Genetic Diversity Studies of the Mango population in Kirigavalu village of Malavalli Taluq –Mandya district

Submitted From,

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Mango is the main fruit of Asia and this fruit has developed its own importance all over the world. Being an useful and delicious fruit, it was the part of culture and religion since long time. Besides of its being of fine taste and good qualities, it is called as the **king of the fruits.** Mango (Mangifera indica) is the natural fruit of India and since long it is the choicest fruit in India and abroad. This fruit has been in cultivation in India sub-continent for well over 4000 years and has been the favourite of the kings and commonners because of its nutritive value, taste, attractive fragrance and health promoting qualities and now it is recognized as one of the best fruits in the world market.

Mango has its different name in different countries:
In Nepal, it called as Ango; in Sri Lanka - Amba, ambi, Kaddum and Watamba; in Burma - Tharet, Taw, Tharet; in Siam-Mamong; in Vietnam Cay Xoai; in Cambodia - Soai, In Malaysia-Manga, Mangga, Mampalam and Pauh; in Indonesia - Ampalam, Manga, Maplane, Mapoolane Booah Bibe, Manilja and Pager; in Philippines-Mampalam, Mangka and Pao; in Formosa-Jap; in China - Anlokuo and Mongkwo; in Persia - Amba and Ambeh; in Turkey - Manguag; in Arabia - Abning; in Africa - Manora, Mango, Mano, Mangga and Mangueira; in French - Mangier, Manguier and Loubi; in German-Mangga, muembe; in Brazil - Mangaiba; in Dutch - manja in English - Mango and in India Aam.

Karnataka owes much of its position as one of top ranking horticultural states in the country to the initiations taken by Tipu Sultan who sent missions abroad to

collect seeds of flowers,fruits and vegetables during the latters 18 year rule (1782-1799).Tippu Sultan is one of the earliest champions of land reformers and donated cultivable land in addition to regular payment. Land seized from Palegars was handed over to farmers, tenants and bonded labourers.Historical evidence reveals in 1799 immediately after the death of Tipu Sultan the British asked Francis Buchanan to survey south India who wrote a book " A journey from Madras through the countries of Mysore,Canara and Malabar (1807)." This book gives an interesting account of horticultural fields called Thota as existing during Tipu regime and one such is the fruit orchard of Malavalli (which no longer exists today) had 2400 trees with mangoes and oranges in abundance. It was made mandatory for the village patels to plant avenue trees on either sides of roads throughout his kingdom. But the interesting aspect is that Tipu ordered planting of Mangoes and Tamarind trees among other trees which reveals that preference was given to useful trees over ornamental or just shade giving tree. He imported plants from Delhi, Multan,Lahore and Arcot for laying out a garden at Malavalli and another fruit garden at Srirangapatna called LalBagh. Tipu Sultans love for horticulture was so great that he linked this with dispensation of justice . For petty offences convicts had to plant fast growing plants and for major offences they had to plant trees like Jamun, Mango and coconut.In 1788 Tipu Sultan issued a circular to all amildars and in 1792 he passed a regulation that the fine to farmers shall be commutted if the offender plants two trees,waters them and nurtures them till they reach a certain height. No wonder Tippu Sultan was one of the best environmentalist among the kings gone by, long before environment and climate change became fashionable slogans.

The fact that the mango orchard in Kirugavulu village of Malavalli taluq owned by a farmer Mr.Syed Ghani is a gift by Tipu Sultan and having 120 varieties of

mangoes has become the cynosure of every mans eye.The farmer having preserved the varieties for more than 100 years is a site that needs to be investigated not only for its rich diversity but to explore its legend to the late Tipu Sultan.The fruit orchard could be a part of the thota having 2400 trees of mangoes and oranges as mentioned by Francis Buchanan in his book mentioned earlier.There are trees whose fruits tasted and smelt like citrus.The trees could be a product of natural hybridization between mango and citrus groups. But it is remotely so. Introduction of Indian commercial mango varieties and a high rate of logging of old mango trees are major threats to maintainance of mango genetic resources.Important traits like their ability to grow in marginal and drought areas adaptation to high altitude , high rate of fruit setting, fruiting in off – season, special aroma and fibreless pulp are some of the characteristics that is being investigated in the orchard. In recent years the habitats of local mangoes such as villages in communal land or along pilgrim trail have been affected by various factors and their exhistence is threatened by genetic erosion

In order to strengthen the scientific basis on in situ conservation of agricultural biodiversity on farm the KBDB has sanctioned a project to the University Of Agricultural Sciences ,GKVK ,Bangalore in 2012.The project has initiated characterization and evaluation of the mango population in Kirigavulu village and the results presented here under is the final report of the same fulfilling the following objectives.

I . Objectives

a) Determining the age of some of the oldest trees.
b) Characterization and evaluation of the mango population.
c) Estimation of the genetic diversity of the mango population

II.Project Details

a) Project was sanctioned in 20/02/2012

b)Project was implemented in 17/04/2012

c)Duration of the project: is one year to begin with

d)Total grants provided :

II. Investing team

a)Principle Investigator : Dr.R.Nandini ,Asst Professor (Genetics and Plant Breeding) U.A.S,Bangalore

b)Project Assistant : Mr.Chandra shekar G.N/Miss Rajini S.B

III.Historical Background of the Mangifera Indica

a) Nomencleature:

The genus *Mangifera* belongs to the order Sapindales in the family Anacardiaceae which is a family of mainly tropical species with 73 genera . The other distant relatives of *Mangifera* are cashew (*Anacardium occidentale*), gandaria (*Bouea gandaria*), pistachio (*Pistacia vera*), marula (*Sclerocarya birrea*), ambarella (*Spondias cytherea*), yellow mombin (*Spondias mombin*), red mombin (*Spondias purpurea*), imbu (*Spondias tuberosa*) , dragon plums *(Dracontomelum* spp.*)*

.Malaysia has been considered as the phytogeographic region extending from the Malay peninsula south of the Kangar-Pattani line to the Bismarck archipelago east of New Guinea (Whitmore, 1975). Apart from edible fruit Anacardiaceous species also yield other valuable products like wood, gums and resins, wax and varnishes and tanning materials. It is also a family well known for the dermal irritation produced by some of its members, including some *Mangifera* spp. whose resinous sap may induce allergic reaction.

The genus *Mangifera* consists of 69 species and mostly restricted to tropical Asia. The highest diversity occurs in Malaysia, particularly in peninsular Malaya, Borneo and Sumatra representing heart of the distribution range of the genus. The natural occurrence of all the *Mangifera* species extends as far north as 27^{o} latitude and as far east as the Caroline Islands (Bompard and Schnell, 1997). Wild mangoes occur in India, Sri Lanka, Bangladesh, Myanmar, Sikkim, Thailand, Kampuchea, Vietnam, Laos, southern China, Malaysia, Singapore, Indonesia, Brunei, the Philippines, Papua New Guinea, and the Solomon and Caroline Islands. Maximum species diversity exists in western Malaysia and about 28 species are found in this region. *Mangifera* species are mostly distributed below 300 m but can occur at 600-1900 m above sea level. The species is found as scattered individuals in tropical lowland rain forests on well-drained soils.

b)Origin

Historical and philological facts bear that M. Indica has been introduced to the archipilogic regions of India from the mainland. Mango is known to be grown in older days as early as 327 AD. It is said that Emperor Sikandar when attacked India, stayed in a Mango Garden. The other persons who praised mango were the travellers, Hwen'Sang, Ibnahoukul (902-968 AD), Ibnabatoota (1325-1349AD) and Leudo Visde Varthma (1503-1508 AD) .

Mango is said to have originated in the Indo-Burma region . On the basis of the presence of maximum number of allied species growing in Malaysia, some workers believe that Malaysian region is the original home of Mango, as about 20 species are grown there. Mango is undoubtedly under cultivation for more than 4000 years in eastern India & Burma (Decandolle, 1904).

Hwen 'Sang, a Chinese traveler who visited India between 632-645AD, was the first person to take mango to the outside world. Early in fifteenth century, Spanish voyagers, Muslim missionaries and Portugese carried mango to South East Asia and Philippines. In the beginning of sixteenth century Portugese introduced mango from Goa into South Africa and from Bombay to Egypt in 1825. In 1889, USDA introduced grafted Mulgoba Variety from India into Florida.

c) Area ,Production And Productivity-Growth pattern

The Indian position

The production scenario of different fruits in India indicates that all the fruits occupied 3.788 million ha area with a production of 45.203 million tonnes. The total allocation to the fruits in the country has in fact declined from 4.01 mill ha during the previous year, while the total production of fruits has increased over and above 43.001 mill. tonnes in the previous year. Mango was the most important crop occupying **42.84** per cent of the total area under the fruits however, it accounted for only **28.17** per cent of the total production of fruits. Mango productivity depicts increase from 6.4 to 7.8 tonnes per ha during 2001-02 and 2002-03. Next important fruit crops were Citrus fruits and banana. Even guava, which ranked fifth in terms of area by accounting for 4.09 per cent of the total area under fruits, had higher productivity (11.06 tonnes per ha) than mango.

The Karnataka position

Karnataka and Andhra Pradesh are striving to increase their share in export by diversifying the export basket. Highest productivity of mango, i.e. 9.6 and 9.8 MT per ha during 2000-01 and 2001-02, respectively, was reported from Karnataka.

Mango varieties suited to the season of April-July are Banganpalli, Totapuri, Neelum, Alphonso, Pairi and Mallika.

Concentrated pockets of mango in Karnataka are Kolar, Bangalore,Chitradurga, Mysore,Mandya and Chickamagalur.

IV. Materials and methods

1) Enumeration of the population at site

A total of 116 plants were enumerated and labelled and accordingly the trees were classified into 3 categories

a)	Old Trees	17
b)	Middle aged Trees	85
c)	Young Trees	14
	Total	**116**

2) Age Determination :

Wood Samples from the core of the steelar region of the trunk of trees **No-28,80,93,99,110** were collected and sent to the below mentioned institute for analysis and determination of the age :

Birbal Sahany Institute of Paleo Botany,Lucknow to determine the age through "Liquid Scintillating counting"(LSC) technique and

3)<u>The following were the observartions recorded</u>:

a) Type of trunk- i) Mono trunk
ii) Double trunk
iii) Triple trunk
iv) Multiple trunk
v) Wedged trunk

b) Crown shape-i) Circle shape
ii) Semi circle shape
iii) Irregular shape
iv) Cone shape

c) Phenological characters recorded at vegetative phase:

1) Leaf type- i) Alternate
ii) Simple

2) Leaf margin- i).Undulate
ii).Entire

3) Leaf Shape- i) Lanoceolate
ii) Oblong
iii) Linear
iv) Oval
v) Obovate

4) Matured Leaf colour- i) Dark Green
ii) Green

iii) Pale green

5) Young leaf colour- i) Light green
iii) Light green with brown tinge
iv) Reddish brown
v) Deep coppery tan

6) Leaf length (inches)

7) Leaf width (inches)

d) Phenological characters at Reproductive phase

Observations recorded on flower characteristics:

1) Colour of Inflorescence- i) Pink
ii)white
iii)Yellow

2) Flower density- i) Sparse
ii) Medium Dense
iii) Dense

3) Date of flowering

e) Observations recorded on fruit parameters

1) Shape of fruit-Oval, Kidney, Egg, Round, Irregular
2) Length of fruit (Cm)
3) Width of fruit-(Cm)
4) Thickness of fruit-(Daimeter- Cm)
5) Volume of fruit-(ml of water displaced)
6) Weight of Raw fruit-(gms)
7) Weight of Ripe fruit-(gms)
8) Colour of skin-Green,Dark Green, Reddish green, Yellow green,

9) Colour pulp-Orange, yellow
10) Taste of pulp-Sour, Mild sweet, Sweet
11) Keeping quality of the fruit(Days)
12) Harvesting date(Days)
13) Ascorbic acid content of fruit (%)

V) RESULTS :

The results of the present investigation have been presented under the following Heads

I. Enumeration of the Mango p[opulation:A total of 116 trees have been recorded and . Out of them 17 belong to the old aged group , 86 are middle aged and 14 are of young aged.

The following are the pictures representing the 17 old aged trees.

Old Aged Trees (17)

Tree No-110 Lale Badam/ IC-569731

Tree No-99 Khadar/ IC-569723

Tree No-93 Tajmahal IC-569788

IC-569679**Tree No-80Madeena**

Tree No-28 Mehdi /IC-569744

Tree No-49 Khanjimiyanpassand

Tree No- 50 Shad

Tree No-56 Rang Raze

Tree No-92 Hydar- IC-569712

IC-569678 **TreeNo-3 Jamal**

Tree No 35 Mithamiyan IC-569745

Tree No-45 Mujahid- IC-569753

Tree No-47 Musareen- IC-569752

Tree No- 61 Mothi--569750

Tree No-81 Abidpuri- IC-569679

Tree No-100 Mosambhi Kaaam IC-569747

Tree No-102 Bebemaa- IC-569693

Middle Aged Trees (86):

Tree No-1 Abid- IC-569678

Tree No-2 Lalpassand- IC-569734

Tree No-4 Kwapassand- IC-569722

Tree No-5 Rassol- IC-569766

Tree No-6 Chotto- IC-569697

Tree No-9 Bharath- IC-569694

Tree No-11 Iman- IC-569714

Tree No-12 Azeez- IC-569687

Tree No-13 K-P- IC-569717

Tree No-14 Riyaz- IC-569769

Tree No-19 Miysa Passand- IC-569746

Tree No-20 Badagolo- IC-569690

Tree No-21 Sogora- IC-569782

Tree No- 23 Kalamalgoba- IC-569720

Tree No-26 KM- IC-569730

Tree No-27 Haleema- IC-569707

Tree No- 30 Kabini- IC-569718

Tree No -31 Baba- IC-569718

Tree No -33 Nargees- IC-569757

Tree No-36 Shakeeb- IC-569778

Tree No-37 Muzu- IC-569754

Tree No-38 Faraz- IC-569701

Tree No – 39 Shereen- IC-569781

Tree No-40 Ameerjan- IC-569682

Tree No-41 Nawaz- IC-569758

Tree No-42 Mahaboob-- IC-569738

Tree No-43 Arshad- IC-569684

Tree No -44 Ameer- IC-569681

Tree No-46 Khanumiyapassand- IC-569726

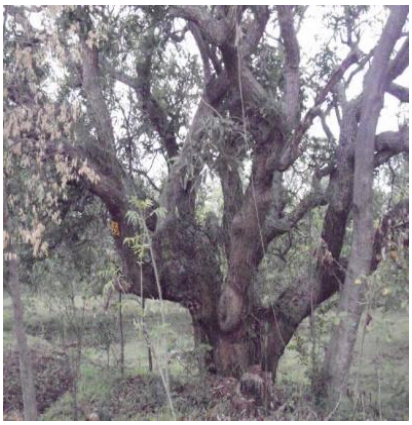
Tree No- 48 Khudmir- IC-569727

Tree No-51 Shafi- IC-569776

Tree No-52 Nikhat- IC-569759

Tree No-54 Nahanamiyanpassand- IC-569756

Tree No-55 Shakar Gudlee- IC-569777



Tree No-57 Shakir- IC-569779

Tree No-58 Syedan passand- IC-569786

Tree No- 62 Anwar- IC-569683

Tree No-63 Dedar- IC-569699

Tree No-64 Hidayath -IC-569711

Tree No-65 Syede- IC-569785

Tree No-66 Khunza- IC-569728

Tree No-68 Attal- IC-569686

Tree No-70 Firdose- IC-569703

Tree No -71 Kaju- IC-569719

Tree No-72 Ameer- IC-569681

Tree No-74 Irfan- IC-569715

Tree No-75 Dari-

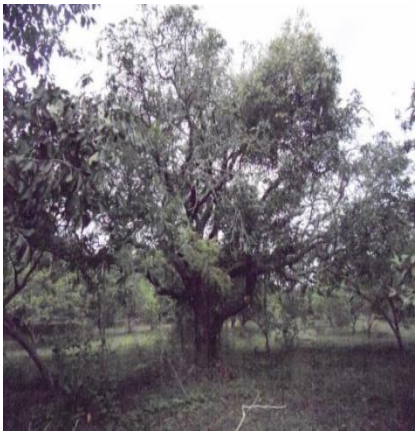
Tree No-76 Badaam- IC-569689

Tree No-77 Imran- IC-569714

Tree No-78 Noor-

Tree No-79 Maka- IC-569739

Tree No-82 Fazal-



Tree No-83 Pheeka aam- IC-569762

Tree No-85 Khanshaibe- IC-569725

Tree No-86 Mysoree- IC-569755

Tree No-88 Mandaviya- IC-569741

Tree No-89 Muhee- IC-569751

Tree No-90 Attaka- IC-569685

Tree No-91 Sultan- IC-569784

Tree No-93 Tajmahal- IC-569788

Tree No-95 Dadabhai passand- IC-569698

Tree No-96 Mangmari- IC-569742

Tree No-98 Manjibi passand- IC-569743

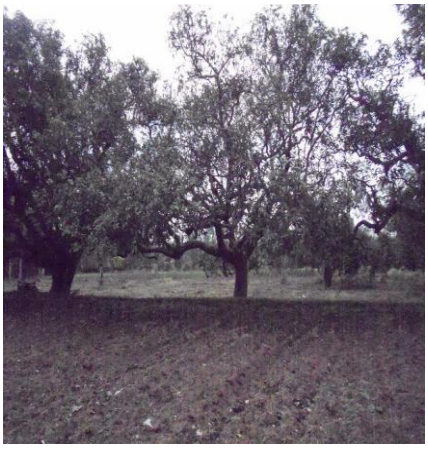
Tree No-101 Tahara- IC-569787

Tree No-105 Jeevan puri- IC-569716

Tree No-107 Hassan- IC-569708

Tree No-108 Rizwan- IC-569771

Tree No-111 Morish Badam- IC-569748



Tree No-112 Farha IC-569702

Tree No-113 Hasumiyanpassand- IC-569709

Tree No-114 Sajeeda- IC-569709

Tree No-115 Banahi passand- IC-569692

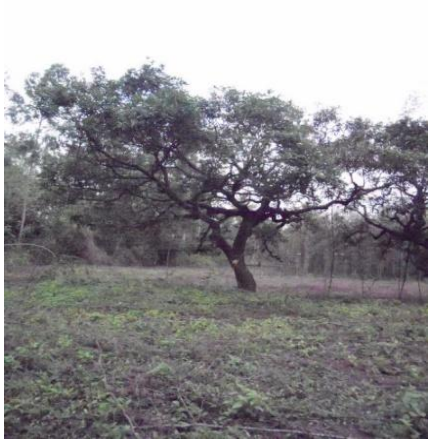
Tree No-116 Lalibi passand- IC-569732

Young Trees(14)

Tree No-10 Sabe ka aam- IC-569773

Tree No-15 Kaleeje- IC-569721

Tree No-18 Heera- IC-569710



Tree No-22 Sangitha- IC-569774

Tree No-24 Devinder- IC-569700

Tree No-32 Almas- IC-569680

Tree No-48 Khudmir- IC-569727

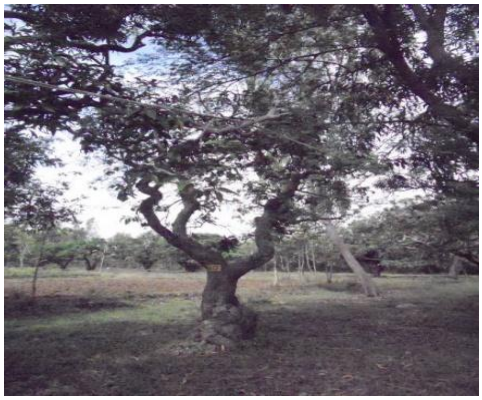
Tree No- 58 Syedan passand- IC-569786

Tree No-59 Rehaman- IC-569768

Tree No-69 Rasheeda- IC-569765

Tree No-70 Firdose- IC-569703

Tree No-60 Nuha- IC-569760



Tree No-84 Chandan- IC-569696

Tree No-97 Khajori- IC-569724

II Determination of the age of the Old Trees:

Wood samples from the core of the steelar region of the trunk of the tree **Nos-110,99,93,28,80** were C-dated and the age of these trees are determined to be around **200± years.**

Tree no-99- Khadar-IC-569723 Tree no-110- Lal Badam-IC-569731

Trees of wood samples sent for C-Dating

Tree samples used for C-dating

Tree no-99- Khadar-IC-569723 **Tree-110-** Lal Badam-IC-569731

III . Phenological characters at vegetative phase:

a)Trunk Characteristics

MonoTrunk

Double Trunk

Triple Trunk

Multiple Trunk

Wedged Trunk

b)Crown characteristics:

Circle Shape

Semi Circle Shape

Irregular Shape

Cone Shape

c. Shape of Leaves:

Laneceolate Linear Oval Obovate Oblong

d).Leaf Colour of mature leaves

Dark green Light Green

e) Leaf colour of young leaves

Deep Coppery tan : Tree no-53- Hajeera-IC-569706

Reddish brown-Tree no 48

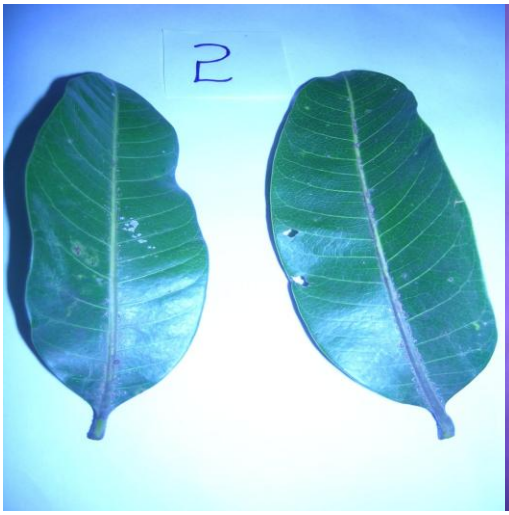
Light green with brown tinge

Light green: Tree no-48- Khudmir-IC-56972

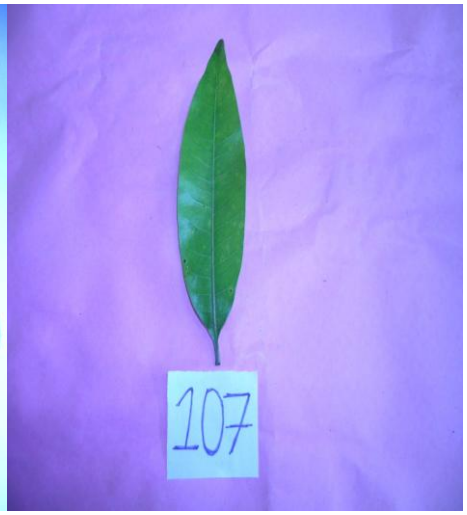
f) Leaf Margins

g) Leaf Texture

Leathery Texture



Waxy Texture



h) Leaf Length

Tree having longest leaf length
Tree No-05- Rasool-IC-569766

Smallest Length
Tree no-18- Heera-IC-569710

i) Leaf width

Tree having highest width
Tree no-80- Madeena-IC-569737

Smallest width
Tree no-18- Heera-IC-569710

III Phenological studies at Reproductive Phase

a) colour of inflorescence:

White

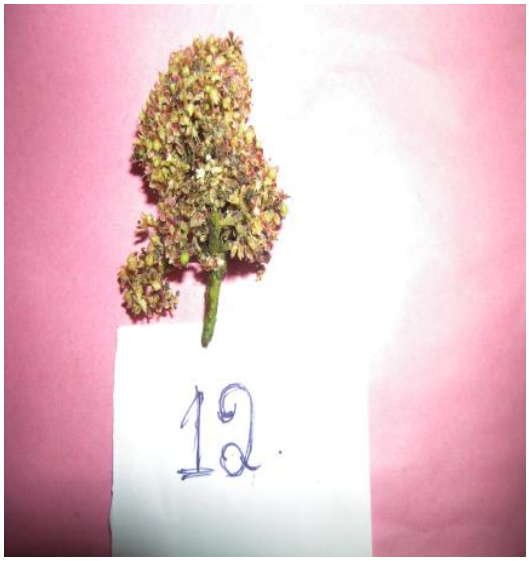
Pink

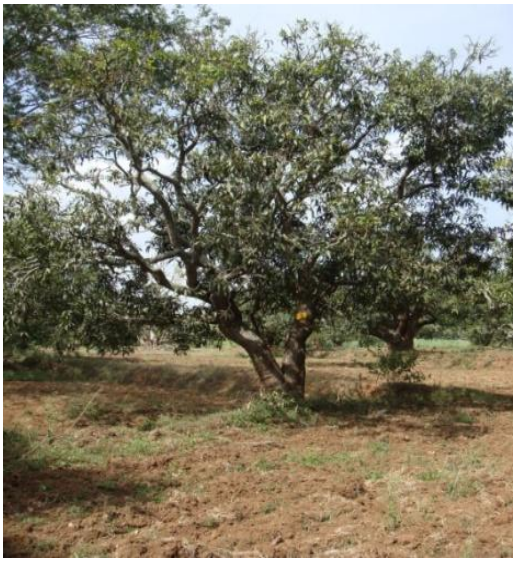
Yellow

Yellow flower colour
Tree no-13- K-P-IC-569717

White flower colour
Tree no-18- Heera-IC-569710

Pink flower colour
Tree no-12



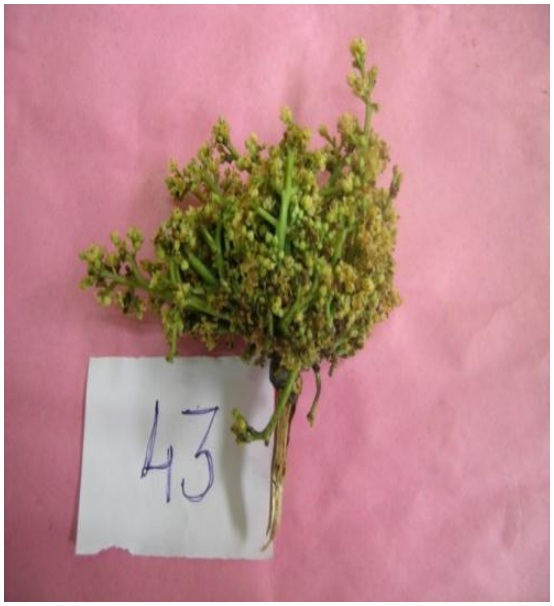


b) Density of florets

Dense Inflorescence with pink rachis **Sparse Inflorescence with green rachis**

Dense flowers:

Tree no-43- Arshad-IC-569684 **Tree no-73- Mosa-IC-569749(whitish pink)**



Sparse Flower
Tree no-41- Nawaz-IC-569758

c) Alternate Bearing Trees

Tree No-14- Riyaz-IC-569769

Tree No-17- Badamothi-IC-569691

Tree No-77- Imran-IC-569714

d)fruit observations:

i) <u>Shape of Fruit</u>

Kidney shape

Oval shape

Egg shape **Round shape**

ii)<u>Length of fruit</u>

1).Longest fruit
Tree no-23- Kalamalgoba-IC-569720

2) Smallest fruit
Tree no-68- Attal-IC-569686

iii)Highest thickness of fruit

Tree no-76- Badaaam-IC-569689

iv) Lowest thickness of fruit

Tree no-88- Mandaviya-IC-569741

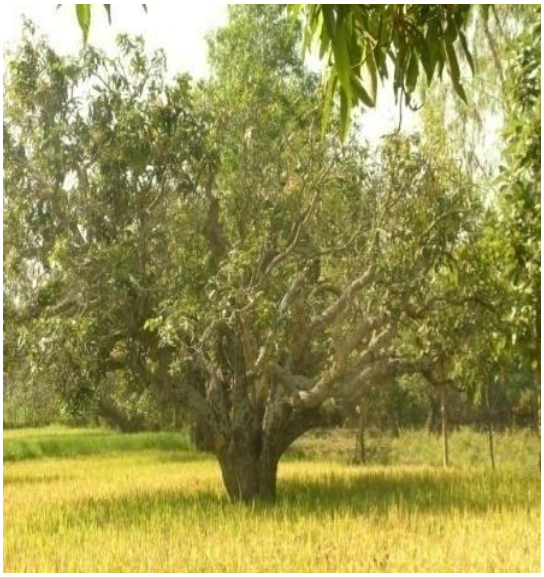
v) <u>Weight of fruit</u>

Heavy weight of fruit
Tree no-76- Badaaam-IC-569689

lowest weight of fruit
Tree no-88- Mandaviya-IC-569741

vi) <u>Fruit Volume</u>

Highest volume of fruit
Tree no-33- Nargis-IC-569757



Lowest volume of the fruit
Tree no-71- Kaju-IC-569719

vii) <u>Ascorbic Acid content</u>

High ascorbic acid
Tree no-100- Mohsam Kaaam-IC-569747

Lowest ascorbic acid
Tree no-96- Mangmari-IC-569742

viii)<u>Taste Of Pulp</u>

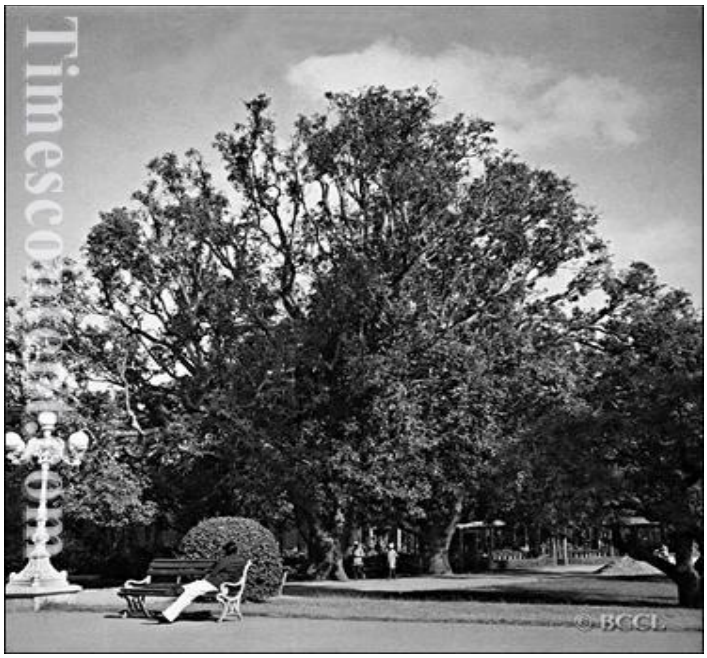
Sweetest pulp
Tree no-5- Rasool-IC-569766

Sour Pulp
Tree no-4- Kawapassand-IC-569722

Mangos prefer a warm, frost-free climate with a well defined winter dry season. Rain and high humidity during flowering and fruit development reduces fruit yields. The tree generally flowers in mid- to late winter, with fruit maturing in the early to mid-summer months. Mango trees are usually between 3 and 10 m (10–33 ft) tall but can reach up to 30 m (100 ft) in some forest situations. The canopy is evergreen with a generally spreading habit. The heavy canopy of the mango is a source of shelter and shade for both animals and humans.

It is evident from the research conducted and the scientific evidence of Carbon dating that the mango trees in the orchard of the Kirigavulu village of Malavalli Taluq ,Mandya district supposed to have

been donated by the Mughal King Tippu Sultan are aged around 200 years which also coincides with the reign of the King. Several literary documents have indicated Tippu Sultan's passion for mango plants.One such example is a tree planted by Tippu Sultan himself in the Botanical gardens of Lal Bagh .



A magnificient mango tree planted by Tippu Sultan himself in the Botanical gardens of LalBagh, Bangalore as seen through the lens of the cameraman on January 1st 1920.

The mango orchard of Kirigavulu village has not only exhibited variability for growth and its related traits, the extent of diversity portrayed by the fruits are even more, may it be qualitative traits like shape, colour,, taste or even quantitative traits like fruit weight and volume .It is interesting to note that the colour of fruits ranged of from green, orange, yellow, Reddish green, but the colour of pulp was either orange or yellow. A wide array of fruit shapes round, oval, kidney and

egg shaped fruits have been observed in the population. Diversity of this population is not just limited to many such qualitative parameters but extends to several quantifiable traits, some of which are discussed here under .Visual assessment of morphological traits assumes importance in characterizing the genotypes in the absence of fruits of trees which are irregular and alternate in bearing .In addition mango being a cross pollinated open pollination could have led to the appearance of new varieties naturally grown in the orchard which need to be characterized

The orchard besides housing several old trees are also a rich source of genetic variability. Most of the mango trees have exhibited flowering during the months of Jan-feb 2013 however some of the trees like IC-569714, IC-569746, IC-569778, IC-569753, IC-569776, IC-569785, IC-569728, IC-569719, IC-569749 and have shown early flowering during the month of December-2012 like IC-569679, IC-569741, IC-569788, IC-569736, IC-569787, IC-569767, IC-569702, IC-569709 . The present day mangoes usually flower during the month of March- April but however most of the genotypes in this mango orchard of Malavalli have flowered 2-3 months earlier to the present day cultivars.

The most commonly observed inflorescence colour was pink (117) some of them were yellow (74) while 23 genotypes exhibited white

colour which is rarely noticed elsewhere. Such a colouration of inflorescence enhances cross pollination and thereby maximum fruit set.

Width of leaf ranged 3 cm to 10 cm in Heera and Jeevan puri, heera had narrow and small leaves. Broadest leaves were noticed in jeeven puri genotype Tahara has leaves measuring and length of 26.5cm making it the longest of all in general same genotypes like tree numbers 10,17,105 have broad and long leaves making them photo synthetically efficient trees.

Fruit length exhibited a range from 5 to 10 cm. IC-569720 (Kalamalgoba) produced longer fruits as compared to Ameer lari (IC-569682) Sageeta (IC-569774) which produced very small sized fruits, fruit weight ranged from 60-325 gms Imran and kalamalagoba produced fruits with maximum weight (3-25 gms) other like badagola, Devindra, Almas, Nargis, Badam, Hidayath, Niolish badam, farhe and Hassan have heavy weight fruits while low fruit weight was noticed in trees Bharath,lalkaimi,K.M, Shaeen, Noor, Kaju, Ameer, Attal, and Ramzan, trees.

Percent ascorbic acid in fruits ranged from 0.42 to 0.88% Genotypes with high ascorbic acid incidently did not exhibit sweet pulp sweetness of fruits were graded as 1(sour) 2(Medium sweet) 3(Very Sweet). Sweet fruit bearing trees were Rasool, Kalizee, cavery, Kabine,

Baba, Raseeda, Irfan, Jeevan pur and Hasumiyapassand. Variety Fazal and Mangamari having 0.42% ascorbic acid content are the most suitable types for pickling types .

In general the keeping quality of fruits ranged from 8-15 days. Genotypes Imam,Azeez,Gulzar,KM,Haleema,Syeda,Ramzan,Irfan and Rehen had the longest shelf life and are preferred for long distance transportation.

Figures 1 indicates the relationship between the 116 accessions by the agglomerative heirarchial clustering dendrogram that was divided into four main branches : C1,C2,C3 and C4.based on the qualitative morphological characters associated with them. The first cluster included 41 accessions, C2 includes 13 accessions ,C3 includes 15 accessions and all the remaining fell into the C4 cluster.Tree no:110 Lale Badam has separated out in the C1 , this accession is said to very broad leaves and thereby photosynthetically efficient tree. And tastes very sour.Figure 2 indicates the relationship between the 116 accessions by the agglomerative heirarchial clustering dendrogram that was divided into two main clusters.Accessions 19 seperated out fromm all the clusters.

Several unique characters like leathery /waxy leaves have been reported which has not been captured elsewhere. Such unique differences enable the breeders to identify the genotypes withmore

simplicity . In this study different leaf shapes that combines the characters of lanceolate, linear, oblong and ovate leaf outlines have been documented and such variations serve as useful descriptors for these accessions.The correlation among descriptor traits has shown several clusters using both the qualitqtive and quantitative parameters.

Salient Features of the study:

1.The orchard comprises of 116 genotypes ,out of which 17 are old trees,85 are middle aged and 14 are younger trees.

2. Oldest trees are aged around 200+ years

3.The trunks were either mono trunked, double trunked, triple trunked multiple trunked or wedged trunks.

4. Accessions had a range of crown shapes varying from oval, circula to irregular shapes

5. Appearance of leathery, waxy and smooth textured leaves.Leathery leaves were noticed in Lal Pasand and waxy leaves were observed in Hassan.

6. Longest leaves were noticed in Rassol and smallest leaves were observed in Heera.

7. Some genotypes produced obovate shaped leaves in Ameer which is not documented elsewhere.

8.Broadest leaves and very narrow and linear leaves.

9.Trees with dense and sparse inflorescence. Accession Mosa produced white and compact inflorescence.

10. The population had both tetramerous and hexamerous flowersw

11. Imran,Riyaz and Badamoti are alternate bearing.

12.Tree no:23 produced longest fruit and tree no:68 produced the smallest sized fruits.

13.Badaam tree invariably produced fruits with heavy weight while Mandaviya produced fruits with less weight.

14. Trees with high ascorbic acid content and small sized ones to be used for pickling purposes and trees that have given the sweetest pulp.

The results presented in this study are particularly important because they represent morphological traits that are available all year round , some of which remain the same even at seedling stage of the mango tree.Although all accessions are not exclusive to each other as some of them are dedundants as they presented only one phenotypic class.Even in the absence of fruit traitsa the genotypes can be distinguished based on the phonological traits at vegetative phase. Nevertheless this study presented significant morphological variation in differentiating the accessions under study.Each of the clusters generated by the dendrogram drawn out of the study pocess varieties that can be

used as parents in breeding efforts.However pest and disease scoring is essential at summarize the most healthiest accessions.The characteristic traits represented in the tables will no doubt serve as data banks and accurate descriptors of all the 116 accessions studied.

Inflorescence having pink and yellow coloured florets

Trees bearing single fruit per bunch

Tree bearing several fruits per bunch

Fruits having pear shapes

Fruits having round shape


Low bearing fruits


Low bearing trees

Heavy bearing tree

Fruits tasting like citrus

Conclusion:

Morphological characterization allows for the study of plant variation using visual attributes.We investigated the morphological diversity of 116 genotypes of mango trees in the mango orchard of Mr.Syed Ghani located in Krigaulu village of Malavalli taluq , Mandya district. The orchard gains its importance due the very many old trees dating back to the period of Tippu Sultan as evident from the Carbon dating . The age of some of these trees is determined to be around **200+ years** .While geneticistws and plant breeders are particularly interesed in diversity at molecular level farmers are more concerned with how visible traits and agronomic variations can be used for sustainable farming.In this study both qualitative and quantitative characterization of the 116 accessions were performed and documented .The correlation among descriptor traits showed several clusters and relationship among these accessions is illustrated by the aglomerative heirarchial clustering dendrogram.Some of the unique charaters observed include the appearance of waxy and leathery types of leaves,obovate shaped leaves(Ameer),white and compact inflorescence in the variety Mosa, Sweet fruit bearing trees were Rasool, Kalizee, cavery, Kabine, Baba, Raseeda, Irfan, Jeevan pur and Hasumiyapassand. Variety Fazal and Mangamari having 0.42% ascorbic acid content are the most suitable types for pickling types . Badaam tree invariably produced fruits with heavy weight while Mandaviya produced fruits with less weight.Although this study has established that the mango germplasm in this orchard dates back to Tipppus' reign and the germplasms pocess unique traits that differentiate each other, focus on development of disease ,pest and drought also should be putforth along with the molecular characterization.