**Original Research Article**

# Screening of germplasm accession for breeding programme specific withmulberry fruit production

**Abstract:**The present study evaluates the screening of germplasm accession for breeding programme specific with mulberry fruit production. Mulberry plants are heterozygous species due to their wide range of character differences and capacity to adapt to cross-pollination in the absence of inter-specific reproductive barriers. Since every plant in a natural population is unique, it is challenging to compile data and conduct research on how various edaphic conditions affect the expression of genotypic features in order to assess variations. In lieu of this known diversity for posterity, the collection of mulberry genotypes from diverse genetic sources, their conservation, evaluation and consequent documentation is of prime importance. In the present study, 71 mulberry accessions were characterized for morphology, reproductiveand 37 fruit parameters. Based on multiple trait analysis, 14 top performing accessions viz., Mysore local,MI-11 and MI-012,ME-182,S-34,S-1635,MI-143,MI-47,MI-04,MI-79,Srinagar local,MI-231,China white,MI-07, MI-524, *M. laevigata*, M5,C-20,ME-224,MI-231,ME-185,ME-65, China whitewere identified. These accessions could serve as resources for further evaluation aimed at trait-specific crop improvement.

**Keywords:**Screening, Mulberry (*Morus* sp.), Germplasm, Accessions, Reproductive traits, Fruit traits.

## 1. Introduction

"Mulberry is a perennial, fast-growing, deciduous, woody and dioecious plant. It has a deep root system. The leaves are simple, alternate, stipulate, petiolate, entire or lobed. Plants are generally dioecious. Inflorescence is catkin with pendent or drooping peduncle bearing unisexual flowers. Male catkins longer than female catkins. The ovary is one celled and stigma is bifid. The chief pollinating agent in mulberry is wind. Mulberry fruit is a sorosis, and mainly violet and black in colour.Information on the reproductive behaviour and floral biology forms the pre-requisites for breeding programme of sexually reproducing crops. Though the mulberry is vegetative propagated, studies on floral biology in general and pollen fertility, viability, and germination still play a vital role in conventional breeding methods like open pollinated hybrid selection, controlled hybridization and polyclonal nursery"(Tikader and Kamble, 2010).

"Mulberry fruit is known for its delicious taste and medicinal properties. It is consumed fresh as well as in dry state and has unique nutritional value among the fruits" (Bhattacharjya*et al.*,2021). "These fruits provide proteins, carbohydrates, vitamins and mineral nutrients. Mulberry fruits are rich in sugar, glucose, sucrose, carotenes, tartaric acid etc., and are used for curing sore throat, fever, dyspepsia and melancholia" (Singh, 1992, Giusti, 2003). "It can also provide cardio-vascular protection, immune enhancement, antiviral, anti-inflammatory activity and stress reduction as potential health benefits" (Kumaresan*et al.*, 2008). Fresh mulberries are an excellent source of vitamin C (36.4 mg/100

g, about 61 per cent of RDI), which is also a powerful natural antioxidant. In addition, anthocyanin pigment can be extracted from the berries for use as a natural dye and as a food colourant in food industry thereby preventing the hazardous health effect of chemicals. Since, mulberry is grown for its foliage, breeding work related to fruit yield and its quality is limited. Mulberry fruit has been increasingly evaluated as desirable trait for use in fresh and processed food and industry. Further, mulberry varieties suited to mulberry fruit production remains to be addressed. The genetic improvement of any fruit species depends on the availability of genetic variability in germplasm. Selection of suitable genotypes from gene pool requires a thorough knowledge on fruit characters of different genotypes for utilizing them in hybridization studies.

"Mulberry is highly heterogeneous and heterozygous plant easily adapted to different agro ecological conditions and hybridised both naturally and artificially which creating the wide series of variability in the existing gene pool". (Banerjee *et al.*, 2007)."Screening of germplasm accessionresources is one of the prerequisite for efficient utilization. *Morus* species exhibits rich phenotypic diversity. Many improved varieties are developed to meet the sericulture industry demand. The improvement in quantity and quality of mulberry genotypes over existing ones is a continuous process and breeders want suitable parental material for developing superior genotypes. Moreover, at present, there is an increasing demand to develop region and season specific mulberry varieties for rearing hybrid silkworm breeds. Standard characterization and evaluation of mulberry accessions are continuously carried out using different methods and traditional practices such as use of descriptor lists for morphology, reproductive and fruit characters. Characterization includes recording highly heritable phenotypic characters, which can be visually observed and expressed in various environments"(Tikader and Kamble, 2010).

"In order to identify the best performers and evolve new varieties suitable for specific zones, evaluation is essential. There is an increasing demand for new varieties suitable for various climatic conditions. To achieve this, identification of suitable parents from the germplasm accessions available is the need of the hour. In the present study, characterization of mulberry accession for different morphological, reproductive and fruit characters was done" [15]. The germplasm was also evaluated for different growth and propagation traits. The trait-specific best performers were identified that can be utilized in future breeding programs.

## 2. Materials and methods

The experimental material consists of 71 mulberry accessions were used for the study on morphological, reproductive and fruit characters in mulberry accessions. These mulberry accessions were maintained in the germplasm at Department of Sericulture, UAS, GKVK, Bangalore.All mulberry accessions were planted in one row with four plants with a spacing of 2.4x2.5 m. These accessions were planted during 2006. The experiment was conducted during2019 to 2020. All the standard cultural practices *viz.*, loosening of soil, irrigation, weeding, fertilizer application measures were followed as per the package of practices adopted for rainfed mulberry (Dandin and Giridhar, 2010). Pruning was done at five feet height from the ground level and thereafter all the morphological, reproductive and fruit characters were recorded from four plants in each accession.

The screening of mulberry germplasm accessions for reproductive traits was recorded in the main flowering season (February- March). Number of days required for first flower initiation were observed daily by counted number of days from the date of pruning to first flower initiation.Time of flower opening in a day was recorded based on visual observation from day of flower initiation to flower opening time in a day at early morning hours.Fully bloomed catkins of different accessions were collected and the length as well as breadth of pedicel was measured.Complete flower duration was recorded on visual observation from first day of flower initiation to complete flowering. The data was subjected to statistical analysis to determine the significance of treatments.

To generate Iformation on fruits from different mulberry accessionsthe following observations were recorded*viz*.,number of days required for fruit formationwas recorded on visual observation from complete flowering stage to first fruit formation stage. The length of 5 randomly selected fruits from each plant was recorded from measuring scale and expressed in centimeters. The width of five randomly selected fruits from each plant was recorded from base to the tip of fruit with the help of measuring scale and expressed in centimeters.For each accession five fruits were randomly selected and weighed with electric balance to compute mean.Number of fruits per branch were recorded by counting the number of fruits in the branches.Number of fruits per plant was recorded by counting the number of fruits present in all branches of plant. Fruit of each accession were smashed in water to count the seeds/fruit.Number of days required for fruit formationwas recorded on visual observation from complete flowering stage to first fruit formation stage.Germination percent of seed per fruit was recorded by the seeds sown in the pot and made observation when seeds were germinated, and seedling began to sprout from the seeds. Different mulberry accessions were categorized based on different fruit colour as black, pink, purple and white.

## 3. Results and discussion

### 3.1 Morphological characterization of mulberry germplasm accessions

All the 71 mulberry germplasm accessions were characterized for morphological descriptors. Different morphological characters were recorded mainly by visual observations (branching pattern, leaf shape). Among the accessions characterized, most of the accessions (58%) were with erect branching nature followed by (22%) semi erect branching nature and (20%) were drooping branching nature showed in Fig.1.The present results are agreement with the earlier studies of Bindroo*et al*., 2012 who reported among 243 accessions branching habit varied from Erect, semi erect and Spreading nature of branching habit. Among the accessions leaf shape was characterized, most of the accessions are narrow ovate (40%), followed by ovate (32%), wide ovate (17%), cordate (10%) and lobed (1%) shaped leaves are found (Fig.2). The present results are agreement with the earlier findings of Munir *et al*.,2018 who reported qualitative character leaf shapes it varies from cordate to lobate in the mulberry accessions.

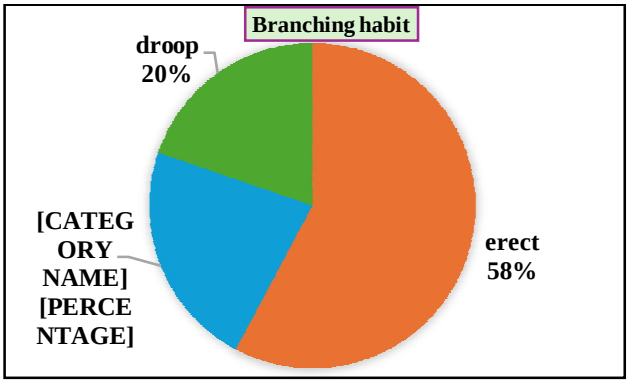


**Fig. 1: Branching habit of 71 mulberry accessions**

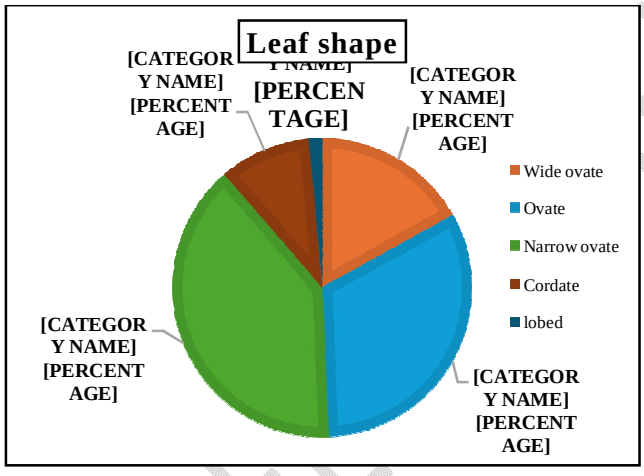


**Fig. 2: Leaf shape of 71 mulberry accessions**

### 3.2 Reproductive characterization of mulberry germplasm accessions

The results showed that number of days required for first flower initiation in different mulberry accessions ranged between 10.66 to 16.33 days. Mysore local showed early flowering i.e. 10.66 days after pruning. Late flowering observed in *M. multicaulis*i.e.16.33 days.Time of flower opening observed in morning hours of the day from 7.30am to 11.00am in a day. MI-11 and MI-012 shows early flower opening in a day (8.00-8.30 am). Whereas in *M. laevigata* shows late flower opening time (9.30-11.00 am).Male inflorescence length ranged between 1.30 to 5.30 cm in ME-65 and ME-182 respectively. Female inflorescence length ranged between 1.63 to 3.56 cm in *M. alba* and S-34, respectively. Male inflorescence breadth ranged between 1.26 to 2.23 cm in ME-05 and S-1635, respectively. Female inflorescence breadth ranged between 1.23 to 1.86 cm in ME-08 and MI-143, respectively. Complete flower duration differs in both in male and female flower. Male flower duration varied from 13 to 18 days. Whereas in female flower duration varied from 17 to 27 days (Table 1).The present results are line with earlier studies of Ann., 2016 who reported among 22 accessions male inflorescence breadth ranged between 0.34 to 0.72 cm. whereas female inflorescence breadth ranged between 0.28 to 0.60 cm.

**Table 1: Reproductive characterization of mulberry germplasm**

| Parameters | Range | Min | Max. | Top performing accessions |
|---|---|---|---|---|
| Number of days required for first flower initiation (Days) | 10.66 - 16.33 | 10.66 | 16.33 | Mysore local |
| Time of flower opening (Day) | 7.30am - 11.00am | 8.00-8.30 am | 9.30-10.00 | MI-11 and MI-012 |
| Male Inflorescence length (cm) | 1.30 - 5.30 | 1.30 | 5.30 | ME-182 |
| Female Inflorescence length (cm) | 1.63 - 3.56 | 1.63 | 3.56 | S-34 |
| Male Inflorescence breadth (cm) | 1.26 - 2.23 | 1.26 | 2.23 | S-1635 |
| Female Inflorescence breadth(cm) | 1.23 - 1.86 | 1.23 | 1.86 | MI-143 |
| Malecomplete flower duration (Days) | 13 - 18 | 10 | 28 | MI-47,MI-04 |
| Femalecomplete flower duration (Days) | 17 -27 | 17 | 27 | MI-79 |

**3.3 Fruits characterization of mulberry germplasm accessions**

Mulberry is cultivated for its leaf, which supports sericulture industry, it has multipurposes and produces fruits. Mulberry fruit is an aggregate fruit composed of smaller fruits called drupes. It is fleshy succulent known for its delicious taste and medicinal properties. It is consumed in fresh as well as dry state and has inimitable nutritional value among the fruits. Though references on mulberry fruit are available but in *ex-situ* condition, not much information generated on fruits and its utility.

Among 37 female accessions, more number of days required for fruit formation was recorded in Srinagar local (29.33). Whereas less number of days required for fruit formation was recorded in Karanahalli (17.33) days.MI-231 recorded maximum fruit length of (3.63 cm) and minimum fruit length was recorded in ME-107 of1.33 cm.Maximum width of fruit was observed in China white (2.60 cm) and minimum fruit width recorded in MI-11 (1.03 cm).In MI-07, MI-524, *M. laevigata* and M5 observed more number of fruits per branch was observed (6.33). whereas MI-556 recorded less number of fruits per branch (1.33).*M. laevigata* recorded more number of fruits per plant (259.66). Whereas minimum number of fruits per plant was observed in ME-06 (23.66).Highest fruit weight was found in C-20 (48.64g). Whereas ME-08 recorded lowest fruit weight (1.95g).Maximum fruit yield was recorded in C-20 (5764.50g). Whereas MI-169 recorded minimum fruit yield (146.25 g).ME-224 recorded highest $p^H$ of mulberry fruit juice (6.61), and MI-79 recorded lower $p^H$ of mulberry fruit (3.95).More number of seeds was present in MI-231(33.66). Whereas in Mysore local recorded less number of seeds (5.33).The highest germination per cent of seed was found in ME-185, ME-65, China white (33.33%). On other hand MI-169, ME-224, MI-231, MI-07 recorded lowest seed germination per cent (13.33%) Table 2.Among 37 female accessions, the fruit colour was Pink in MI-556, MI-79, ME-224, M-5 accessions. Most of the accessions fruits colour is black (62%), Purple (22%), pink (11%) and white (5%) are found (Fig.3).

The present results are corroborating with the findings of earlier studies of Mangammal 2012, who recorded maximum length of fruit was observed in ME-18 (3.22cm).Gunes and Cekic.,2004, who reported more number of seeds in Red mulberry and lesser number of seeds was recorded in white mulberry.The present results are line with the earlier studies of Chowdhuri *et al*., 2009, who reported highest seed germination was found in *M. indica* (96.95%).The present results are line with the earlier studies ofChikkalingaiah*et al*. (2009)who reportedfruit length was recorded maximum in accession ME-18 (3.20 cm). whereas minimum fruit length of 0.90cm was registered in Surat local. Machii*et al*., 1999, who reported that two hundred and sixty mulberry genotypes were estimated for traits such as inflorescence, fruit quantity and sizes, seeds per fruit. The okaragawa genotype had largest fruit. Hashemi and Khadivi, 2020 who reportedfruit length varied from 14.35 to 26.98 mm with an average of 19.48 and fruit weight ranged between 0.94 and 2.86 g with an average of 1.59. Total soluble solids varied from 7.70 to 25.80% with an average of 16.17.

**Table 2: Fruits characterization of mulberry germplasm**

| Sl. No. | Parameters | Mean | Min. | Max. | SE | CV% | Top performing accessions |
|---|---|---|---|---|---|---|---|
| 1 | Number of days required for fruit formation | 26.52 | 17.33 | 29.33 | 0.70 | 2.64 | Srinagar local |
| 2 | Fruit length (cm) | 2.31 | 1.33 | 3.63 | 0.10 | 4.72 | MI-231 |
| 3 | Fruit width (cm) | 1.84 | 1.03 | 2.60 | 0.11 | 6.39 | China white |
| 4 | Number of Fruits /branches | 4.14 | 1.33 | 6.33 | 0.61 | 14.75 | MI-07, MI-524, *M. laevigata* and M5 |
| 5 | Number of Fruits/plants | 130.18 | 23.66 | 259.66 | 4.92 | 3.78 | *M. laevigata* |
| 6 | Fruit weight (g) | 14.42 | 1.95 | 48.64 | 0.33 | 2.30 | C-20 |
| 7 | Fruit yield per plant (g) | 1499.55 | 146.25 | 5764.50 | 9.59 | 0.63 | C-20 |
| 8 | $P^H$ of mulberry fruit juice | 5.21 | 3.95 | 6.61 | 0.03 | 0.58 | ME-224 |
| 9 | Number of seeds/fruits | 15.14 | 5.33 | 33.66 | 1.51 | 9.98 | MI-231 |
| 10 | Germination per cent of seed per fruit | 22.79 | 13.33 | 33.33 | 3.82 | 16.77 | ME-185,ME-65, China white |

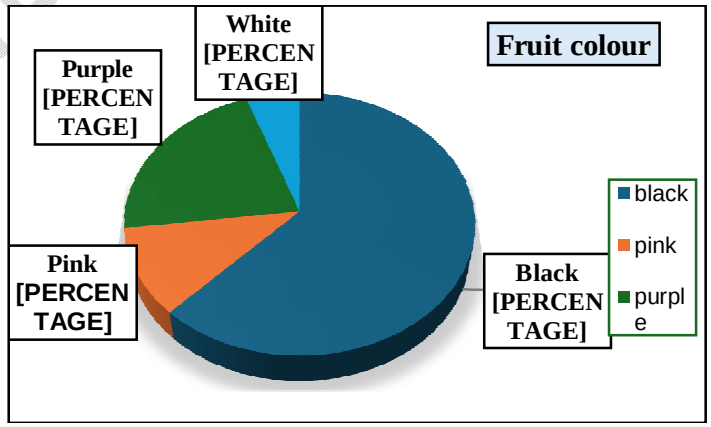


**Fig. 3: Fruit colour of 37 mulberry accessions**

## 4. CONCLUSION

It is concluded that effective and efficient utilization of germplasm depends on the detailed and systematic characterization. Phenotypic characterisation is critical in the description and classification of germplasm. It also makes it easier to address the truth and discover duplicates. However, molecular research is required to confirm the morphological distinctions.

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