards the psuedostem. The petiole margin colour are light green. The shape of leaf blade base are both sides pointed. The colour of the cigar leaf is light green. The bunch position is slightly angled and the female flower will turn into fruit. The compound tepal basic colour is yellow. The immature fruit peel colour is medium green and mature fruit colour is yellow. They are firm in texture.

Lacatan

This is a type of banana found in the subtropical region of South India . They are rarely seen in Kerala.. They are normal in shape and slightly higher in size. They are seen in a mix of yellow green colour and the sap colour is

watery. The margins are winged and not overlapping. The petiole margin is light green in colour. Both sides of the leaf are rounded in shape. The bunch position is slightly angled and asymmetric in shape. The female flower will turn into fruit. The young bract slightly overlapped. The lobe colour of the compound tepal is cream. The ovary are arched in shape. The fruit is firm and sweet.

Kunnan

This is a variety of banana found in southern part of India (Kerala and Tamil Nadu). They are erect in shape and they are green yellow in colour. The female flower will turn into fruit. They have small blotches. Both sides of the leaf are rounded in shape. The cigar leaf is rounded in appearance. The young bract slightly overlapped. The ovary is straight in shape. The fruit is firm and sweet.

Kullan

This is a dwarf variety of banana found in Kerala. The height is about 1-2.5 m. The have a colour combination of medium green. The sap colour is watery. The presence of extensive blotches are well identified. The margins are winged and clasping towards the pseudostem. Both sides of the leaf are rounded in shape. The bunch position is falling vertically. The compound tepal is green in colour. The pollen sac is cream in colour. The fruits are usually curved towards the stalk. They are sweet in taste.

Krishnavazha

They are the southern variety of banana locally found in Kerala. They are normal in shape and have a medium green colour with brown blotches. The sap colour is watery. They have wide and erect margins. The both sides of the leaf are rounded in shape. The female flower will turn into fruit. The young bract slightly overlapped. The pollen sac is bright yellow in colour. The ovary is cream in colour. The fruits are sweet and soft in texture.

High Gate

This is a rare variety of banana. They are normal in size. They are light green in colour. The sap colour is watery. The bunch is hanging at 45°. The female flower will turn into fruit. They are soft in texture and very sugary in taste.

Dudhsagar

This is a rare variety of banana found in the southern part of India especially in Karnataka, and Kerala. They are intermediate in shape and they are light green in colour. The leaf habitat is normal and the presence of blotches on the leaf are noticed. Both sides of the leaf base are rounded. The colour of the cigar leaf is medium green. The bunch is hanging downwards with asymmetric in shape. The male flower falls with the bract. The fruit pulp is soft and sweet in taste.

Pisang Lilin

This is a rare variety of banana found in India. They are rarely seen in Kerala. They are normal in size. They have a dull appearance. The presence of extensive blotches were seen on this variety. Both sides of the leaf base are round in shape. The colour of the cigar leaf is a mix if green with pink purple shades. The male flower will falls after the bract. The fruit are soft in texture and sweet in shape.

Yangambi

The Yangambi is a rare variety of banana found in India. They are intermediate in shape and light green in colour. The sap colour is watery. The leaf habitat is normal.. The presence of blotches were noticed. The colour of blotches are black brown in colour. Both sides of the leaf are round in shape. The colour of the cigar leaf is light green in colour. The bunch position is hanging downwards and asymmetric in shape. The male flower will falls after the bract. The fruit pulp is soft and sweet in shape.

Thiruvanthapuram

This is a common variety of banana found in Kerala. They are widely seen in the Thiruvananthapuram (district of Kerala) hence called Thiruvananthapuram. They are normal in shape and green in colour. They are very rich in protein content hence they are used widely. Both side of the leaf is rounded in shape. The cigar leaf appears in light green colour. The bunch has a curve on its axis. The sap colour is watery. The male flower will falls after the bract. The pulp is sweet in taste.

Chakkarakaeli

This is one of the most common variety of banana found in the southern part of India mainly in South Kerala. They are intermediate in shape and they are present in a mix of medium green yellow colour. One side of the leaf is pointed and other side rounded. The bunch position is hanging at 45° the bract colour discontinues towards the

end. The ovary is arched in shape. The fruit is soft in texture and sweet in taste.

Proximate analysis

The powdered banana samples were subjected various proximate analysis using standard protocols. The analysis includes estimation of dry matter and moisture content, estimation of crude protein, estimation of crude ash and insoluble ash, crude fat and determination of dietary fibre.

Estimation of dry matter and moisture

The dry matter (DM) is calculated using oven dry methods where fresh samples were kept hot air oven at 85°C for 48 hrs. The values are calculated based on the initial and final weight of the samples using the equation given below

$$\% \text{ DM} = \frac{DM_1 \, XDM_2}{100}$$

Estimation of crude ash and insoluble ash

The weight of clean dry empty silica crucible is determined as 'W' gms approximately 3 gms of the dried powdered sample is weighed noting the exact weight of crucible + sample as W1. Ignite it in the muffle furnace at 600°C for 3 hrs, allow to cool overnight. Take the weight of silica crucible + crude ash as W2. Digest the ash in the crucible with 25 ml of 5N HCl, boiling it for 10 minutes, cool, filter through Whatman no 42 ashless filter paper and make paper and crucible acid free. Transfer the paper with residue to respective crucible. Dry in hot air oven and ignite in the muffle furnace at 600°C for 3 hrs. Cool overnight and take the weight of the crucible 'W3' gms, and acid insoluble ash is calculated as

$$\% \text{ crude ash (\% CA)} = \frac{W_2 - W}{W_1 - W} \text{ X } 100; \left[\frac{\text{Weight of ash}}{\text{Weight of sample}} \text{ X } 100\right]$$

$$\% \text{ acid insoluble ash} = \frac{\text{Weight of AIA}}{\text{Weight of sample}} \text{ X } 100 = \frac{W_3 - W}{W_1 - W} \text{ X } 100$$

Estimation of crude fat

The crude fat is done using solvent extraction with petroleum ether. The extraction is done on soxtec fat analyser. Clean dry aluminium cups marked appropriately are weighed W1. Dry powdered sample are weighed approximately 3 gms of sample, noting exact sample weight, W in marked thimbles. The thimbles are attached in correct order on the adaptors of soxtec extractor. 60 ml of petroleum ether is taken in the aluminium cups and assembled seeing that markings of thimble, cup and sample numbers tally. Condenser water supply is switched on. The heating bench is turned on using the 'power on' button on control unit of soxtec unit and when the temperature reaches 100°C, the thimbles are dipped into boiling ether and boiling cycle is done for 15 minutes. The thimbles are raised and rinsed with condensed ether in the rinsing cycle for 30 minutes.

This is followed by 10 minutes of recovery cycle where pure unsaturated ether is collected back and recovered. The fat containing cups with residual ether is then dried in hot air at 100°C for 1hr, cooled in desiccators and weighed, W2 gms. The crude fat is calculated as

$$\text{Crude fat} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \text{ X } 100 = \frac{W2 - W1}{W} \text{ X } 100$$

Estimation of crude fibre

The thimbles containing fat free extract from the forgoing estimation are dried in hot air oven at 50°C for overnight. Approximately 0.8 gms of fat free sample is weighed exactly 'W' gms into gooch crucibles provided with fibretec extraction assembly. They are set on the assembly and two digestions, acid & alkali digestions in 1.25% H_2SO_4 and 1.25% NaOH are done one after the other for 30 minutes.

With draining of acid and alkali and flushing of hot distilled water done in between each digestion. The residue containing crucibles are removed, over dried at 60°C for overnight, weighed 'W1'gms. They are ashed at 600°C for 3 hours in muffle furnace overnight, cooled and weighed 'W2' gms.

$$\text{Then \% crude fibre} = \frac{\text{Weight of crude fibre}}{\text{Weight of fat free extract}} \text{ X } 100 = \frac{(W_1 - W_2)}{W} \text{ X } 100$$

Figure.1 Map of Kerala showing the sample collection point.

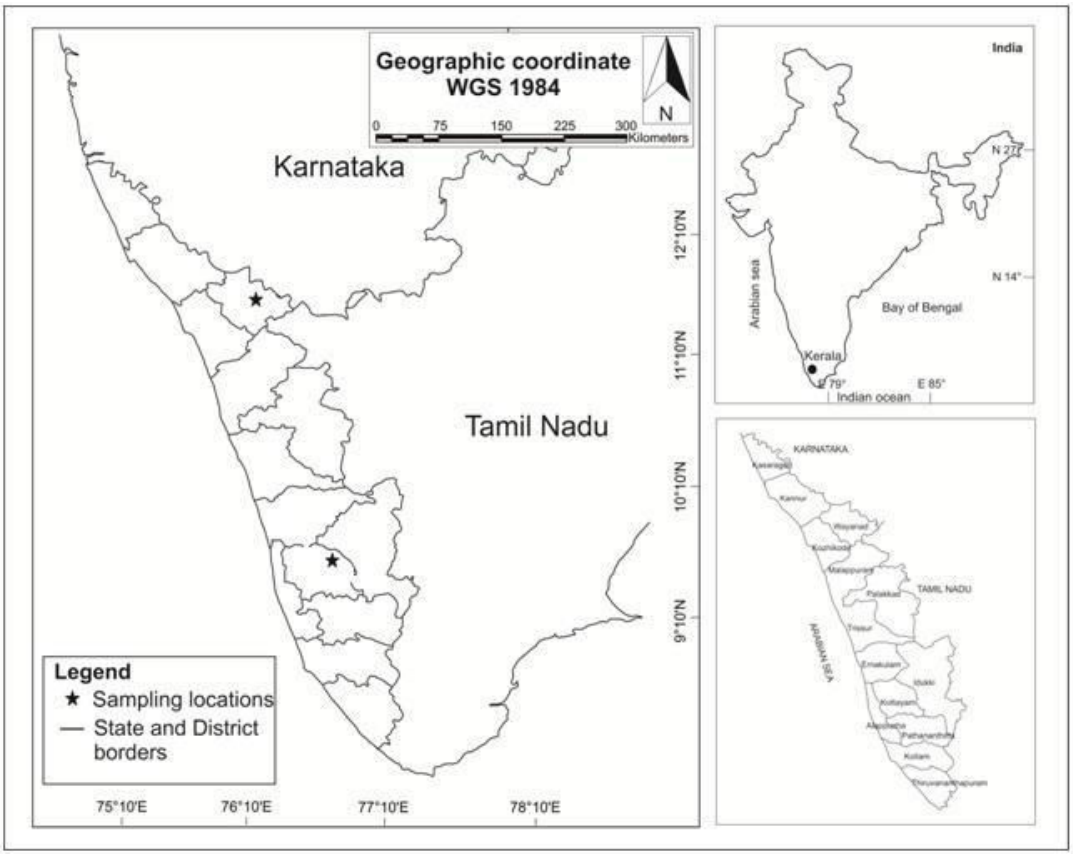


Figure.2 The evolution of the banana complex: A, *M. acuminata*; B, *M. balbisiana*. Genotypes known to occur naturally are encircled, those known only from experiment are not encircled (adopted from Simmonds and Shepherd, 1955).

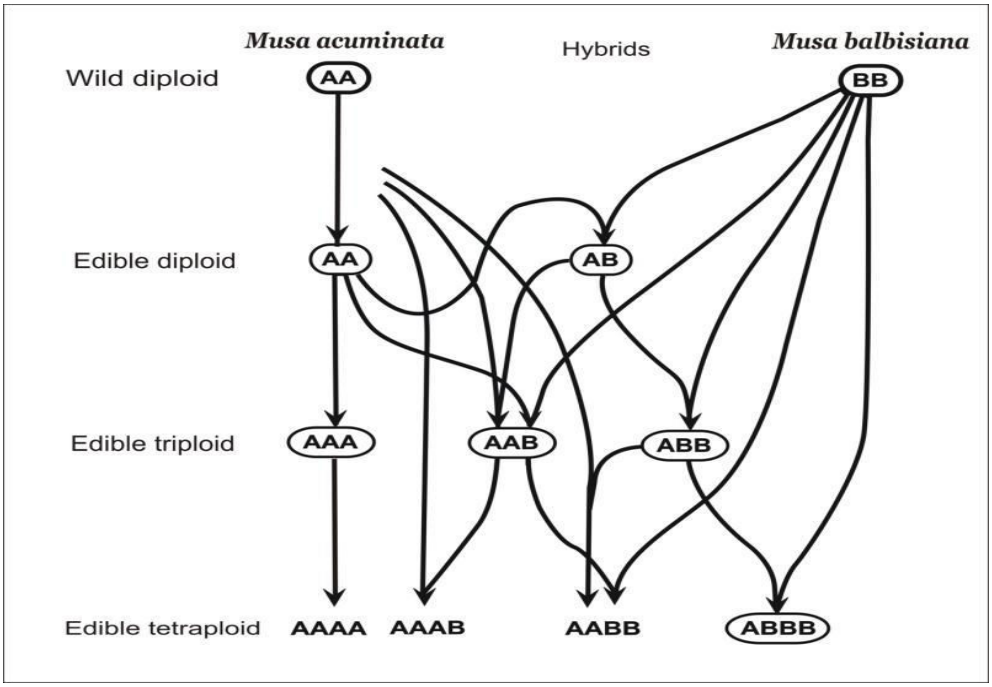
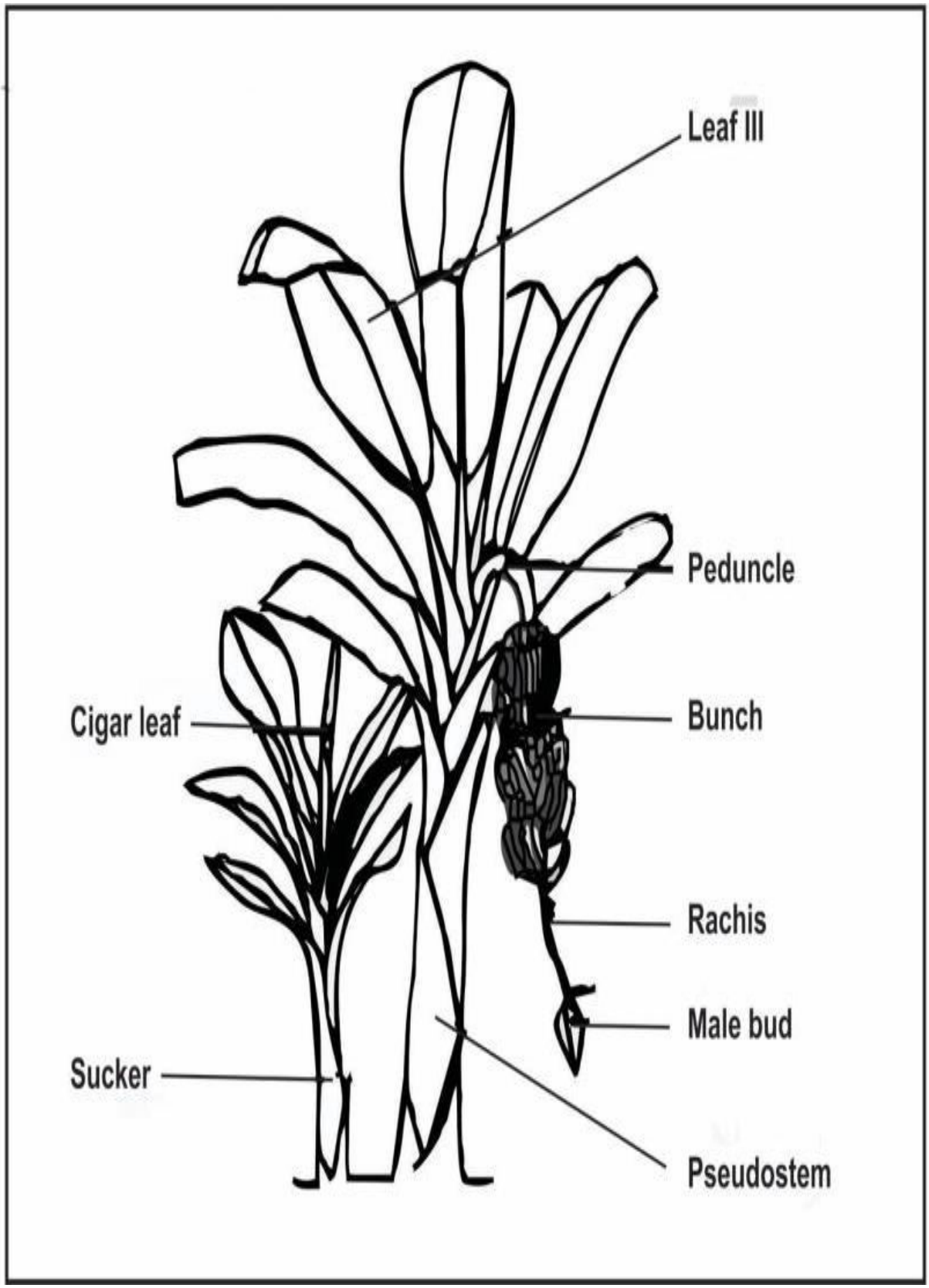


Figure.3 Description of pseudostem/suckers of banana. Modified after: IPGRI, 1984.



Estimation of crude protein

Estimation of crude protein consists of two parts: digestion and distillation. Weigh approximately 0.25 gm of dried powdered sample noting the exact weight, 'W'gms, into clean dry digestion tubes. Add approximately 1 gm of digestion mixture (potassium sulphate & copper sulphate, 9:1 by weight) into each tube. Add 12ml of con.H_2SO_4 into each tube, place on the digester (Kjeltec) assembly and digest at 400°C for 11 to 12 hrs. Cool down to room temperature.

Place on distillation unit (Kjeltec) and set the program (water-70 ml, alkali-70 ml, receiver-30 ml, tube drain) and distil it with steam in the unit. The instrument estimates the crude protein on entering the weight of sample W as

$$\% \text{ crude protein} = \frac{\text{volume of 0.1N HCl x 0.0014 x 6.25 x 100}}{W}$$

Estimation of nitrogen free extract

NFE or soluble carbohydrate is calculated based on difference

NFE = Dry matter-(crude protein+ crude fat+ crude ash + crude fibre)

NFE = 100–(moisture + crude protein + crude fat + crude ash + crude fibre)

Statistical analysis

The results were analyzed and descriptive statistics were done using SPSS 12.0 (SPSS Inc., an IBM Company, Chicago, USA) and graphs were generated using Sigma Plot 7 (Systat Software Inc., Chicago, USA).

Results and Discussion

Morphological analysis

In the present study, an attempt to know about the morphological characteristics and nutritional analysis (male flower) of selected banana varieties in Kerala. The morphological studies allows a better knowledge about the common varieties. Ten banana varieties were studied which differ each other on the basics of height, length, colour of pseudostem, leaf, flower bud and fruit.

The habitat of the pseudostem are of mainly 4 types like normal, slender, robust, tall and stout. The height of the plant shows a wide difference. The pseudostem colour varies from one another based on the varieties of Musa sp. that is mostly they are heavily marked with brown or black blotches whereas in other, it is predominantly green or yellowish green, often with black blotches in the upper part. The sap colour is watery in with certain exceptions. The leaf habitat can be of drooping, intermediate or erect with an asymmetric symmetry. The length of the petiole differs from one another and the base of the petiole can be winged or not winged, clasping or not clasping. The margin colour of the petiole ranges from purple, pink or maroon etc.

The orientation of the inflorescence can be pendulous or sub horizontal with a peduncle with hairy or slightly hairy in appearance with the variation of colour from each variety. The bud shape can be lanceolate, intermediate, linear-lanceolate etc. with imbricate or slightly imbricate in nature. The majority of female bract shape is lanceolate where the other variety behaves as reflexed and revolute. The compound tepal of female flower posses' cream or creamy white with lobe colour yellow and the free tepal colour is white, creamy white or cream with purple tinge. The pale green, yellowish green, are the different ranges of the ovary colour with two number of rows of ovule per locule. The position of the rachis is falling vertically, at an angle, or in horizontal position. The bract scars are prominent in some varieties with exceptions.

Proximate analysis

The nutritional analysis help us to identify the difference in the nutritional composition of the selected 4 varieties of banana male flower. From the analysis we conclude that sample of Palayamkudan contain higher composition of crude fibre. While the sample Nyalipoovan contain lower concentration of crude fibre. The crude protein is slightly higher in Palayamkudan (14.37) and other three variety contain an average of 13.00 ± 0.5.The ether extract is also present in an average concentration of 5.00 in all the four variety. The gross energy content of various varieties: Poovan (3687 kcal/kg), Etha (3725 kcal/kg), Palayamkudan (3669 kcal/kg) and Nyalipoovan (3795 kcal/kg).

Figure.4 General morphology A) habitat (A1, suckers; A2, pseudostem; A3, petiole base; A4, inflorescence; A5, petiole; A6, leaf base; A7, 3rd leaf), B) inflorescence at early stages (B1, peduncle; B2, sterile bract; B3, female bud; B4, female flowers; B5, female bract), C) female flower (C1, ovary; C2, free tepal; C3, compound tepal; C4, stigma), D) compound tepal, E) free tepal, F) pistil with staminodes (F1, ovary; F2, staminodes; F3, style; F4, stigma), G) c.s of ovary, H) infructescence (H1, peduncle; H2, fruits; H3, rachis; H4, male bract; H5, male bud), I) male flower, J) rudimentary pistil with stamens (J1, rudimentary pistil; J2, stamens), K) fruit hand (K1, pedicel; K2, fruit; K3, fruit apex).

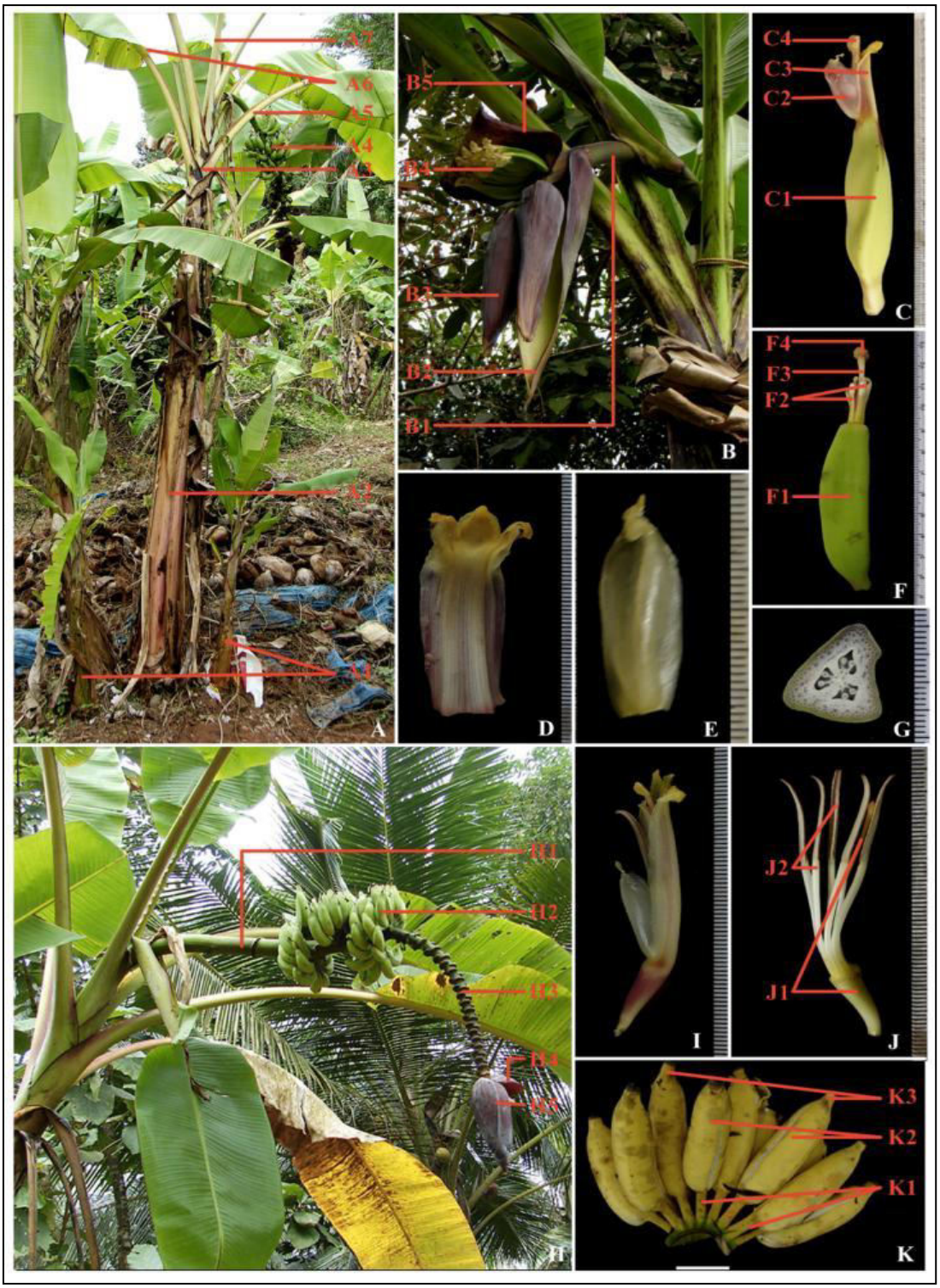


Figure.5 *Musa acuminata* Colla A) habitat, B) pseudostem coloration, C) inflorescence at early stage, D) leaf base, E) leaf apex, F) female flower, G) compound tepal, H) free tepal, I) pistil with staminodes, J) c.s of ovary, K) male bract abaxial surface, L) male flower, M) compound tepal, N) rudimentary pistil with stamens, O) ripened fruit hand, P) seeds.

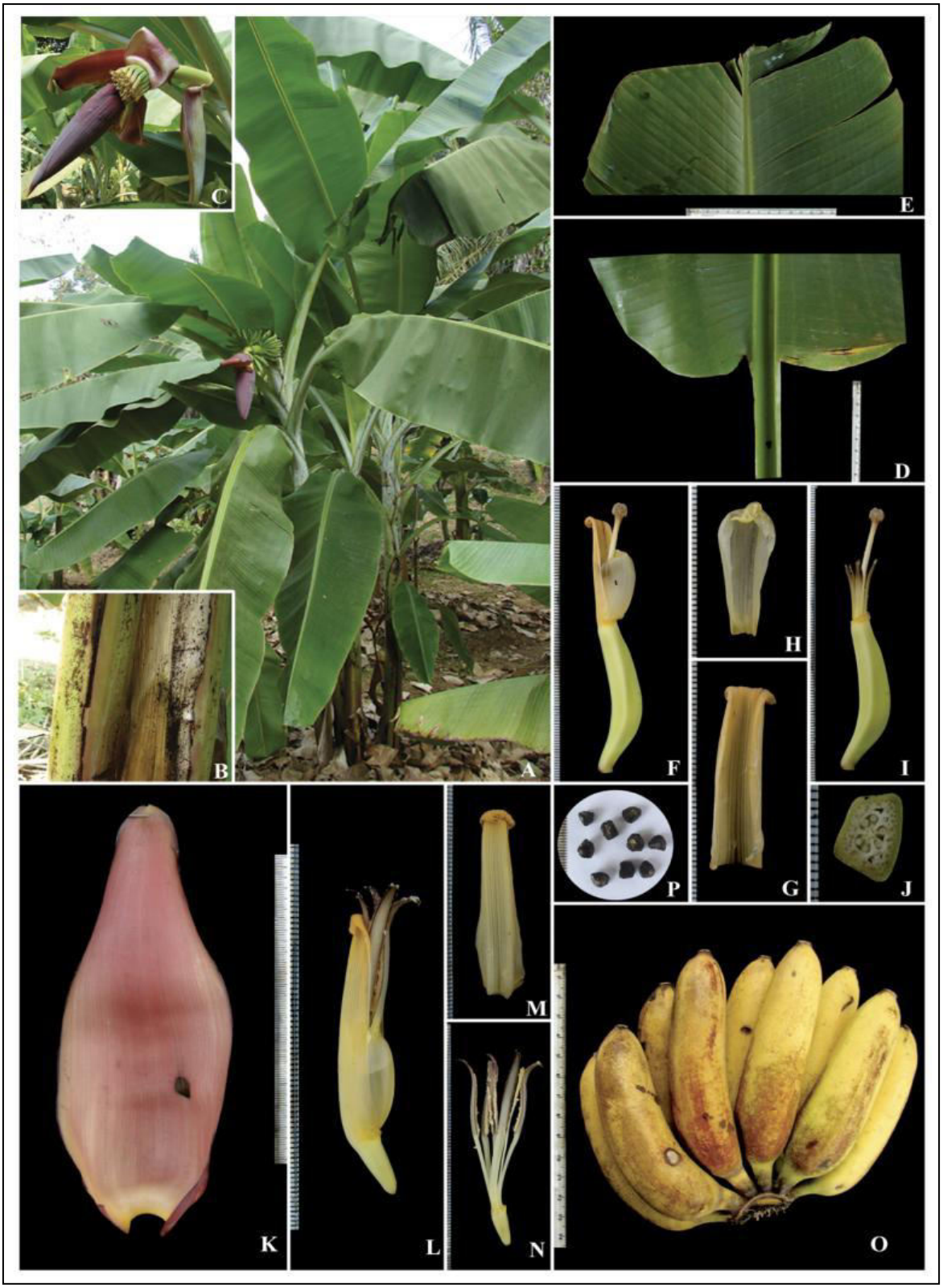


Figure.6 *Musa balbisiana* Colla A) habitat, B) infructescences with advanced stage of male bud, C) leaf base, D) leaf apex, E) female flower, F) compound tepal (female), G) free tepal (female), H) pistil with staminodes, I) c.s of ovary, J) male bract, K) female flower, L) compound tepal (male), M) free tepal (male), N) rudimentary pistil with stamen, O) ripened fruit hand, P) single fruit, Q) seeds.

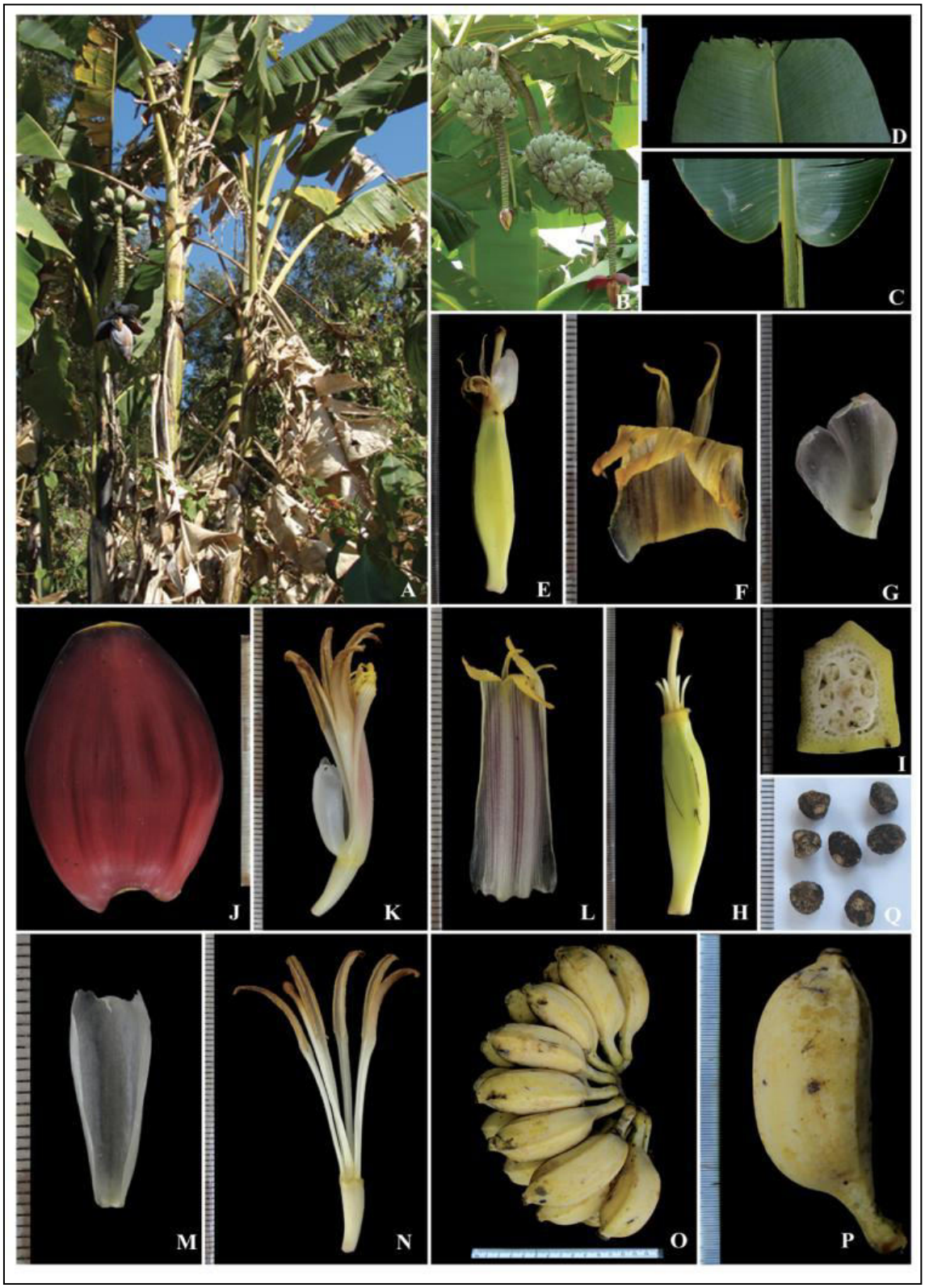


Figure.7 Important characters used in species and genome groups of edible banana. Modified after: IBPGR, 1984.

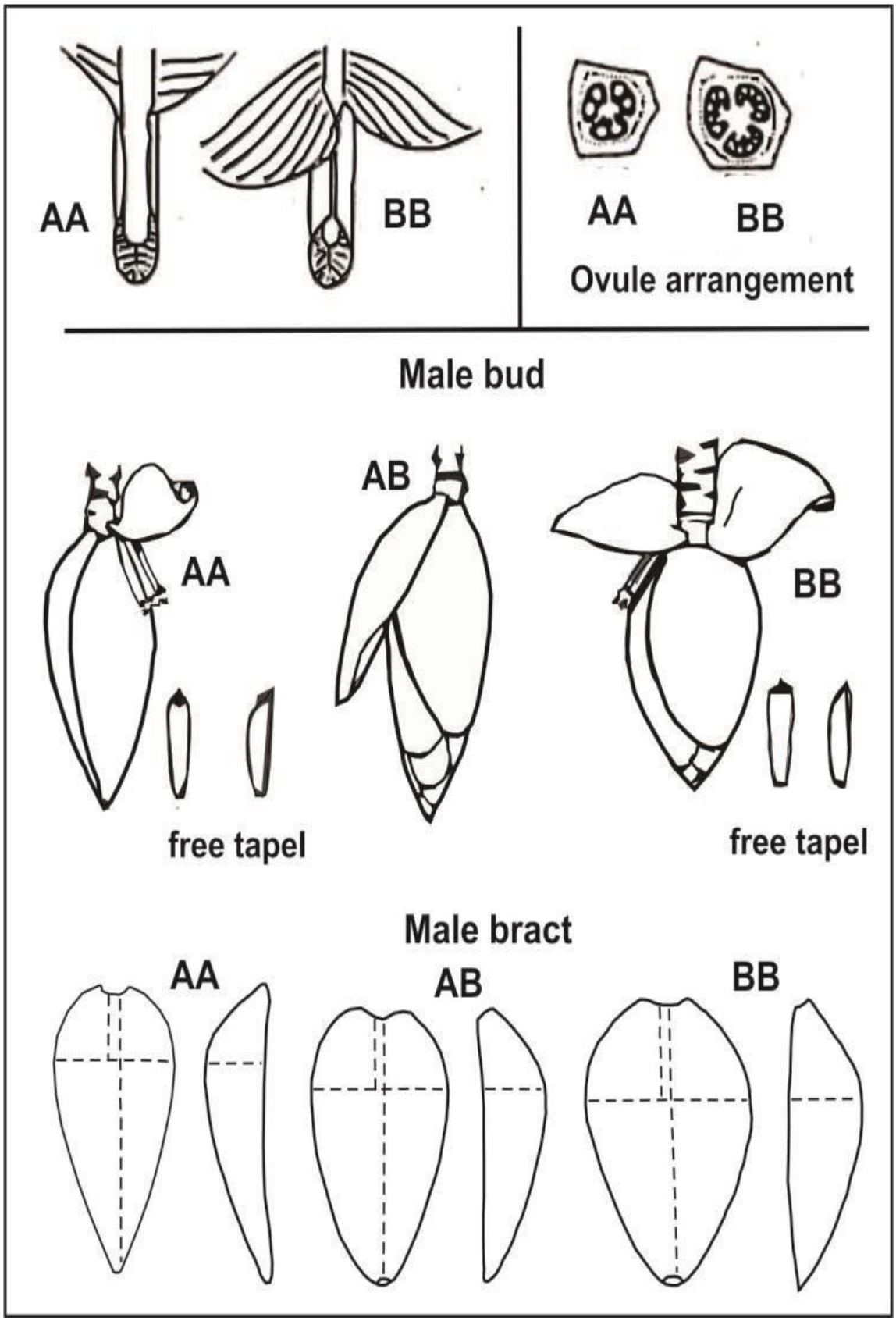


Figure.8 Different leaf habit of banana 1) Erect, 2) Intermediate, 3) Drooping. Modified after: IPGRI, 1984.

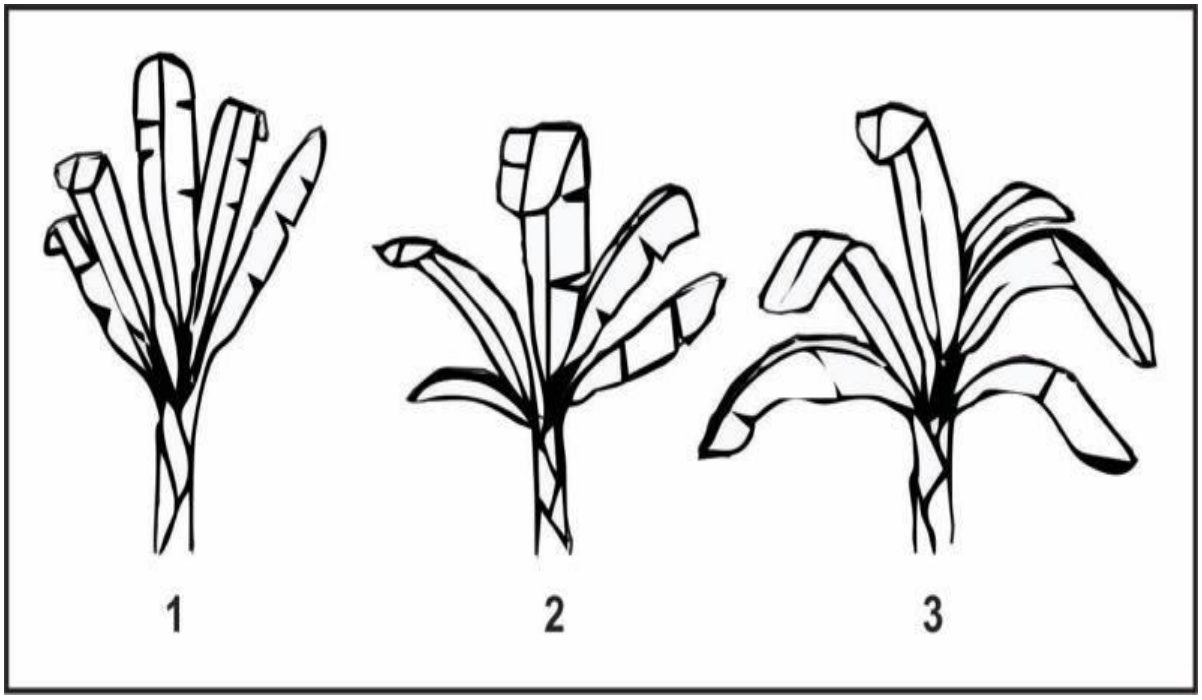


Figure.9 Petiole/midrib/leaf of banana. Modified after: IPGRI, 1984.

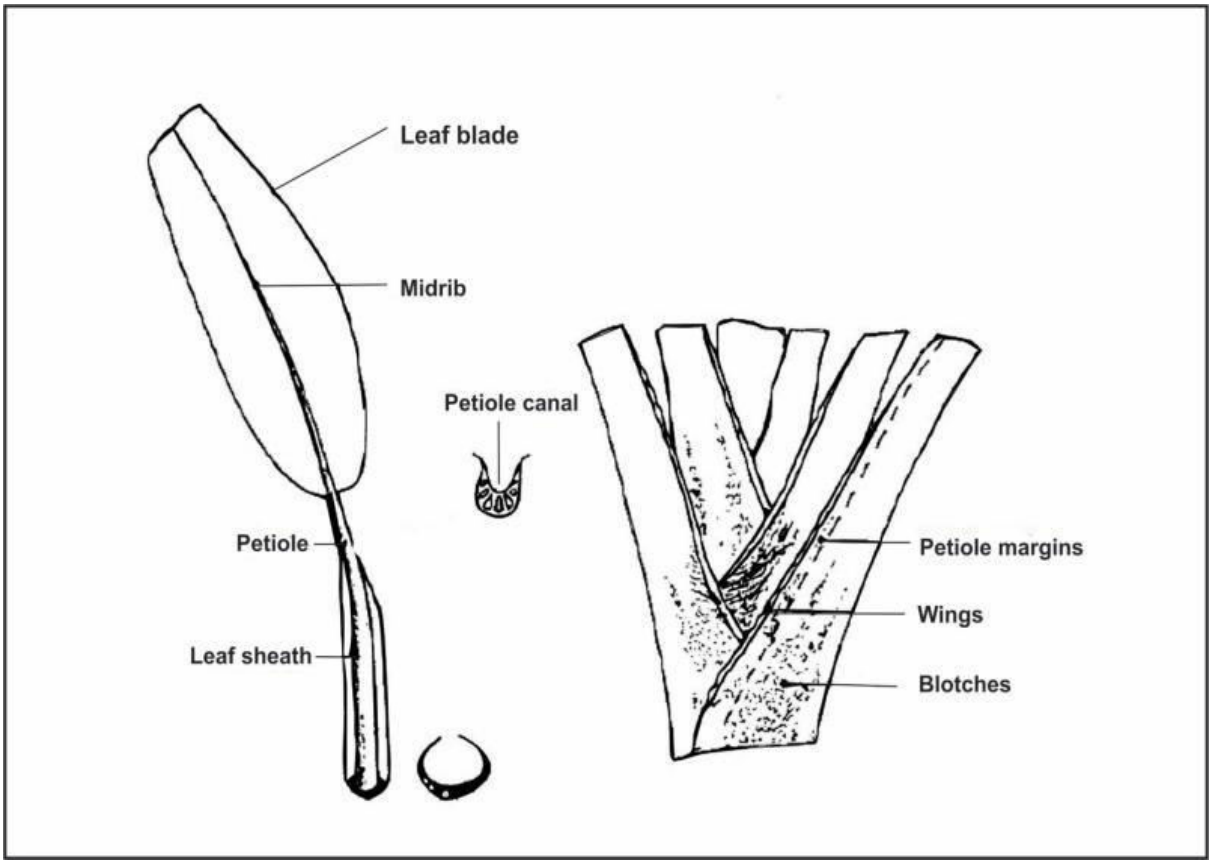


Figure.10 Shape of leaf blade base 1) both side rounded, 2) one side rounded, one pointed, 3) both side pointed. Modified after: IPGRI, 1984.

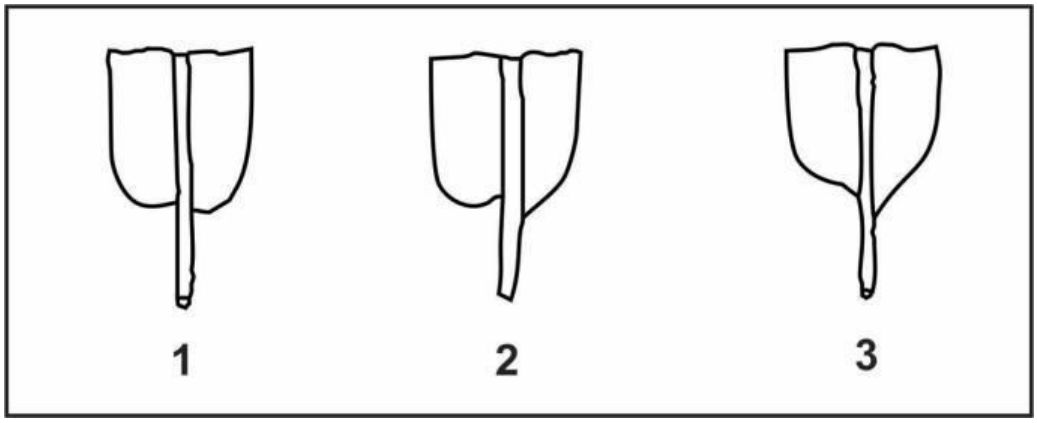


Figure.11 Rachis position 1) falling vertically, 2) at an angle, 3) with a curve, 4) horizontal, 5) erect. Modified after: IPGRI, 1984.

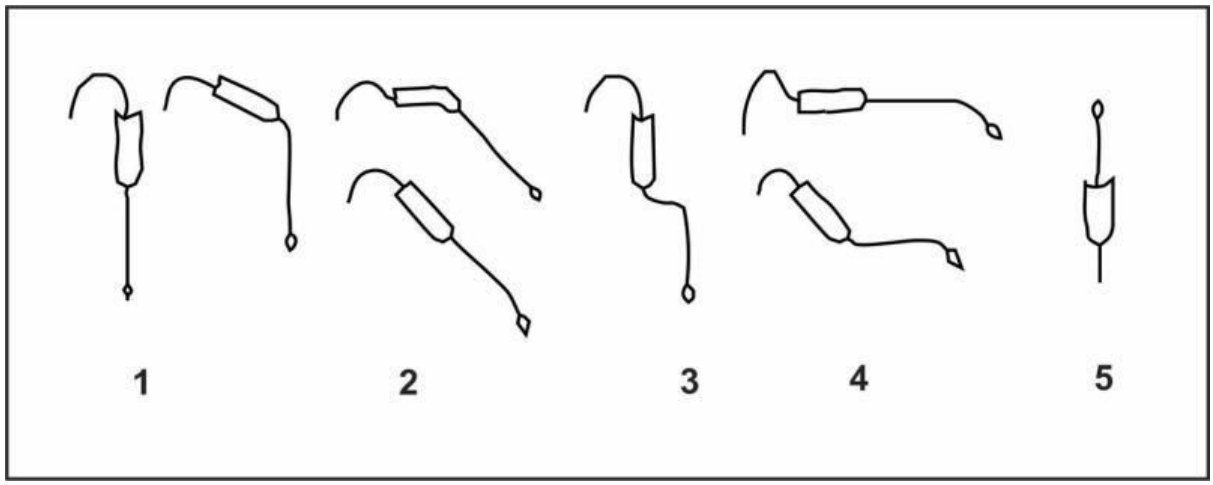


Figure.12 Petiole canal leaf III. Modified after: IPGRI, 1984.

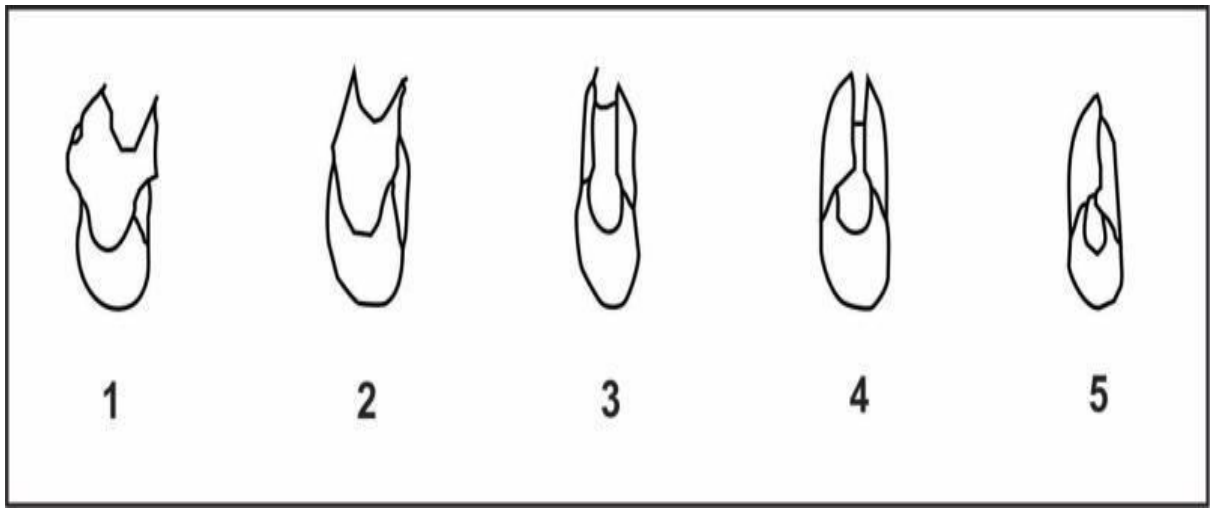


Figure.13 Male bud shape 1) like a top, 2) lanceolate, 3) intermediate, 4) ovoid, 5) rounded. Modified after: IPGRI, 1984.

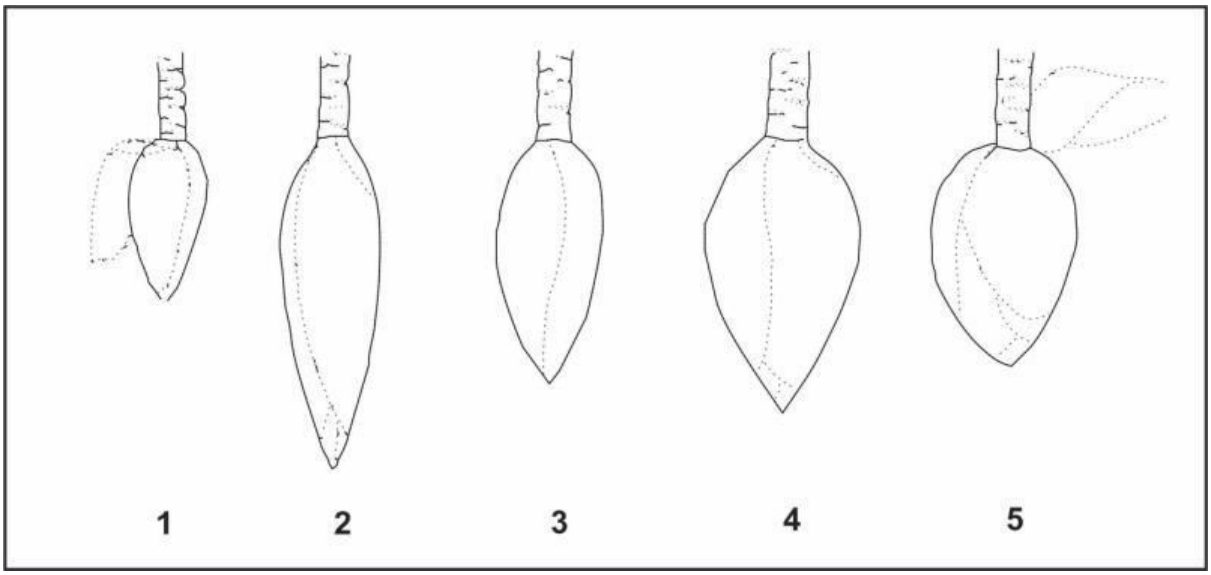


Figure.14 Bract base shape 1) small shoulder, 2) medium, 3) large shoulder. Modified after: IPGRI, 1984.

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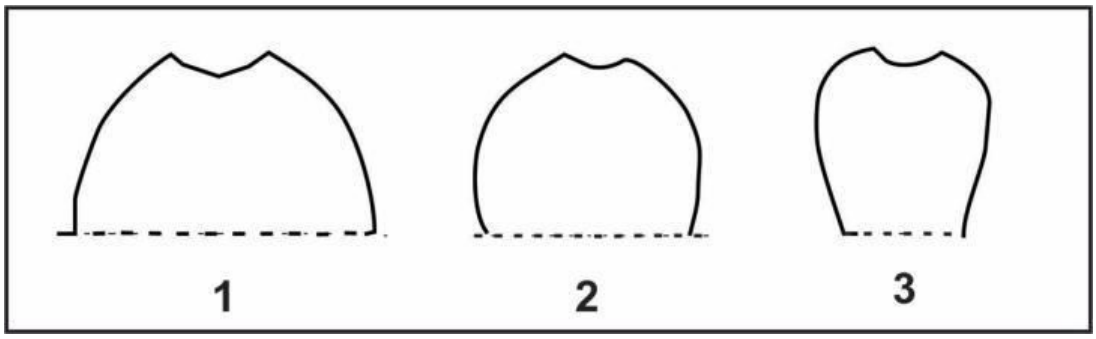

Figure.15 Bract apex shape 1) pointed, 2) slightly pointed, 3) intermediate, 4) obtuse, 5) obtuse and split. Modified after: IPGRI, 1984.

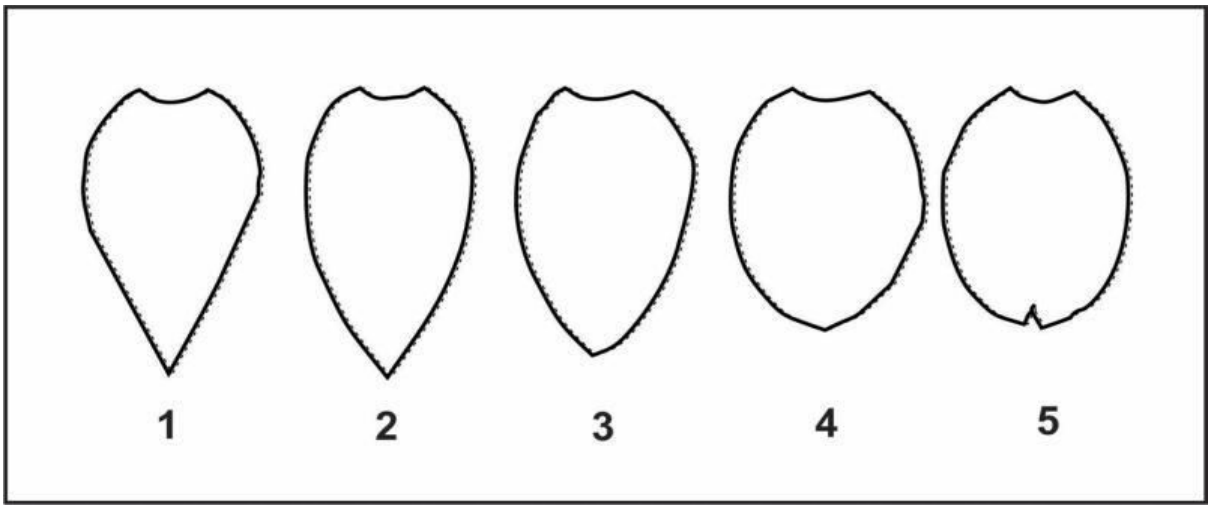

Figure.16 Male bract shape. Modified after: IPGRI, 1984.

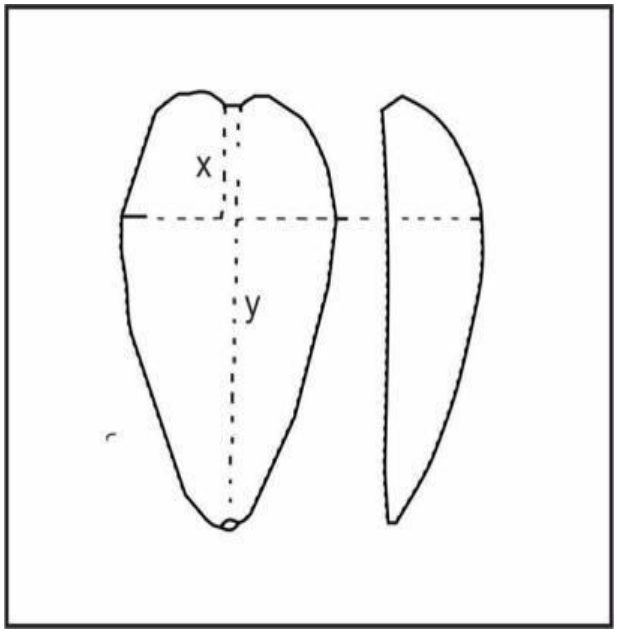

Figure.17 Bract behaviour before falling 1) revolute (rolling), 2) not revolute (not rolling). Modified after: IPGRI, 1984.

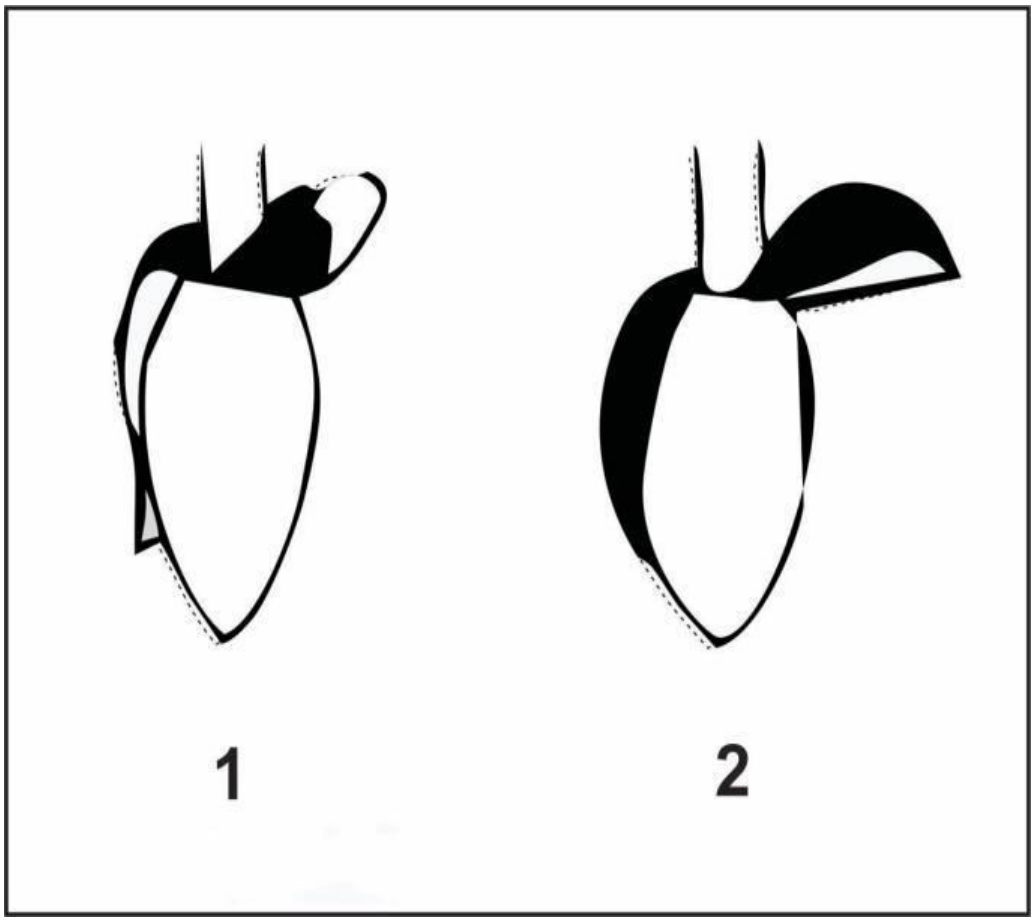

Figure.18 Male bud and flower. Modified after: IPGRI, 1984.

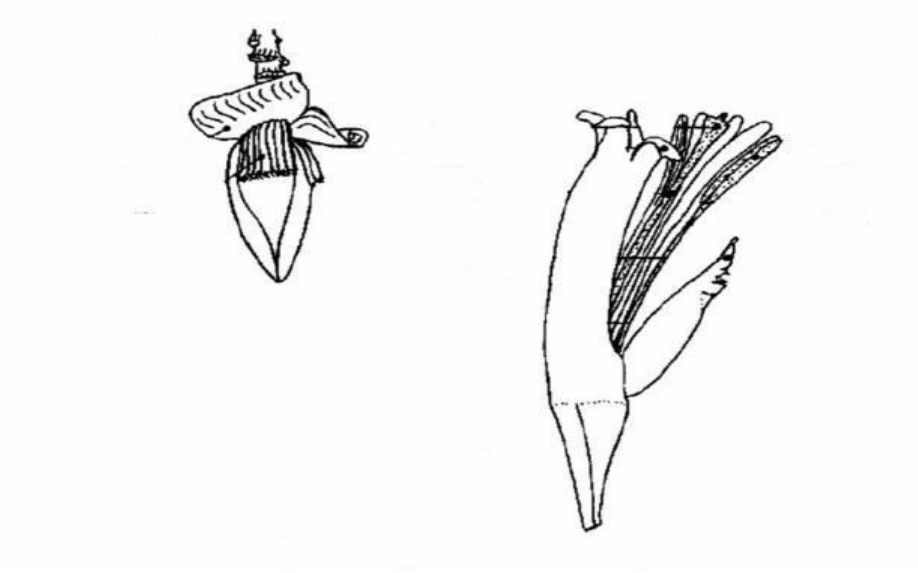

Figure.19 Free tepal apex development 1) little or no visible sign of development, 2) developed, 3) very developed. Modified after: IPGRI, 1984.

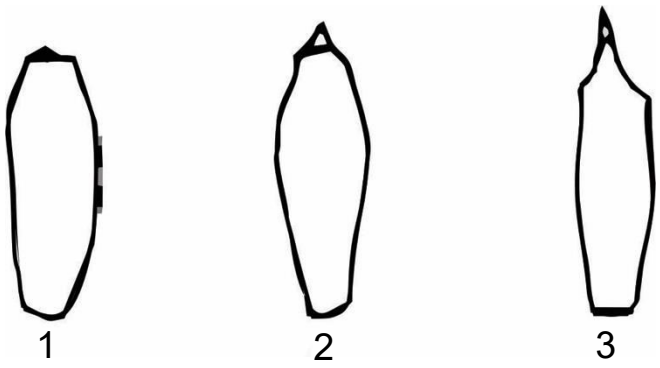

Figure.20 Style shape 1) straight, 2) curved under stigma, 3) curved at the base, 4) curved twice, 5) other. Modified after: IPGRI, 1984.

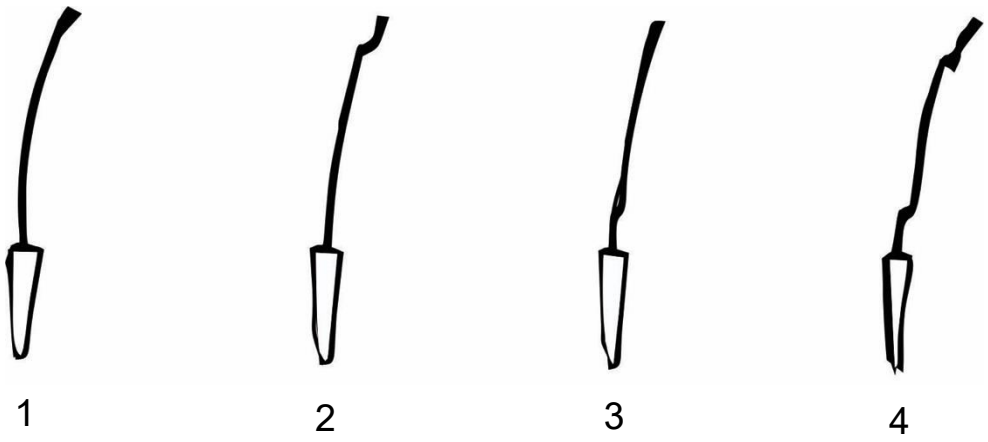

Figure.21 Ovary shape 1) straight, 2) arched. Modified after: IPGRI, 1984.

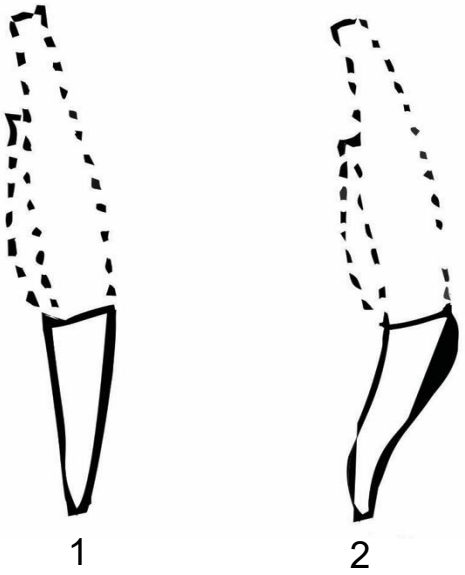

Figure.22 Arrangement of ovules 1) two rowed, 2) four rowed (more or less). Modified after: IPGRI, 1984.

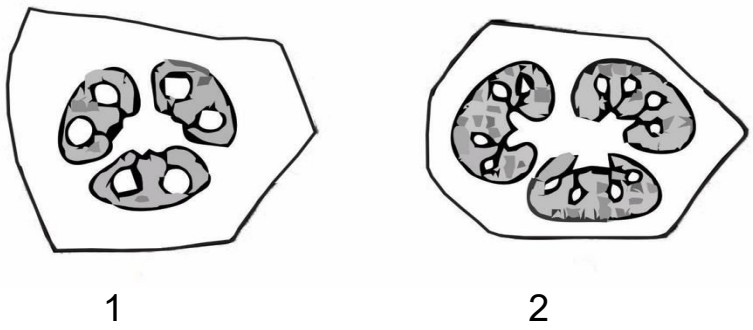

Figure.23 Fruit shape (longitudinal curvature) 1) straight (or slightly curved), 2) straight in the distal part, 3) curved (sharp curve), 4) curved in 'S' shape (double curvature, 5) other. Modified after: IPGRI, 1984.

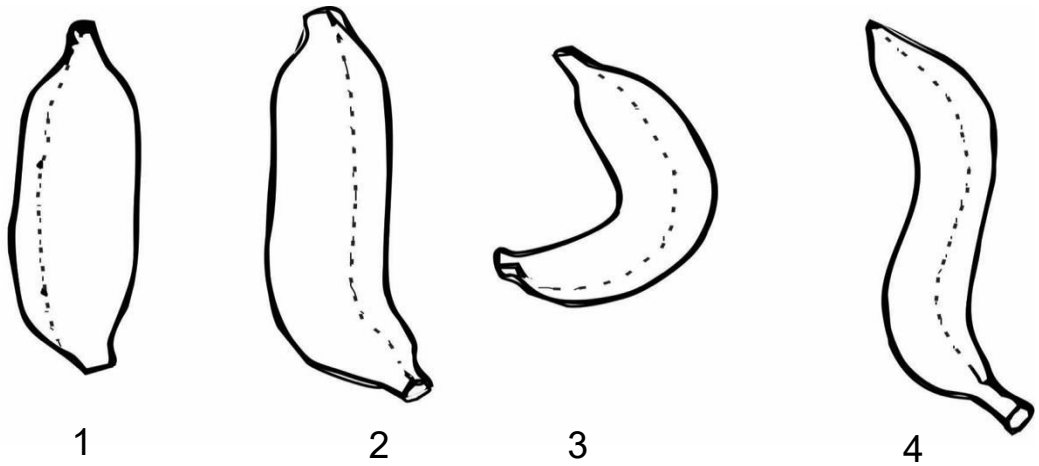

Figure.24 Transverse section of fruit 1) pronounced ridges, 2) slightly ridged, 3) rounded. Modified after: IPGRI, 1984.

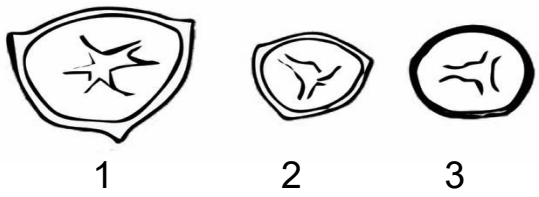

Figure.25 Fruit apex 1) pointed, 2) lengthily pointed, 3) blunt-tipped, 4) bottle-necked, 5) rounded. Modified after: IPGRI, 1984.

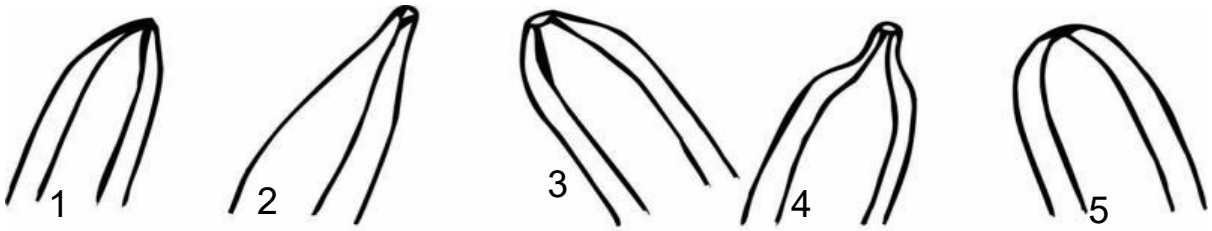

Figure.26 Remains of flower relicts at fruit apex 1) without any floral relicts, 2) persistent style, 3) base of the style prominent. Modified after: IPGRI, 1984.

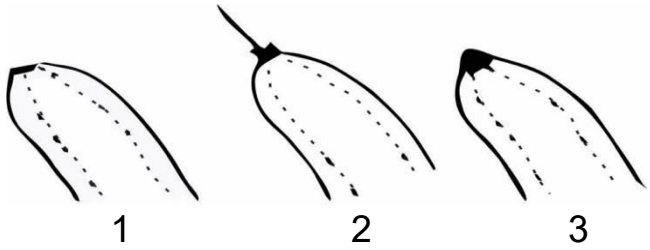

Table.1 Different vernacular names of *Musa paradisiaca* around the globe and India.

Language	**Names**
Scientific names	*Musa paradisiaca*
Name in various global languages	
French	Bananier
German	Banane
English	Banana
Name in various Indian languages	
Sanskrit	Kadali
Hindi	Kela
Urdu	Bonana
Marathi	Kela
Kannada	Baale
Gujarati	Kelphool
Malayalam	Vazha
Tamil	Vazhai

Table.2 Classification of edible bananas.

Genomic group	Score	References
AA diploid	15-23	Simmonds and Shepherd (1955); Stover and Simmonds (1987)
AAA triploid	15-23	
AAB triploid	24-46	
AB diploid	49	
ABB triploid	59-63	
ABBB tetraploid	67	
AA/AAA	15-25	Silayoi and Chomchalow (1987)
AAB	26-46	
ABB	59-63	
ABBB	67-69	
BB/BBB	70-75	

Table.3 Important banana varieties cultivated in different states of India.

State	Varieties grown
Andhra Pradesh	Dwarf Cavendish, Robusta, Rasthali, Amritpant, Thellachakrakeli, Karpoora Poovan, Chakrakeli, Monthan and Yenagu Bontha
Assam	Jahaji (Dwarf Cavendish), Chini Champa, Malbhog, Borjahaji (Robusta), Honda, Manjahaji, Chinia (Manohar), Kanchkol, Bhimkol, Jatikol, Digjowa, Kulpait, Bharat Moni
Bihar	Dwarf Cavendish, Alpon, Chinia , Chini Champa, Malbhig, Muthia, Kothia , Gauria
Gujarat	Dwarf Cavendish, Lacatan, Harichal (Lokhandi), Gandevi Selection, Basrai, Robusta, G-9, Harichal, Shrimati
Jharkhand	Basrai, Singapuri
Karnataka	Dwarf Cavendish, Robusta, Rasthali, Poovan, Monthan, Elakkibale
Kerala	Nendran (Plantain), Palayankodan (Poovan), Rasthali, Monthan, Red Banana, Robusta
Madhya Pradesh	Basrai
Maharashtra	Dwarf Cavendish, Basrai, Robusta, Lal Velchi, Safed Velchi, Rajeli Nendran, Grand Naine, Shreemanti, Red Banana
Orissa	Dwarf Cavendish, Robusta, Champa, Patkapura (Rasthali)
Tamil Nadu	Virupakshi, Robusta, Rad Banana, Poovan, Rasthali, Nendran, Monthan, Karpuravalli, Sakkai, Peyan, Matti
West Bengal	Champa, Mortman , Dwarf Cavendish, Giant Governor, Kanthali, Singapuri

Table.4 Characters used in the classification of bananas through a taxonomic scorecard. Modified after (Simmonds and Shepherd, 1955).

Character	*Musa acuminata*	*Musa balbisiana*
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	Usually downy or hairy	Glabrous
Pedicels	Short	Long
Ovules	Two regular rows in each loculus	Four irregular rows in each loculus
Bract shoulder	Usually high (ratio < 0.28)	Usually low (ratio > 0.30)
Bract curling	Bract reflex and roll back after opening	Bracts lift 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 yellow outside, pink, dull purple or yellow inside	Distinctive brownish-purple outside; bright crimson inside
Colour fading	Inside bract colour fade to yellow towards the base	Inside bract colour continuous to base
Bract scars	Prominent	Scarcely prominent
Free tapel of male	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

Table.5 Taxonomic score card of Musa.

Genome Group	Score
AA/AAA	15-25
AAB	26-46
AB/AABB	47-49
ABB	59-63
ABBB	67-69
BB/BBB	70-75

Table.6 Comparison of characters of Musa cultivars (1).

Name	Habitat	Pseudostem					
		Height (cm)	Circumference at base (cm)	Colour	Underlying colour	Blotches at the tip	Sap colour
Sanna chenkadali	Normal	231	39	A mix of green - yellow-pink	Pink red	Brown red blotches present	Watery
Red jaisara	Normal	287	43	Yellow green	Green	Green pigmentation	Watery
Rasakadali	Intermediate	225	38	Light green	Green	Brown blotches present	Watery
Chara padathy	Erect normal	229	39	Dark green	Dark green shade	Brown blotches present	Watery
Kaligali	Normal intermediate	290	45	Green	Light green	Brown blotches present	Watery
Vannan	Intermediate leaves not overlapped	213	34	Light green	Light green	Pink black blotches	Watery
Petit naine	Intermediate and leaves not overlapped	174	32	Dark green	Green shiny	Black blotches present	Watery
Ladies finger	Erect leaves not overlapped	264	47	Pink purple light green	Red purple	Red small blotches present	Watery

Table.7 Comparison of characters of Musa cultivars (2).

Name	Habitat	Pseudostem					
		Height (cm)	Circumference at base (cm)	Colour	Underlying colour	Blotches at the tip	Sap colour
Navaral	Erect intermediate	298	43	Red purple green	Light pink purple	Pink purple blotches present	Watery
Malavazha	Intermediate	240	39	Light green	Light green	Red blotches present	Watery
Kalyan bale	Dropping	300	45	Red purple green	Light purple green	Red brown blotches present	Watery
Pedda pacha	Normal intermediate	196	34	Medium green	Light green	Brown pink purple blotches present	Watery
Sikuzani	Erect	270	45	Medium green	Light green	Purple brown blotches	Watery
Pisang jaribuaya	Erect	243	43	Green yellow	Light green yellow	Pink purple blotches	Watery
Pachanadan	Intermediate	298	45	Medium green	Light green	Pink purple blotches present	Watery
Lacatan	Intermediate	285	43	Light purple red	Purple brown	Red purple blotches	Watery

Table.8 Comparison of characters of Musa cultivars (3).

Name	**Habitat**	**Pseudostem**					
		Height (cm)	**Circumference at base (cm)**	**Colour**	**Underlying colour**	**Blotches at the tip**	**Sap colour**
KUNNAN	Erect	243	32	Green yellow	Green yellow	Pink purple blotches	Watery
KULLAN	Dwarf type leaves overlapped	174	28	Medium green	Light green	Pink purple blotches	Watery
KRISHNAVAZHA	Normal	301	32	Medium green	Medium green with some brown shades	Brown blotches present	Watery
HIGH GATE	Intermediate	234	30	Green	Light green	Few brown blotches	Watery
DUDHSAGAR	Intermediate	302	32	Red purple	Red purple	Black blotches	Watery
PISANG LILIN	Erect	170	29	Dull	Light green	Brown blotches	Watery
YANGAMBI	Intermediate	221	28	Light yellow	Light green yellow	Few black blotches	Watery
THIRUVANANTHAPURAM	Dropping	286	32	Medium green	Light green	Extensive blotches	Watery
CHAKKARAKAELI	Intermediate	235	34	Medium green yellow	Light yellow	Few brown blotches	Watery

Table.9 Comparison of characters of Musa cultivars (4).1`

Name	Leaf habitat	Leaf				Petiole			
		Blotches at petiole base	**Blotches colour**	**Leaf upper surface colour and appearance**	**Leaf lower surface colour and appearance**	**Petiole canal leaf lll**	**Petiole margins**	**Petiole margin colour**	**Leaf blade length and width (cm)**
SANNA CHENKADALI	Leaves not overlapped	Blotches present	Pink red blotches	Green with pink shade Dull	Dull green with pink shade Dull	Normal margins	Not winged and clasping	Red	176, 48
RED JAISARA	Leaves not overlapped	Few blotches present	Green	Green Shiny	Green Shiny	Margins curved inwards	Not winged and clasping	Green	198, 65
RASAKADALI	Leaves not overlapped	Few blotches	Brown	Green Dull	Green Dull	Margins curved inwards	Not winged	Light green	217, 54
CHARA PADATHY	Leaves not overlapped	Few blotches present	Brown blotches	Green Shiny dull Green	Dull Green	Margins curved inwards	Not winged and clasping	Green	209, 52
KALIGALI	Leaves not overlapped	Small blotches present	Brown blotches	Green Slightly shiny	Light green Dull	Straight with erect margins	Winged and clasping	Brown green	176, 54
VANNAN	Leaves not overlapped	Small few blotches present	Black purple blotches present	Green Shiny	Green Shiny	Straight with erect margins	Not winged and clasping towards the pseudostem	Purple brown	132, 53

Table.10 Comparison of characters of Musa cultivars (5).

Name	Leaf habitat	Leaf				Petiole			
		Blotches at petiole base	**Blotches colour**	**Leaf upper surface colour and appearance**	**Leaf lower surface colour and appearance**	**Petiole canal leaf lll**	**Petiole margins**	**Petiole margin colour**	**Leaf blade length and width (cm)**
PETIT NAINE	Leaves not overlapped	Large blotches present	Black blue blotches	Green Shiny	Green Shiny	Open with margins spreading	Winged and undulating	Green	108, 46
LADIES FINGER	Normal erect	Few blotches	Black spots of blotches	Green Shiny	Green Dull	Margins curved inwards	Not winged and clasping	Light green	197, 67
NAVARAL	Normal	Small blotches present	Black blotches	Dark green Shiny	Light green Shiny	Straight with erect margins	Winged and clasping	Pink colour line	197, 68
MALAVAZHA	Normal	Extensive blotches	Light brown	Green Shiny	Green Shiny	Intermediate canal	Winged and clasping to the pseudostem	Yellow green	217, 68
KALYAN BALE	Dropping	Slightly blotched	Black brown blotches	Green Shiny	Green shiny	Margins curved inwards	Winged and clasping	Light green	213, 89
PEDDA PACHA	Normal	Small blotches rarely seen	Black brown	Green dull	Green Dull	Wide with margins	Winged and not clasping to the pseudostem	Pink purple	224, 55

Table.11 Comparison of characters of Musa cultivars (6).

Name	Leaf habitat	Leaf				Petiole			
		Blotches at petiole base	**Blotches colour**	**Leaf upper surface colour and appearance**	**Leaf lower surface colour and appearance**	**Petiole canal leaf lll**	**Petiole margins**	**Petiole margin colour**	**Leaf blade length and width (cm)**
SIKUZAN	Intermediate	Small blotches present	Black purple blotches	Green Shiny	Green Dull	Straight with erect margins	Winged and clasping the Pseudostem	Light green	221, 32
PISANG JARIBUAYA	Intermediate	Small blotches	Black purple blotches	Green Shiny	Medium Green	Straight with erect margins	Not winged and clasping the pseudostem	Light green	218, 45
PACHANADAN	Intermediate	Large blotches present	Brown black	Green Shiny	Green shiny	Wide with erect margins	Winged and not clasping pseudostem	Watery green	224, 32
LACATAN	Intermediate	Large blotches	Brown black blotches	Green Shiny	Green Dull	Open with margin spreading	Winged and not clasping	Light green	212, 65
KUNNAN	Intermediate	Small blotches present	Black purple	Green shiny	Medium green Dull	Straight with erect margin	Not winged and clasping	Light green	217, 64
KULLAN	Intermediate	Large blotches	Black purple	Green Shiny	Green Dull	Wide with erect margin	Winged and clasping the Pseudostem	Pink purple to red	134, 59

Table.12 Comparison of characters of Musa cultivars (7).

Name	Leaf habitat	Leaf				Petiole			
		Blotches at petiole base	**Blotches colour**	**Leaf upper surface colour and appearance**	**Leaf lower surface colour and appearance**	**Petiole canal leaf lll**	**Petiole margins**	**Petiole margin colour**	**Leaf blade length and width (cm)**
KRISHNAVAZHA	Intermediate	Extensive blotches	Brown blotches	Green Shiny	Green Dull	Wide with erect margins	Winged with clasping the pseudostem	Brown purple combo	205, 63
HIGH GATE	Intermediate	Few blotches	Brown	Green Shiny	Green Dull	Open with margins spreading	Winged and undulating	Pink red	190, 74
DUDHSAGAR	Normal	Sparse blotches	Brown blotches	Green Shiny	Green Dull	Wide with erect margins	Winged and clasping the pseudostem	Pink purple to red	248, 73
PISANG LILIN	Intermediate	small blotches	black purple	Green ,shiny	green dull	wide with erect margins	winged and clasping the pseudostem	not dry	141, 49
YANGAMBI	Normal	Extensive blotches	Black brown	Green, shiny	Medium green, dull	Open with margin spreading	Winged and clasping the pseudostem	Light purple brown	211, 60
THIRUVANANTHAPURAM	Normal	Small blotches	Black purple	Green shiny	Green yellow, dull	Open with margins spreading	Winged and undulating	Not distinguishable	241, 88
CHAKKARAKAELI	Intermediate	Large blotches	Brown black	Green Shiny	Green Dull	Apex with margins spreading	Winged and not clasping pseudostem	Pink purple	214, 60

Table.13 Comparison of characters of Musa cultivars (8).

Name	Petiole length (cm)	Wax on leaves	Shape of the leaf blade base	Colour of midrib dorsal surface	Colour of midrib ventral surface	Colour of cigar leaf
SANNA CHENKADALI	47	Few wax	Two sides pointed	Green pink	Green pink	Green with some shade of pink
RED JAISARA	48	Waxy	Both sides rounded	Light green	Light green	Light green
RASAKADALI	46	Waxy	Both sides rounded	Green	Green	Light green
CHARA PADATHY	48	Few wax	Both sides rounded	Green	Green	Light green
KALIGALI	45	Few wax	Both sides rounded	Light green	Light green	Light green
VANNAN	43	Few wax present	Both sides rounded	Medium green	Green	Green
PETIT NAINE	33	Few wax present	Both sides rounded	Green	Green	Light green
LADIES FINGER	45	Waxy	Both sides pointed	Light green	Medium green	Light green
NAVARAL	48	Few wax	Both sides pointed	Light green	Light green	Light green
MALAVAZHA	45	Slightly waxy	Both sides pointed	Light green	Light green	Light green

Name	Petiole length (cm)	Wax on leaves	Shape of the leaf blade base	Colour of midrib dorsal surface	Colour of midrib ventral surface	Colour of cigar leaf
KALYAN BALE	49	Very little wax	One side pointed and other rounded	Red purple	Pink purple	Green with pink shade
PEDDA PACHA	54	Few wax	Both sides rounded	Green	Light green	Light green
SIKUZANI	37	Very few wax present	One side rounded and other pointe	Light green	Medium green	Very light green
PISANG JARIBUAYA	56	Few wax	Both sides rounded	Light green yellow	Medium green	Light green
PACHANADAN	37	Few wax	One side rounded other side pointed	Light green	Medium green	Green
LACATAN	46	Few wax present	Both sides rounded	Green	Light green	Light medium green
KUNNAN	55	Few wax present	Both sides rounded	Light green	Green	Light green
KULLAN	44	Few wax	Both sides rounded	Yellowish green	Green	Light green
KRISHNAVAZHA	43	Moderately waxy	Both sides rounded	Medium green	Light green	Light green
HIGH GATE	31	Moderate waxy	Both sides rounded	Pale green	Light green	Light green

Table.14 Comparison of characters of Musa cultivars (9).

Name	Petiole length (cm)	Wax on leaves	Shape of the leaf blade base	Colour of midrib dorsal surface	Colour of midrib ventral surface	Colour of cigar leaf
DUDHSAGAR	39	Few wax	Both sides rounded	Green	Green	Medium green
PISANG LILIN (AA)	52	few wax	both sides rounded pointed	Pink purple, medium green	Light green	pink purple
YANGAMBI	46	No wax	Both sides rounded	Light green yellow	Medium green	Green
THIRUVANANTHAPURAM	48	Ni wax	Both sides rounded	Light green	Green	Light green
CHAKKARAKAELI	51	Moderate wax	One side rounded and other pointed	Green	Light green	Light green

Table.15 Comparison of characters of Musa cultivars (10).

Name	Petiole length (cm)	Wax on leaves	Shape of the leaf blade base	Colour of midrib dorsal surface	Colour of midrib ventral surface	Colour of cigar leaf
DUDHSAGAR	39	Few wax	Both sides rounded	Green	Green	Medium green
PISANG LILIN (AA)	52	few wax	both sides rounded pointed	Pink purple, medium green	Light green	pink purple
YANGAMBI	46	No wax	Both sides rounded	Light green yellow	Medium green	Green
THIRUVANANTHAPURAM	48	Ni wax	Both sides rounded	Light green	Green	Light green
CHAKKARAKAELI	51	Moderate wax	One side rounded and other pointed	Green	Light green	Light green

Table.16 Comparison of characters of Musa cultivars (11).

Name	Inflorescence				Bunch		
	Peduncle breadth (cm)	Peduncle Length (cm)	Nature (hairness)	Colour	Position	Shape	Flower that form fruit
SANNA CHENKADALI	2.6	28	Slightly hairy	Red green mix	Hanging at 45°	Curved towards the stalk	Female
RED JAISARA	3	35	Hairy	Dark green	Hanging at 45°	With a curve	Female
RASAKADALI	3.5	34	Slightly hairy	Dull green	Hanging at 45°	With a curve in bunch axis	Female
CHARA PADATHY	4	33	Slightly hairy	Dark green	Hanging at a 45°	Dropping downward	Female
KALIGALI	4	35	Slightly hairy	Dark green	Hanging at 45°	With a curve on bunch axis	Female
VANNAN	4.7	34	Very hairy	Dark green with some scratch	Hanging at 45°	With a curve	Female
PETIT NAINE	4	33	Small hairs present	Dark green	Hanging downward	With no curve	Female
LADIES FINGER	4.3	38	Slightly hairy	Medium dark green	Hanging at 45°	With a curve	Female
NAVARAL	4	33	Hairy with short hair	Dull dark green	Hanging downward	Small curve	Female
MALAVAZHA	4.5	32	Short green	Dark green	Hanging downward	Asymmetric	Female

Table.17 Comparison of characters of Musa cultivars (12).

Name	Inflorescence				Bunch		
	Peduncle breadth (cm)	Peduncle Length (cm)	Nature (hairness)	Colour	Position	Shape	Flower that form fruit
KALYAN BALE	3.8	34.5	Slightly hairy	Dark green	Hanging at 45°	With a curve at axis	Female
PEDDA PACHA	2.5	28	Slightly hairy	Dark green	Hanging vertically	Cylindrical	Female
SIKUZAN	4.3	25	Slightly hairy	Green	Hanging at 45°	With a curve in bunch axis	Female
PISANG JARIBUAYA	5.6	53	Very hairy	Green	Hanging at 45°	Asymmetric	Female
PACHANADAN	6	35	Very short hair present	Green	Slightly angled	Cylindrical	Female
LACATAN	5.3	43	Slightly hairy	Green	Slightly angled	Asymmetric	Female
KUNNAN	5.4	58	Hairless	Green	Hanging at 45°	Bunch axis is nearly straight	Female
KULLAN	5.1	62	Hairless	Green	Falling in vertical direction	Cylindrical	Female
KRISHNAVAZHA	5	43	Hairless	Dark green	Horizontal	With a curve in the bunch axis	Female
HIGH GATE	4.6	58	Very hairy short hairs	Green	Hanging at 45°	Symmetric	Female

Table.18 Comparison of characters of Musa cultivars (13).

Name	Inflorescence				Bunch		
	Peduncle breadth (cm)	Peduncle Length (cm)	Nature (hairness)	Colour	Position	Shape	Flower that form fruit
DUDHSAGAR	5.7	60	Very hairy	Green	Hanging vertical	Asymmetric	Female
PISANG LILIN	4	26	Hairless	Green	Horizontal	Asymmetric	Female
YANGAMBI	5.2	28	Short hairs	Dark brown green	Hanging at 45°	Asymmetric	Female
THIRUVANANTHAPURAM	4	43	Hairy with short hair	Dark green	Hanging at 45°	With a curve in bunch axis	Female
CHAKKARAKAELI	4	53	Not hairy	Medium green	Hanging at 45°	Nearly straight	Female

Table.19 Comparison of characters of Musa cultivars (14).

Name	Fruits (positioning)	Rachis position	Male bud type	Male bud shape	Male bud size (cm)	Bract base shape	Bract apex shape
SANNA CHENKADALI	Biserate	Horizontal	Normal like a top	Intermediate	18	Medium	Pointed
RED JAISARA	Biserate	Horizontal	Normal	Intermediate	23	Medium	Slightly pointed
RASAKADALI	Biserate	Horizontal	Normal	Normal	20	Medium	Slightly pointed
CHARA PADATHY	Biserate	Horizontal	Normal	Normal	24	Medium	Slightly pointed
KALIGALI	Biserate	Horizontal	Normal	Intermediate	23	Medium	Pointed
VANNAN	Biserate	Falling vertical	Normal	Intermediate	23	Medium	Intermediate
PETIT NAINE	Biserate	Horizontal	Normal	Like a top	15	Medium	Not pointed
LADIES FINGER	Biserate	Horizontal	Normal	Intermediate	24	Medium	Slightly pointed
NAVARAL	Biserate	Horizontal	Normal like a top	Normal	18.5	Medium	Slightly pointed
MALAVAZHA	Biserate	Falling vertically	Intermediate	Very small	16	Very small shoulder	Intermediate
KALYAN BALE	Biserate	Horizontal	Intermediate	Intermediate	25	Medium	Pointed
PEDDA PACHA	Biserate	Horizontal	Normal	Like a top	23	Medium	Pointed
SIKUZANI	Biserate	Horizontal	Normal	Lanceolate	24	Medium shoulder	Obtuse

Table.20 Comparison of characters of Musa cultivars (15).

Name	Fruits (positioning)	Rachis position	Male bud type	Male bud shape	Male bud size	Bract base shape	Bract apex shape
PISANG JARIBUAYA	Biserate	At an angle	Normal	Lanceolate	22	Small shoulder	Intermediate
PACHANADAN	Biserate	Horizontal	Normal	Intermediate	21	Small shoulder	Obtuse
LACATAN	Biserate	With a curve	Normal	Intermediate	24	Small shoulder	Slightly pointed
KUNNAN	Biserate	At an angle	Normal	Lanceolate	23	Small shoulder	Intermediate
KULLAN	Biserate	Falling vertically	Normal	Like a top	21	Medium	Slightly pointed
KRISHNAVAZHA	Biserate	At an angle	Normal	Ovoid	24	Small shoulder	Intermediate
HIGH GATE	Biserate	With a curve	Normal	Intermediate	22	Large shoulder	Slightly pointed
DUDHSAGAR	Biserate	Falling vertically	Bare, normal	Intermediate	22	Small shoulder	Obtuse
PISANG LILIN	Biserate	At an angle	Normal	Olanveolate	21	Small shoulder	Pointed
YANGAMBI	Biserate	Falling vertical	Normal	Intermediate	19	Medium shoulder	Obtuse
THIRUVANANTHAPURAM	Biserate	At an angle	Normal	Intermediate	20	Small shoulder	Intermediate
CHAKKARAKAELI	Biserate	At an angle	Normal	Ovoid	22	Medium shoulder	Intermediate

Table.21 Comparison of characters of Musa cultivars (16).

Name	Bract imbrication	Colour of the bract		Bract				
		Internal face	External face	Fading colour on bract base	Male bract shape	Male bract lifting	Bract behaviour before lifting	Wax on the bract
SANNA CHENKADALI	Young bract slightly overlapped	Red purple	Red purple	Colour discontinuing towards the end	Intermediate	Lifting one at a time	Revolute	Few wax present
RED JAISARA	Young bract slightly overlapped	Purple brown	Dark purple brown	Colour fades	Intermediate	Lifting one at a time	Revolute	Few wax
RASAKADALI	Young bract slightly overlapped	Purple brown	Dark purple brown	Colour Discontinuing	Intermediate	Lifting one at a time	Revolute	Wax present
CHARA PADATHY	Young bract slightly overlapped	Pink purple	Dark pink purple	Colour discontinuing towards the end	Intermediate	Lifting one at a time	Revolute	Wax present
KALIGALI	Young bract slightly overlap	Red purple	Dark purple red	Colour discontinuing towards the end	Intermediate	Lifting one at a time	Revolute	Few wax present
VANNAN	Young bract slightly overlap	Light purple	Pink purple	Colour discontinuing towards the end	Intermediate	Lifting one at a time	Revolute	No sign of wax

Table.22 Comparison of characters of Musa cultivars (17).

Name	Bract imbrication	Colour of the bract		Bract				
		Internal face	External face	Fading colour on bract base	Male bract shape	Male bract lifting	Bract behaviour before lifting	Wax on the bract
PETIT NAINE	Young bract slightly overlap	Pink red	Dark pink purple	Colour discontinuing towards the base	Intermediate	Lifting one at a time	Revolute	Very little wax
LADIES FINGER	Young bract slightly overlap	Red purple	Dark purple brown	Colour discontinuing towards the end	Intermediate	Lifting 2 at a time	Revolute	Very little wax
NAVARAL	Young bract slightly overlap	Dark red purple	Dark purple	Colour discontinuing towards base	Intermediate	Lifting one at a time	Revolute	Few wax present
MALAVAZHA	Young bract slightly overlap	Light pink	Pink purple	Colour discontinuing	Intermediate	Lifting one at a time	Revolute	Few wax present
KALYAN BALE	Young bract slightly overlap	Dark pink purple	Dark pink purple	Colour discontinuing	Intermediate	Lifting one at a time	Revolute	Few wax present
PEDDA PACHA	Young bract slightly overlap	Light purple	Dark purple brown	Colour discontinuing	Intermediate	Lifting one at a time	Revolute	Wax present

Table.23 Comparison of characters of Musa cultivars (18).

Name	Bract imbrication	Colour of the bract		Bract				
		Internal face	External face	Fading colour on bract base	Male bract shape	Male bract lifting	Bract behaviour before lifting	Wax on the bract
SIKUZANI	Young bract slightly overlap	Light red yellow	Purple brown	Colour homogenous	Lanceolate	Lifting one at a time	Revolute	Few way
PISANG JARIBUAYA	Young bract slightly overlap	Red	Pink purple	Colour homogenous	Lanceolate	Lifting one at a time	Revolute	Very waxy
PACHANADAN	Young bract slightly overlap	Yellowish towards base	Bluish towards edges	Colour discontinuing towards base	Intermediate	Lifting one at a time	Revolute	Few wax present
LACATAN	Young bract slightly overlapped	Purple brown	Purple brown	Colour discontinued towards base	Intermediate	Lifting one at a time	Revolute	Very few wax
KUNNAN	Young bract slightly overlap	Red	Pink purple	Colour homogenous	Lanceolate	Lifting one at a time	Revolution seen	Very waxy
KULLAN	Young bracts slightly overlap	Orange red	Purple brown	Colour homogenous	Intermediate	Lifting one at a time	Revolute	Few wax
KRISHNAVAZHA	Young bract slightly overlap	Orange red	Purple brown	Colour homogenous	Intermediate	Lifting one at a time	Revolute	Very few wax

Table.24 Comparison of characters of Musa cultivars (19).

Name	Bract imbrication	Colour of the bract		Bract				
		Internal face	External face	Fading colour on bract base	Male bract shape	Male bract lifting	Bract behaviour before lifting	Wax on the bract
HIGH GATE	Young bract slightly overlap	Purple brown	Light purple brown	Colour discontinuing towards the base	Intermediate	Lifting one at a time	Revolution	Waxy
DUDHSAGAR	Young bract slightly overlap	Red	Bluish purple	Colour homogenous	Lanceolate	Lifting one at a time	Revolute	Very waxy
PISANG LILIN	Young bracts slightly overlap	Orange red	Dark purple pink	Colour discontinuing towards base	Lanceolate	Lifting one at a time	Revolute	Few wax
YANGAMBI	Yong bract slightly overlap	Light purple brown	Pink purple	Colour discontinuing towards base	Intermediate	Lifting one at a time	Revolute	No wax
THIRUVANANTHAPURAM	Young bract slightly overlap	Red	Pink purple	Colour discontinuing towards base	Intermediate	Lifting one at a time	Revolute	Few wax
CHAKKARAKAELI	Young bract slightly overlap	Light purple brown	Pink purple	Colour discontinuing towards base	Intermediate	Lifting one at a time	Revolute	Few wax

Table.25 Comparison of characters of Musa cultivars (20).

Name	Male flower behaviour	Compound tepal basic colour	Compound tepal pigmentation	Lobe colour of compound tepal	Free tepal appearance	Free tepal apex development
SANNA CHENKADALI	Falling after the bract	Cream	No pigmentation	Cream	Simple folding under the Apex	Developed
RED JAISARA	Falling with the bract	Pink red	No pigmentation	Pink red	Simple folding under the apex	Developed
RASAKADALI	Falling after the bract	Pink	No pigmentation	Pink	Simple folding under the apex	Developed
CHARA PADATHY	Falling with the bract	Pink cream	No pigmentation	Pink cream	Simple folding under the apex	Developed
KALAIGALI	Falling after the bract	Light yellow	No pigmentation	Light yellow	Simple folding under the apex	Developed
VANNAN	Falling with the bract	Light yellow	No pigmentation	Bright yellow	Simple folding under the apex	Development seen
PETIT NAINE	Falling after the bract	Cream	No pigmentation	Bright yellow	Simple folding under the apex	Developed
LADIES FINGER	Falling after bract	Cream	No pigmentation	Light yellow	Folding under the apex	Developed
NAVARAL	Falling with bract	Cream	No pigmentation	Bright yellow with pink shade	Simple folding under the apex	Developed
MALAVAZHA	Falling after bract	Light pink	No visible pigmentation	Light pink	Simple folding under the apex	Developed
KALYAN BALE	Falling with the bract	Cream	No pigmentation	Light yellow	Simple folding under apex	Development present
PEDDA PACHA	Falling before the bract	Cream	No pigmentation	Light yellow	Simple folding under apex	Developed

Table.26 Comparison of characters of Musa cultivars (21).

Name	Male flower behaviour	Compound tepal basic colour	Compound tepal pigmentation	Lobe colour of compound tepal	Free tepal appearance	Free tepal apex development
SIKUZANI	Falling with the bract	Cream	No pigmentation	Light yellow	Several folding under apex	Developed triangular
PISANG JARIBUAYA	Falling before the bract	Cream	No pigmentation	Yellow	Simple folding under apex	Developed triangular
PACHANADAN	Falling with bract	Cream	No pigmentation	Yellow	Rectangular	Developed
LACATAN	Falling before bract	Cream	No pigmentation	Yellow	Several folding under apex	Very developed
KUNNAN	Falling after the bract	Cream	No pigmentation	Yellow	Simple folding under apex	Developed triangular
KULLAN	Falling after the bract	Cream	Some pink pigments present	Yellow	Simple folding under apex	Development seen
KRISHNAVAZHA	Falling before the bract	Cream	No pigmentation	Yellow	Several folding under apex	Developed
HIGH GATE	Falling after the bract	Cream	No pigmentation	Yellow	Several folding under apex	Developed
DUDHSAGAR	Falling with bract	Light yellow	No pigmentation	Bright yellow	Mote Or less smooth	Developed
PISANG LILIN	Falling after the bract	Cream	No visible sign of pigmentation	Bright yellow	Simple folding under apex	Developed
YANGAMBI	Falling after the bract	Light yellow	No pigmentation	Very developed	Simple folding under apex	Developed
THIRUVANANTHAPURAM	Falling with the bract	Light yellow	No pigmentation	Bright yellow	Simple folding under apex	Developing
CHAKKARAKAELI	Falling after the bract	Light yellow	No pigmentation	Yellow	Simple folding under apex	Triangular

Table.27 Comparison of characters of Musa cultivars (22).

Name	Anther excertion	Stigma colour	Pollen sac colour	Style basic colour	Style exertion	Style shape
SANNA CHENKADALI	Exerted	Light yellow	Cream	Cream	Same level	Slightly curved
RED JAISARA	Same level	Light cream	Cream	Pink cream	Same level	Straight
RASAKADALI	Same level	Pink cream	Pink cream	Pink cream	Same level	Straight
CHARA PADATHY	Inserted	Light yellow	Light yellow	Pink cream	Slightly higher	Curved
KALIGALI	Inserted	Cream	Cream	Cream	Same level	Slightly curved
VANNAN	Same level	Bright yellow	Light cream	Cream	Same level	Straight
PETIT NAINE	Inserted	Yellow	Cream	Cream	Inserted	Straight
LADIES FINGER	Same level	Yellow	Cream with pink shade	Cream	Excerted	Straight
NAVARAL	Same level	Yellow	Cream with pink shade	Cream	Same level	Straight
MALAVAZHA	Same level	Yellow	Cream	Cream	Same level	Straight
KALYAN BALE	Same level	Yellow	Cream	White	Inserted	Straight
PEDDA PACHA	Inserted	Light yellow	Cream	White	Same level	Straight
SIKUZANI	Excerted	Bright yellow	Brown rusty	White	Same level	Curved at the base
PISANG JARIBUAYA	Excerted	Cream	Light cream yellow	White	Excerted	Curved under stigma
PACHANADAN	Same level	Yellow	Light pink brown	Cream	Exserted	Straight
LACATAN	Excerted	Bright yellow	Cream	White	Inserted	Straight
KUNNAN	Excerted	Grey	Cream	White	Exserted	Straight

Table.28 Comparison of characters of Musa cultivars (23).

Name	Anther Exserstion	Stigma colour	Pollen sac colour	Style basic colour	Style exertion	Style shape
KULLAN	Same level	Bright yellow	Purple	White	Inserted	Straight
KRISHNAVAZHA	Same level	Bright yellow	Cream	Cream	Same level	Curved at the base
HIGH GATE	Inserted	White	Light pink	Cream	Same level	Straight
DUDHSAGAR	Inserted	Cream	Beige pink	Cream	Inserted	Straight
PISANG LILIN	Same level	Bright yellow	Cream	White	Excerted	Straight
YANGAMBI	Same level	Bright yellow	Light pink	White	Same level	Straight
THIRUVANANTHAPURAM	Same level	Yellow	Pink	White	Excerted	Curved at the base
CHAKKARAKAELI	Same level	Orange yellow	Light pink	White	Same level	Straight

Table.29 Comparison of characters of Musa cultivars (24).

Name	Ovary shape	Ovary colour	Ovary pigmentation	Dominant colour of male flower	Arrangement of ovule
SANNA CHENKADALI	Arched	Cream	No pigmentation	Cream	Two rowed
RED JAISARA	Arched	Cream	No pigmentation	Cream	Two rowed
RASAKADALI	Arched	Cream	No pigmentation	Pink cream	Two rowed
CHARA PADATHY	Arched	Pink cream	No pigmentation	Pink cream	Two rowed
KALIGALI	Arched	Pink cream	No pigmentation	Light yellow	Two rowed
VANNAN	Arched	Light yellow cream	No pigmentation	Light yellow	Two rowed
PETIT NAINE	Arched	Cream	No pigmentation	Cream	Two rowed
LADIES FINGER	Arched	Cream	No pigmentation	Cream	Two rowed
NAVARAL	Arched	Cream	No pigmentation	Cream	Two rowed
MALAVAZHA	Arched	Cream	No pigmentation	Cream	Two rowed
KALYAN BALE	Arched	Cream	No pigmentation	Cream	Two rowed
PEDDA PACHA	Arched	Cream	No pigmentation	Cream	Two rowed
SIKUZAN	Arched	Light green	No pigmentation	Cream	Two rowed

Table.30 Comparison of characters of Musa cultivars (25).

Name	Ovary shape	Ovary colour	Ovary pigmentation	Dominant colour of male flower	Arrangement of ovule
PISANG JARIBUAYA	Arched	Cream	No pigmentation	Cream	Two rowed
PACHANADAN	Arched	Yellow	No pigmentation	Cream	Two rowed
LACATAN	Straight	Cream	No pigmentation	Cream	Two rowed
KUNNAN	Straight	White	Some purple pigments present	Cream	Two rowed
KULLAN	Arched	Cream	No pigmentation	Cream	Two rowed
KRISHNAVAZHA	Arched	Cream	No pigmentation	White cream	Two rowed
HIGH GATE	Arched	Cream	No pigmentation	Cream	Two rowed
DUDHSAGAR	Arched	Cream	No pigmentation	Cream	Two rowed
PISANG LILIN	Arched	Watery green	Without pigmentation	Cream	Two rowed
YANGAMBI	Arched	Light yellow	No pigmentation	Light yellow	Two rowed
THIRUVANANTHAPURAM	Arched	Watery green	No pigmentation	Light yellow	Two rowed
CHAKKARAKAELI	Arched	Cream	No pigmentation	Light yellow	Two rowed

Table.31 Comparison of characters of Musa cultivars (26).

Name	Fruit position	Number of fruit	Fruit length (cm)	Fruit shape	Fruit apex	Remains of flower reflects on fruit apex
SANNA CHENKADALI	Curved towards the stalk	14	9	Cylindrical	Bottle neck	Few remains of style
RED JAISARA	Slightly curved	14	7	Straight at distal part	Bottle neck	Base of style prominent
RASAKADALI	Curved roundly	12	7	Curved	Bottle neck	Persistent style
CHARA PADATHY	Slightly perpendicular	14	10	Slightly perpendicular	Lengthy pointed	Persistent style
KALIGALI	Perpendicular	12	7	Slightly curved	Bottle neck	Few remains seen
VANNAN	Curved towards the stalk	12	8.5	Slightly curved	Bottle neck	Persistent style
PETIT NAINE	Curved towards the stalk	14	8	Perpendicular	Bottle neck	Base of style prominent
LADIES FINGER	Perpendicular towards stalk	12	8	Straight	Blunt tipped	Base of style prominent
NAVARAL	Straight	18	11.6	Straight	Blunt tipped	Persistent
MALAVAZHA	Straight	12	6.3	Straight	Blunt tipped	Without any floral remains
KALYAN BALE	Curved towards stalk	16	8.2	Slightly curved	Bottle neck	Base of style prominent
PEDDA PACH	Curved towards stalk	16	6	Curved	Bottle neck	Persistent style
SIKUZANI	Perpendicular towards stalk	14	10.1	Straight at distal part	Bottle neck	Persistent style

Table.32 Comparison of characters of Musa cultivars (27).

Name	Fruit position	Number of fruit	Fruit length (cm)	Fruit shape	Fruit apex	Remains of flower reflects on fruit apex
PISANG JARIBUAYA	Curved upwards stalk	14	9.4	Straight at distal part	Lengthy pointed	Persistent style
PACHANADAN	Curved towards stalk	12	8	Slightly curved	Blunt tipped	Without floral reflects
LACATAN	Curved upwards	14	9	Straight at distal part	Bottles neck	Persistent style
KUNNAN	Curved upwards towards stalk	12	8	Slightly curved	Bottle neck	Base of style pigments
KULLAN	Curved towards stalk	12	9.6	Slightly curved	Blunt tipped	With floral reflicts
KRISHNAVAZHA	Curved towards stalk	14	11.7	Slightly curved	Slightly pointed bottle neck	Base of style prominent
HIGH GATE	Curved upwards	16	14	Slightly curved	Bottle neck	Base of style prominent
DUDHSAGAR	Curved upwards	16	12	Slightly curved	Bottle neck	Base of style prominent
PISANG LILIN	Perpendicular to the stalk	12	11	Straight in the distal part	Lengthy pointed	Without any floral reflect
YANGAMBI	Curved towards stalk	16	7.9	Curved	Bottle-neck	Persistent style
THIRUVANANTHAPURAM	Curved upwards	12	8.9	Slightly curved	Bottle neck	Base of the style prominent
CHAKKARAKAELI	Curved towards stalk	14	8	Curved	Blunt tipped	Persistent style

Table.33 Comparison of characters of Musa cultivars (28).

Name	Immature fruit peel colour	Mature fruit peel colour	Pulp in the fruit	Pulp colour before maturity	Pulp colour at maturity	Flesh texture	Predominant taste
SANNA CHENKADALI	Red green	Red	With pulp	Cream	Light yellow	Very soft	Sugary
RED JAISARA	Green	Yellow	With pulp	Cream	Cream	Soft	Sweet
RASAKADALI	Green	Yellow	With pulp	Cream	Light yellow	Soft	Sweet
CHARA PADATHY	Green	Dull dark green	With pulp	White	Cream	Firm	Very sweetie
KALIGALI	Green	Dull dark green	With pulp	White	White	Soft	Sweet
VANNAN	Light yellowish green	Yellow	With pulp	Cream	Light yellow cream	Soft	Sweet
PETIT NAINE	Green	Tinned with green	With pulp	Cream	Light yellow	Soft	Sugary
LADIES FINGER	Light green	Tinned with green	Pulp present	Cream	Light yellow	Firm	Sweet
NAVARAL	Medium green	Green	Pulp present	Cream	Cream	Soft	Sweet
MALAVAZHA	Dark green	Yellow	Pulp present	Cream	Light yellow	Soft	Sweet
KALYAN BALE	Green	Yellow	Pulp present	Cream	Yellowish cream	Firm	Sweet
PEDDA PACHA	Light green	Tinned with yellow	Pulp present	Cream	Yellow	Soft	Sweet
SIKUZAN	Light green	Bright yellow	With pulp	Light yellow	Light yellow	Soft	Sweet
PISANG JARIBUAYA	Light green	Yellow	With pulp	White	Cream	Firm	Very sweetie
PACHANADAN	Medium green	Yellow	With pulp	Cream	Cream	Firm	Slightly sweet

Table.34 Comparison of characters of Musa cultivars (29).

Name	Immature fruit peel colour	Mature fruit peel colour	Pulp in the fruit	Pulp colour before maturity	Pulp colour at maturity	Flesh texture	Predominant taste
LACATAN	Green yellow	Yellow	With pulp	Cream	Cream	Firm	Sweet
KUNNAN	Medium green	Yellow	With pulp	Cream	Light yellow	Firm	Sweet
KULLAN	Light green	Yellow	With pulp	White	Cream	Firm	Slightly sweet
KRISHNAVAZHA	Medium green	Yellow	With pulp	White	Cream	Soft	Very sweet
HIGH GATE	Light green	Yellow	With pulp	White	Cream	Soft	Sugary
DUDHSAGAR	Green	Bright yellow	With pulp	Cream	Cream	Soft	Sweet
PISANG LILIN	Medium green	Green	With pulp	Cream	Cream	Soft	Sweet
YANGAMBI	Light yellowish green	Yellow	With pulp	Cream	Cream	Firm	Sweet
THIRUVANANTHAPURAM	Medium green	Bright yellow	With pulp	Yellowish cream	Light orange yellow	Firm	Sweet
CHAKKARAKAELI	Light green	Yellow	With pulp	Yellowish cream	Light yellow	Soft	Sweet

Table.35 Proximate analysis fruit and peel of Musa varieties (J1, J2, J3, J4) in Kerala.

Sample	Moisture (%)	Crude protein (%)	Crude fibre (%)	Ether extract (%)	Total ash (%)	Gross energy (kcal/kg)
Poovan flower (PF)	9.51 ± 0.34	13.52 ± 0.32	19.26 ± 0.28	5.23 ± 0.11	11.02 ± 0.24	3687 ± 121
Etha flower (EF)	9.56 ± 0.22	13.09 ± 0.27	14.95 ± 0.21	5.05 ± 0.34	9.53 ± 0.34	3725 ± 58
Palayamkodan flower (PaF)	9.22 ± 0.18	14.37 ± 23	25.55 ± 0.86	4.99 ± 0.22	11.78 ± 0.18	3669 ± 89
Najalipoovan flower (NF)	8.75 ± 0.37	13.51 ± 0.35	12.53 ± 0.29	5.22 ± 0.32	9.05 ± 0.21	3795 ± 54

J1; Poovan, J2; Etha, J3; Palayamkodan, J4; Najalipoovan
PF; Poovan flower, EF; Etha flower, PaF; Palayamkodan flower, NF; Najalipoovan flower;
Numbers represent means ± one standard error (SE) of the mean

Table.36 Proximate analysis fruit and peel of Musa varieties (J1, J2, J3, J4) in Kerala.

Sample	Moisture content (%)	Organic matter* (g)	Organic carbon* (g)	Crude ash* (g)	Acid insoluble ash* (g)	Acid soluble ash* (g)
Poovan flower (PF)	7.54 ± 0.34	2.14 ± 0.38	1.20 ± 0.28	0.86 ± 0.12	0.09 ± 0.22	0.75 ± 0.08
Etha flower (EF)	5.55 ± 0.29	2.23 ± 0.21	1.25 ± 0.21	0.77 ± 0.31	0.09 ± 0.11	0.68 ± 0.18
Palayamkodan flower (PaF)	5.19 ± 0.22	2.14 ± 0.27	1.20 ± 0.20	0.86 ± 0.12	0.24 ± 0.04	0.62 ± 0.05
Najalipoovan flower (NF)	8.56 ± 0.12	2.21 ± 0.15	1.24 ± 0.46	0.79 ± 0.11	0.14 ± 0.12	0.65 ± 0.09

* Amount obtained for 3 g of dried plant samples
J1; Poovan, J2; Etha, J3; Palayamkodan, J4; Najalipoovan
PF; Poovan flower, EF; Etha flower, PaF; Palayamkodan flower, NF; Najalipoovan flower;
Numbers represent means ± one standard error (SE) of the mean

In conclusion, the research work is concluded that the banana variety in Kerala have different morphological character in terms of size, shape, appearance and external features. The difference were quite noticeable and easily been identified. The male flower of selected varieties have difference in terms of nutritional properties. It is studied through the proximate analysis of the flower varieties, which shows difference in the nutritional constituents. From the analysis it is studied that the Palayamkudan variety is most popular and nutritionally rich while compared to other varieties. But this varieties are not much widely used. The popularity and acceptance of the banana vary among people. And the acceptance not only depending in the nutritional constituents but also the quantity that produce.

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