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Distribution, Diversity, Utilization and Conversation of Mulberry (*Morus* spp.) in North West of India

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ABSTRACT

To ascertain the availability of mulberry genetic resources in Northwest India, an extensive survey and exploration was conducted. A total of 261 collections were made in different states of northwest India. The variation of these collections was recorded during a survey as well as after establishment at an *ex-situ* field gene bank. Four species of mulberry reported in India were collected and a good number of collections showed significant variation within and among different species. Some collections were utilized in a crop improvement programme while others were used directly in a field evaluation. The performance of wild species indicated that genetic improvement is possible through a pre-breeding approach and the incorporation of wild genes into cultivated varieties. Broadening of the genetic base of cultivated varieties was attempted with wild species and an improvement both in qualitative and quantitative aspects was observed. Valuable collections from different geographical regions of north-west India have some economic bearing and require extensive studies and conservation for posterity. Thus, genetic improvement, *ex-situ* conservation and future utilization can be assured by correctly exploiting collected materials.

Keywords: conservation, exploration, survey, utilization, variation

INTRODUCTION

Wild relatives of plant species play a vital role for any crop improvement. More collections of a particular crop provide the lifeline in genetic improvement for present and future generations. In this regard, collection, introduction, establishment, characterization, evaluation, utilization, and conservation of genetic resources are the base work for further improvement in existing crops. Within collection, exploration plays a major role to procure the germplasm from a natural (wild) source and from primitive cultivars. After collection, introduction is the first step followed by characterization, evaluation and utilization of genetic resources. Further, natural resources need to be collected and accumulated in one place to save them from extinction and to conserve them for posterity. In nature, genotypes themselves are adapted to local conditions and represent a wide range of variability. Thus, collection of germplasm through a survey and exploration should be part and parcel of germplasm procurement activities.

Moreover, a large variety of cultivated plants used by humankind today are derived from wild relatives through artificial selection or hybridization to bring out desired improvement. The contribution of wild relatives for economic returns is well exemplified by crop plants such as rice, wheat, sugarcane, potato and tomato besides several forages and other crops. Exploiting wild gene pools requires intensive efforts and extensive knowledge of taxonomy, reproductive biology, cytogenetics, genetics, genetic engineering and in many cases cell culture techniques.

Biodiversity refers to genetic diversity in living organisms. Mulberry is a fast growing deciduous tree naturally distributed in tropical, sub-tropical and temperate climates. Mulberry taxonomists in different countries have adopted different systems of classification. Hotta (1954) and Koidzumi (1917, 1923) reported 64 species of mulberry around the world. In India, the genus *Morus* is represented by four species i.e., *M. indica*, *M. alba*, *M. laevigata* and *M. serrata*

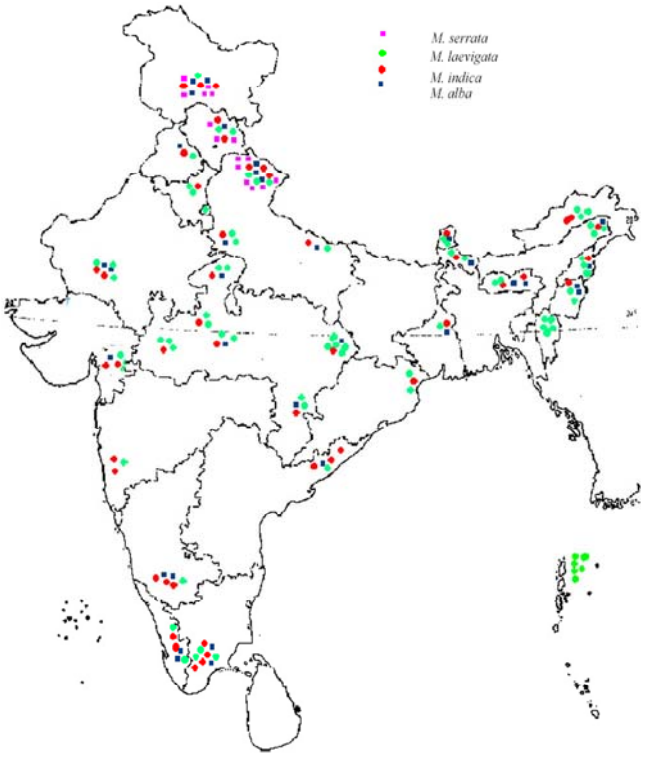

Fig. 1 Distribution of mulberry genetic resources in North West (India).

(Hooker 1885; Brandis 1906), which are distributed in different parts of the country (**Fig. 1**). The Northwestern zone, particularly Uttar Pradesh, Uttarakhand, Himachal Pradesh, Punjab and Jammu and Kashmir, has rich natural mulberry resources. In this area, collection through survey and explo-

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Research Note

ration showed wide degree of genetic variation (Rao *et al*. 2011).

The Northwest zone covers the Sub-Himalayan belt of India where 4 species of mulberry are available. Among them, *M. serrata* Roxb. is a wild species, endemic to Northwest India whereas other mulberry species are distributed throughout India. *M. serrata* shows a wide range of variability in morphological features, reproductive, cytological and growth attributes. Chromosome number varies from diploid (2n=28) to hexaploid (6x=84). The species is hardy in nature and may be useful for a disease, drought, or stress tolerance breeding programme (Dandin *et al*. 1993; Tikader *et al*. 1999, 2000). *M. laevigata*, *M. indica*, *M. alba* and *M. multicaulis* (syn. *M. latifolia* Poir.) collected from Himachal Pradesh also showed variability. Wild and naturalized mulberry collections with specific characters need to be characterized, evaluated, documented and conserved adopting indigenous and improved techniques for future utilization.

In this report, a detail account is presented of mulberry collections from Northwest India, their utilization and conservation for further exploitation.

MATERIALS AND METHODS

The Central Sericultural Germplasm Resources Centre (CSGRC), Hosur, Tamil Nadu, India collects, characterizes, evaluates and conserves mulberry germplasm for future utilization. As a part of a regular programme, a survey was conducted in different parts of Northwest India i.e. Jammu and Kashmir, Uttar Pradesh, Uttarakhand, Himachal Pradesh, New Delhi, Haryanan, and Punjab in two seasons (February-April and September-November) during the regular flowering season. Before conducting the survey, published literature and herbarium records of the Botanical Survey of India at Dehradun, Forest Research Institute, were consulted. *Morus* is distributed naturally in sub-Himalayan regions up to 3000 m extending between Indus and Brahmaputra rivers with varying climate from temperate to tropical. While collecting samples, a standard format was used to record information like passport data, ethno-botanical notes on special uses with special note on sericultural utilization. The plants were sampled based on distinct morphological, reproductive and other related features. Random sampling of wild forms and a biased procedure were followed when the population accounted for at least 10% of the total population (Tikader *et al*. 2000). Herbarium specimens were created from collected samples. Mulberry is usually multiplied by vegetative shoots and in general vegetative parts are collected during a survey and exploration. Healthy, mature, disease-free shoots minimum of 25 numbers with dormant buds were collected for further multiplication in the nursery and subsequent establishment from the nursery to a field gene bank at CSGRC, Hosur for ex-*situ* conservation and utilization.

After establishment of mulberry plants in the field gene bank, they were subject to characterization, preliminary evaluation of different aspects like ploidy status, leaf yield, leaf quality through bioassays with silkworms, etc. The ploidy status of mulberry can be ascertained through cytology, pollen study, leaf anatomy including chloroplast count. The leaf anatomical characters were studied following standard procedures (Metcalf and Chalk 1979; Tikader and Rao 2001; Rao *et al*. 2011). Chloroplast number per stomata was counted using epidermal peelings of freshly collected leaf samples and stained with 2% potassium iodide-iodine solution and observed under microscope and confirmed the ploidy based on size variation (Tikader *et al*. 1999; Tikader and Rao 2001). Pollen study was studied with 0.5% aceto-carmine staining method and based on size variation (Das *et al*. 1970; Tikader *et al*. 1995; Tikader and Rao 2001).

The young age silkworms were reared with 45 days old leaves following standard procedures with control variety (Krishnaswami 1978: Tikader and Kamble 2007; Tikader and Qadri 2009).

RESULTS AND DISCUSSION

The materials collected from different states and their distribution is presented next.

Jammu and Kashmir State

Jammu and Kashmir (J&K) State is located in the silk belt at the same latitude in which leading sericulture countries lie. It has four agro-climatic zones viz., temperate, intermediate, sub-tropical and cold arid (desert). Sericulture is practiced in all areas of the state except in cold arid zones. The British and the then Maharaja exploited the Kashmir valley for the production of silk cocoon.

Factors like temperature, climate, population, soil status and others are well suited for the growth of sericulture in J&K State. The growth pattern of sericulture is prioritized in the J&K valley for good harvest of bivoltine cocoons. Jammu Division has 6 districts i.e., Jammu, Kathua, Doda, Rajouri, Udhampur and Poonch. Kashmir Division also has 6 districts namely Srinagar, Badgam, Phulwama, Anatanag, Baramula and Kupwara.

The Ladakh region is popularly known as the "high altitude cold desert". Ladakh lies between 32 to 36° North and 76 to 79° East. Ladakh covers 70% of the geographical area of J&K State. The Himalayan ranges are rocky, barren and devoid of soil, hence vegetation cover is not seen on the mountain ranges. Most of the hills are high ranges between 5000-5900 m. The mountain ranges between 2500 and 4500 m consist of rivers and valleys where agriculture and human settlements are noticed. The soil of Ladakh is poor in organic matter and looks like fine silt/sandy. The annual rainfall in Ladakh varies from 9 cm in Leh to 23.9 cm in Kargil. All the data is available in State reports and is made available through different bulletins and brochures about the condition of the area. Details exist due to its importance as a cold desert area, conditions in which mulberry survives where other vegetation does not.

The climate of Ladakh is unique and ranges from 0 to 30°C during July. Winter is freezing (-40 to -27°C) in the valley and -40°C in the mountains. Physico-graphically the entire Ladakh region is divided into five valleys i.e., Indus, Nubra, Changthang, Zanskar and Suru covering two districts of Leh (113 villages) and Kargil (130 villages). The survey was conducted in Nubra and Sung valleys in two districts of the Ladakh range.

Natural mulberry is abundant in J&K state, and is suitable for sericulture. Introduced and cultivated mulberry is also abundantly available. The mulberry genetic resources available should be used judiciously to better the sericulture industry in J&K. Natural mulberry is available in the Ladakh region, which should be given prime importance. As mulberry is found growing in the cold desert, it may possess noble genes suitable for frost or cold resistance. Several mulberry accessions were collected from J&K covering different districts (**Table 1**).

Uttar Pradesh

Uttar Pradesh (UP) is a large state with 70 districts. Mulberry is found growing in many places as wild and cultivated forms in farmer's fields. The survey and exploration were conducted in UP at an altitude of 115 m above mean sea level (masl). The annual rainfall of the region is 1153 mm. Maximum temperature reaches up to 43°C in summer and a minimum of 8°C in winter. The state has vast natural resources. Forest cover is predominant with tropical deciduous plants. Sericulture is being practiced in a limited area of UP. In general, mulberry is cultivated for fodder, fuel and fruits. Morphological variation was observed and the following mulberry germplasm was collected from different districts of UP (**Table 2**).

Uttarakhand

Uttarakhand State has 12 districts and mulberry is naturally available in forest and mountain areas. All districts were covered within the survey; more than 111 mulberry germplasms were collected. Species-specific characters were recorded during the survey and summarized below (**Table 3**).

Table 1 Collection of mulberry germplasm from Jammu and Kashmir.

Districts	*M. alba*	*M. indica*	*M. laevigata*	*M. serrata*	Total
Jammu	---	1	---	---	1
Rajouri	---	3	---	2	5
Udhampur	1	3	---	---	4
Kathua	---	1	1	---	2
Ladakh (Leh)	7	3	---	---	10
Kargil	1	3	---	---	4
Total	9	14	1	2	26

Table 2 Collection of mulberry germplasm from Uttar Pradesh.

Districts	*M. indica*	*M. alba*	*M. laevigata*	Total
Sidharthanagar	4	---	---	4
Maharajganj	3	---	---	3
Gorakhpur	5	---	2	7
Mau	1	---	---	1
Varanasi	1	1	---	2
Juanpur	1	---	---	1
Sultanpur	1	1	---	2
Faizabad	1	---	1	2
Lucknow	1	---	2	3
Baharaich	1	---	7	8
Lakhimpur	4	---	1	5
Pilhibit	2	---	---	2
Sahajahanpur	1	---	---	1
Sravasthi	1	---	---	1
Mathura	4	---	---	4
Total	31	2	13	46

Table 3 Collection of mulberry germplasm from Uttarakhand.

Districts	*M. indica*	*M. alba*	*M. laevigata*	*M. serrata*	Total
Dehradun	23	9	6	12	50
Pauri Garhwal	1	1	1	2	5
Tehri Garhwal	1	---	1	1	3
Haridwar	6	---	3	---	9
Rudrprayag	2	1	---	1	4
Chamoli	1	1	---	17	19
Uttarkashi	---	---	---	5	5
Udhamsinghnagar	1	---	---	---	1
Nainital	4	1	2	4	11
Almora	---	2	---	6	8
Champawat	3	---	---	---	3
Pithoragarh	1	---	---	2	3
Total	43	15	13	50	121

1. Geographical distribution and morphological variability

M. serrata, the Himalayan mulberry, is confined to the North Western belt in natural habitats. The sacred mulberry at Joshimath, Chamoli and Uttarakhand holds the oldest existing mulberry tree. *M. serrata* has a trunk girth of 21.34 m and is 1200 years old (Rau 1967). *M. serrata* is widely distributed in Uttarakhand at Chakrata, Salna, Urgam Valley, Dehradun, Mussoorie, Pandukeshar, Hanumanchetti, Uttarkashi, Ranachetti, Almora, Pithoragarh, Nainital, Bhimtal, Gangnani, Gangotri, Yamunotri, Barkote and other places in a higher altitude range up to 2200 masl.

M. laevigata is available all over India in wild and cultivated forms. In Uttarakhand, the species is available at Dehradun, Haridwar, Rishikesh, Tehri Garhwal, Rudraprayag, Uttarkashi, Haldwani, Chamoli, Almora, Bhimtal and Pithoragarh.

M. indica is indigenous to India, is widely distributed in different parts of the country and is grown for fruit, fodder, fuel and timber. The present study indicates that wild resources of *M. indica* have become scarce due to deforestation.

M. alba is a deciduous and dioecious tree species cultivated in different parts of the country particularly in traditional belt of sericulture in different states i.e., Andhra Pradesh, Jammu and Kashmir, Karnataka, Tamil Nadu and West Bengal for its foliage. In Uttarakhand, the species is available in and around Dehradun, Chamoli, Rudraprayag, Pauri Garhwal, Nainital, Almora and other places where sericulture is practiced. The species is native to China and is extensively cultivated throughout the plains of India and in the lower altitudes of the Himalayas (Tikader *et al.* 2002).

2. Specific characters

Wild mulberry species (*M. serrata* and *M. laevigata*) possess drought- and salt-tolerant characters like leaf rolling, an abundant xylem, less stomata/unit area and slow growth in response to moisture stress (Tikader and Kamble 2008a), which are useful in a breeding programme. Genetic resources can be used to develop stress-tolerant varieties. Moreover, thick leaves are a desirable character and known to confer resistance to different diseases in addition to retaining moisture (Tikader and Dandin 2005).

3. Religious sanctity

M. serrata is confined to the North Western Himalayan belt of India at higher altitudes. *M. serrata* is worshipped at Joshimath, Pithoragarh, Hanumanchetti, Salna, Ranachetti, Pandukeshar, Almora, Nainital and other places. The giant mulberry tree, the oldest in India at Joshimath of Chamoli district, where Adi Guru Sri Sankaracharya meditated, has gained religious importance. The people do not even use the dried leaves, stem or other parts of the tree (Tikader *et al.* 2000).

Himachal Pradesh

Himachal Pradesh (HP) has 12 districts, out of which sericulture dominated mainly in the districts of Kangra, Mandi, Hamirpur, Bilaspur, Una and Sirmour. In general, the soil status of the hills is neutral to slightly acidic (pH 6.5 – 7.0) with a loam to clay loam texture, rich in iron and carbon but lacking salts and mineral constituents (Tikader and Thangavelu 2004). The climate ranges from tropical to temperate. The hills are grouped into lower hills (up to 925 masl), mid hills (> 925 to 1500 m) and high hills (> 1500 to 5500 m). With the changes in climate, the temperature, humidity and rainfall of HP ranges in summer from 14 to 33°C, in winter from 0 to 15°C, relative humidity (50.0 to 99.0%) and rainfall (1500 to 3000 mm), with a monsoon period (July to September); rainfall is highest after Cherapunji. The materials collected from different districts fall are all covered by the above climatic conditions. The forest area is covered with chir pine (*Pinus roxburgii* Sargent), kali (*Salsola kali* Linn.), deodar (*Cedrus deodara* G. Don), khair (*Acacia catechu* Linn.), seasam (*Dulbergia sissoo* Roxb.), ban oak (*Quercus incana* Bartr.), karsu oak (*Quercus semicarpifolia* Smith), moru oak (*Quercus dilatata* Lindl. Ex A. DC.) and mulberry (*Morus serrata* Roxb.). Natural and cultivated mulberry co-exist with oak trees in abundance in HP. In general, sericulture is being practiced as a subsidiary occupation in the districts of Kangra, Bilaspur, Hamirpur, Una and Mandi.

As a part of germplasm collections from natural as well as cultivated sources, four surveys and exploration trips were conducted in 9 districts of HP during the mulberry growth season (spring and autumn) and 34 mulberry samples were collected based on distinct taxonomical parameters viz., morphology, anatomical, reproductive and other special features (**Table 4**).

New Delhi

Mulberry grows well in New Delhi, Old Delhi and surrounding areas. Mulberry is mainly grown as avenue trees, for shade and fruit and covers wastelands after afforestation. Otherwise the plants grow naturally through seed dispersal. There is a lot of mulberry available, mainly *M. laevigata*

Table 4 Collections of mulberry germplasm from Himachal Pradesh.

Districts	*M. indica*	*M. alba*	*M. laevigata*	*M. serrata*	*M. multicaulis*	Total
Sirmour	3	1	1	2	2	9
Solan	---	---	---	2	---	2
Shimla	---	---	---	1	---	1
Bilaspur	2	1	---	---	---	3
Mandi	4	---	---	---	1	5
Hamirpur	5	1	---	---	1	7
Una	1	---	---	---	---	1
Kangra	2	2	1	---	---	5
Kullu	1	---	---	---	---	1
Chamba	4	2	3	9	---	18
Total	22	7	5	14	4	52

Table 5 Collection of mulberry germplasm from Punjab.

Districts	*M. laevigata*	*M. indica*	*M. alba*	Total
Gurdaspur	3	3	3	9
Roopnagar	---	2	---	2
Total	3	5	3	11

and *M. indica.* During the survey and exploration, three samples (*M. laevigata* - 2, *M. indica* - 1) were collected from New Delhi.

Haryana

Haryana state borders Delhi and UP and also has mulberry plantations, mostly in cultivated form. At Chandigarh, many mulberry trees can be seen growing as in Delhi, and are used as avenue plantation. Sericulture is practiced in pockets like Panchkula near Chandigarh and some plantations are maintained for silkworm rearing. Most land is used for agricultural crops. Some of the areas consisting of fallow lands are used for avenue plantation using mulberry. Birds, humans and livestock use mulberry fruits. The mulberry leaves are used as fodder, and twigs as fence materials and fuel. Four collections (*M. laevigata*) were made from the National Bureau of Animal Genetic Resources, Karnal and maintained in field gene bank of CSGRC, Hosur.

Punjab

Punjab is a sun-burnt land, flat, sloping imperceptibly down from the Himalayan foothills towards the deserts of Rajasthan on the one side and the extensive plain of Haryana, UP, Uttarkhand on the other. At one time, Punjab extended North West up to the river lands and beyond. The Greeks named the entire terrain as Pentopotamia because of the five rivers that ran through it. The Persian named it received was Panj (five) abb (waters) – a name that stuck (Sircar 2004).

The climate of Punjab ranges from breaching cold in winter to scorching heat in summer. The state also has winter and summer monsoons. These seasonal changes consequently bring about a diversity of landscape at large. The spring comes in early February gives away to a long summer. Trees, which shed their leaves and come to life again with blossoms and new foliage, flower in late May. In summer, the temperature is 35-45°C but in winter it ranges from 0-14°C and the monsoon season continues from July to September. Sericulture is practiced in two districts of Punjab. However, the major share of sericulture products is produced in the Gurudaspur district in Sujanpur and Pathankote. Mulberry germplasm collected from different areas are listed in **Table 5**.

The largest collection was made from Uttarakhand (121) followed by HP (52), UP (46), J&K (26), Punjab (11), Haryana (4) and New Delhi (3). The survey collection includes four species of the genus *Morus* whose diversity is presented in **Table 6**.

M. serrata is native to India and is known as the Himalayan mulberry (Roxburg 1832). Osmoston (1927) reported this species in the Kumaon Hill regions of Uttarakhand. *M. serrata* is confined to the North Western Himalayas in the states of Uttarakhand, HP and J&K at higher altitudes (750-2100 m). *M. serrata* was found growing in wild habitats. Morphological variability in different populations of *M. serrata* were recorded and described taxonomically (**Table 6**). All the collections showed variation in ploidy levels, from diploid to hexaploid (Tikader and Dandin 2005). The sacred tree of Joshimath (Rau 1967) is found as a natural hexaploid (Basavaiah *et al*. 1989). The leaves of *M. serrata* are a common source of fodder and the wood is used for the preparation of agricultural appliances. The wood is also used for sports goods. Silkworm feeding trials showed that the leaves are acceptable to worms. The species may be used for disease or drought tolerant breeding programmes (Dandin *et al*. 1993; Tikader *et al*. 1999, 2000).

M. laevigata is one of the indigenous species to India and was recognized by Wallich and validated by Brandis (1906). *M. laevigata* is distributed as a wild tree in forests and also in cultivated forms up to 600-1500 masl. Morphological variation is listed in **Table 6**. Rooting in stem cuttings is very poor. Grafting is an alternative method to multiply and propagate plants. The collections showed diploidy, triploidy and tetraploidy (Tikader *et al*. 2002). Feeding trials showed that leaves are acceptable to late age silkworm rearing and enhance early cocoon spinning (Tikader and

Table 6 Characteristics feature of different species collected from North West India (also see **Figs. 2** and **3**).

Characters	*M. indica*	*M. alba*	*M. laevigata*	*M. serrata*
Bark colour	Brown, grey, blackish brown	Brown, dark brown	Brown, grey, greenish grey, grey blackish	Brown, dark brown, blackish brown
Leaf lobation	Lobed, unlobed, mixed	Unlobed, lobed	Lobed, unlobed, highly dissected	Lobed, unlobed, dissected, mixed
Leaf texture	Coriaceous, chartaceous	Coriaceous, chartaceous	Coriaceous, chartaceous	Coriaceous, chartaceous, leathery
Leaf shape	Wide ovate, ovate	Ovate, narrow ovate	Ovate, wide ovate, long ovate	Wide ovate, narrow ovate, ovate
Leaf margin	Serrate, crenate, dentate	Serrate	Serrate	Serrate, dentate
Leaf surface	Smooth, slightly rough	Smooth	Smooth, rough	Smooth, slightly rough, rough
Leaf size (L × B) cm	13.3 × 12.0 to 20.0 × 12.0	14.0 × 12.0 to 15.5 × 12.5	15.0 × 11.0 to 18.0 × 12.0	15.0 × 10.0 to 20.5 × 20.0
Sex	Male, female	Male, female	Male, female	Male, female
Catkin length (cm)				
Male	2.0 - 3.5	1.5 - 2.5	4.0 - 9.0	2.5 - 5.0
Female	1.5 - 3.0	1.2 - 2.0	7.0 - 12.0	3.0 - 4.5
Phyllotaxy	1/2,1/3,2/5	1/2,1/3	1/2	1/2,1/3,2/5
Internodes distance (cm)	3.8 - 5.5	3.5 - 4.0	6.0 - 7.0	4.0 - 7.0
Fruit length (cm)	2.0 - 3.0	2.0 - 3.5	7.0 - 14.0	3.5 - 4.5
Fruit colour	Black	White, pink	Green, white, pink	Black, pink
Fruit taste	Sour, sweet	Very sweet	Very sweet	Very sweet
Altitude (m)	580 - 1340	580 - 1350	600 - 1500	750 - 3500

Fig. 2 (**A, B**) *Morus alba* flower, fruit; (**C, D**) *M. indica* flower, fruit; (**E, F**) *M. laevigata* flower, fruit; (**G, H**) *M. serrata* flower, fruit; (**I, J, K, L**) Leaf of *M. alba*, *M. indica*, *M. laevigata*, *M. serrata*.

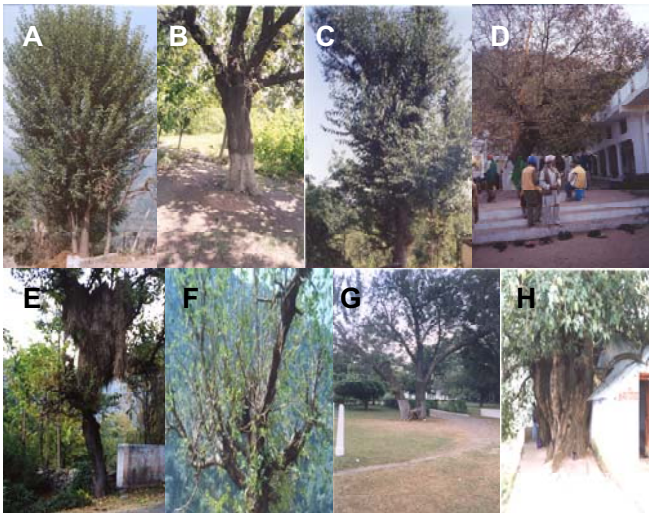

Fig. 3 (**A, E**) *Morus alba*; (**B, F**) *M. indica*; (**C, G**) *M. laevigata*; (**D, H**) *M. serrata*.

Kamble 2007). The species is used for furniture making, fencing and other purposes. The majority of collections showed fast growth, succulent large leaves, late senescence and drought tolerance, which may be used for mulberry breeding programmes (Dandin *et al*. 1995).

M. indica, the wild and cultivated mulberry for sericulture, has several morphological characteristics (**Table 6**). *M. indica* is indigenous to India and grows in various climates. The collections were diploid and are regularly used for silkworm rearing, as fodder, fruit and for other purposes (Tikader and Dandin 2008). *M. indica* is commonly used for silkworm rearing by sericulturists.

M. alba, a deciduous, monoecious tree, is indigenous to China (Vavilov 1926). After introduction into India, it was extensively cultivated throughout the plains of India and in the Himalayas, particularly in J&K, Punjab, HP and Uttarakhand. *M. alba* is known as white mulberry for its white fruit colour. The species is cultivated mainly for silkworm rearing and has several morphological peculiarities (**Table 6**). The leaves are also used for fodder, branches for fencing and wood for toys and furniture. The species may be exploited for a mulberry crop improvement programme. The utility of this species was also reported by Tikader *et al*. (2000).

Biodiversity, which refers to variability in living organisms, is not equally distributed across the globe. The diversity available in collected *Morus* species from North West India are maintained at the Central Sericultural Resources Centre, Hosur for further utilization and are conserved in an *ex-situ* field gene bank. The mulberry accessions are primarily selected based on characterization, evaluation and feeding trial. The suitable accessions are short listed for different purposes (Tikader and Rao 2003). For leaf yield and quality, the selected accessions can be used as parent material for breeding programme with target objectives. Besides this, mulberry germplasm is supplied to different research Institutes, Universities and other interested users. Thus the mulberry germplasm maintained at CSGRC, Hosur is actively used to cater for the needs of sericulturists.

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