Geographical Distribution of Mulberry *(Morus)* Species in India

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In India, genus *Morus* is represented by four species viz., *M. indica, M. alba, M. serrata* and *M. laevigata* (Hooker, 1885; Brandis, 1906). The natural distribution of the genus has considerably changed because of its extensive cultivation for silkworm rearing. Vavilov (1926) while reviewing the centre of origin of crop plants placed the genus *Morus* in China-Japan region which includes East China, Korea and Japan. There are about 68 species recognized in the genus of which 24 species are represented in China, 19 in Japan, 6 in Korea, 4 each in Taiwan and India, 3 each in Myanmar and Indonesia, 2 each in Thailand, Vietnam and Afganistan and 1 each in Arabia, Oman and Muscat. Further, 14 species are found in North America and 7 in Central and South America (Sanjappa, 1989). Parkinson (1923) reported the availability of *M. laevigata* in Andaman and Nicobar islands. Sreekumar *et al.* (1995) have extensively explored Kerala and collected mulberry resources from farm backyard/ cultivated gardens, tea and coffee estates. The wide spread urbanization, for agricultural used and denudation of forest areas, threatens the natural habitats of mulberry particularly the primitive and obsolete varieties available in different parts of the country (Chauhan and Thakur, 1995; Sanjappa, 1989). The genus *Morus* is distributed naturally in the Sub-Himalayan region up to an altitude of 2200 m extending between Indus and Brahmaputra rivers with varying climate from temperate to tropical. *M. serrata,* the Himalayan mulberry is available in natural habitat in North-western Himalaya. The natural and sacred mulberry tree, belongs to *M. serrata* at Joshimath, is the oldest and about 1200 years old (Rau, 1967; Tikader *et al.,* 1999). Therefore, regular explorations are essential to identify the different locations of mulberry resources available in natural and cultivated habitats and to document the diversity of mulberry for further utilization in mulberry crop improvement programme.

Materials and Methods

Regular surveys and explorations were conducted in various geographical regions of the country in two different seasons (February-April and September-November) in every year during 1993-2000. The exploration sites are indicated in Fig. 1. To expedite the process of exploration in different areas, the geographical regions of the country were grouped into 4 zones, viz., North-east, North-west, Central and South India.

Accordingly, the zones were covered to identify the mulberry germplasm. Random sampling in case of wild forms and biased sampling procedure were used when the population was above 25 plants i.e. at least 10% of the population were sampled. Healthy, mature, disease-free shoots with dormant buds were collected for further multiplication in the nursery and subsequent establishment in the field genebank.

Results and Discussion

A total of 367 mulberry germplasm accessions were collected from different zones and states are presented in Table 1. The distribution pattern revealed that in India two species *M. laevigata* and *M. serrata* exist as wild trees (Fig. 2). *M. serrata* exists in North-western India up to an altitude to 2200m (Dandin *et al.,* 1993, 1995; Tikader *et al.,* 1999, 2000) growing with oak plantation in natural habitat. *M. laevigata* grows in varied climates both in wild and cultivated forms. The natural distribution of *M. laevigata* was observed in Eastern Himalaya, North West India and Andaman and Nicobar Islands. Cultivated forms of *M. laevigata* was observed in Central India, North-West India, South India which are grown as shade trees in tea and coffee estates. In Andaman and Nicobar Islands, wild trees of *M. laevigata* differ in characteristics from main landforms. *M. serrata* is the only representative of North-west India and confined to higher altitude in Sub-Himalayan belt (750-2200 m).

The variation observed in different species are presented in Table 2. *M. laevigata* collected from different parts of the country indicates lot of variation. The important characters of the species is ½ phyllotaxy, long inflorescence and big size leaf.

M. indica, the wild and cultivated mulberry for sericulture, possess varied leaf shape. Leaf serration varied from serrate to crenate. The special characteristic features of the species is long leaf, acuminate, style long hairy, female flower spike short, ovoid. Fruit spikes slightly enlarged, dark purple, black when ripened and tastes sour to sweet.

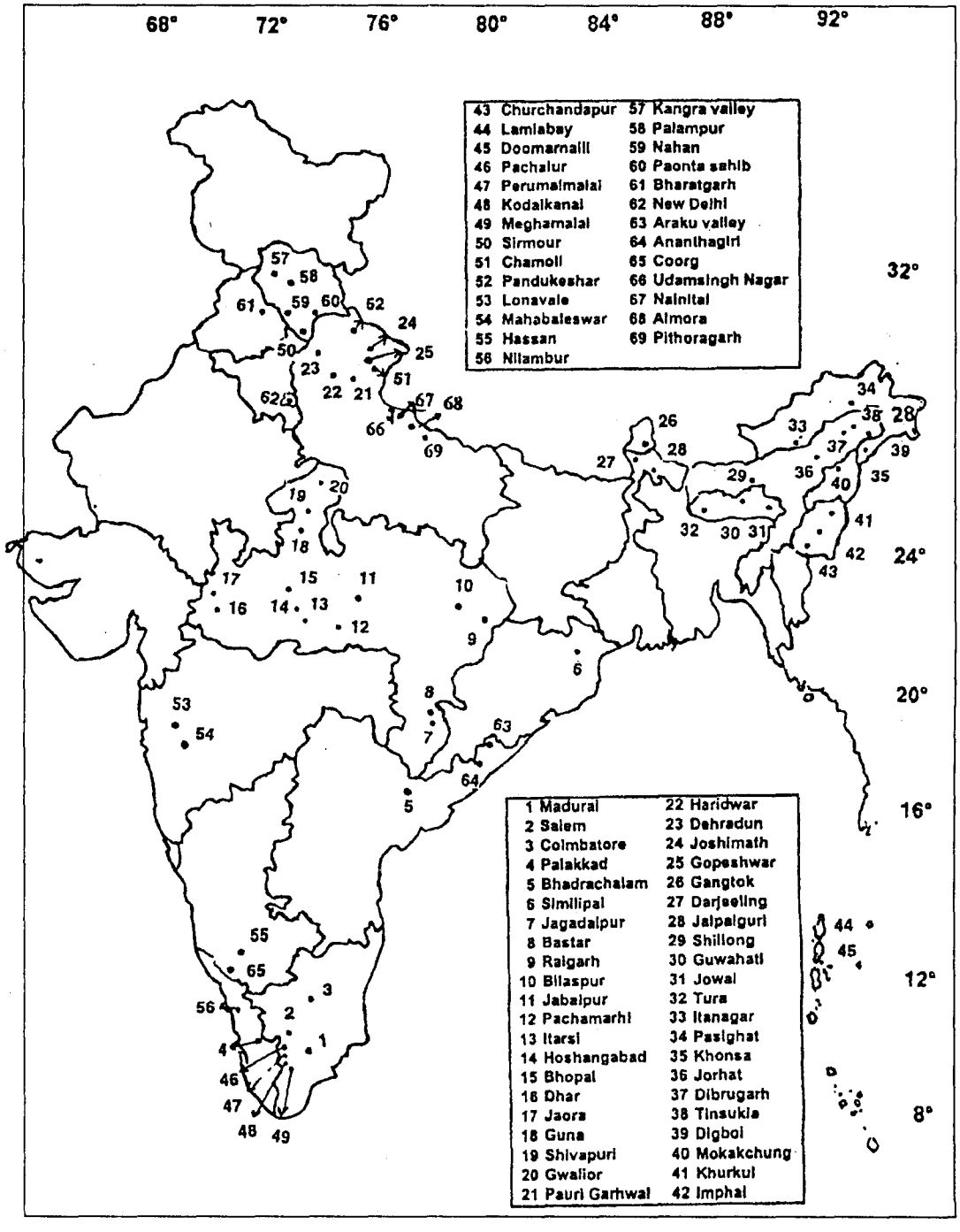

Fig. 1. Exploration sites of Morus Indica, M. alba, M. laevigata and *M. serrata in India*

Table 1. Number of mulberry germplasm accessions collected under each species and zones

Zone	Species					
	M. alba	*M. indica*	*M. laevigata*	*M. serrata*	*Unidentified*	*Total*
North-East India	—	32	33	—	4	69
North-West India	16	60	14	34	—	124
Central India	2	8	8	—	—	18
South India *(A&N islands)*	2	49	59	—	46	156
Total	20	149	112	34	50	367

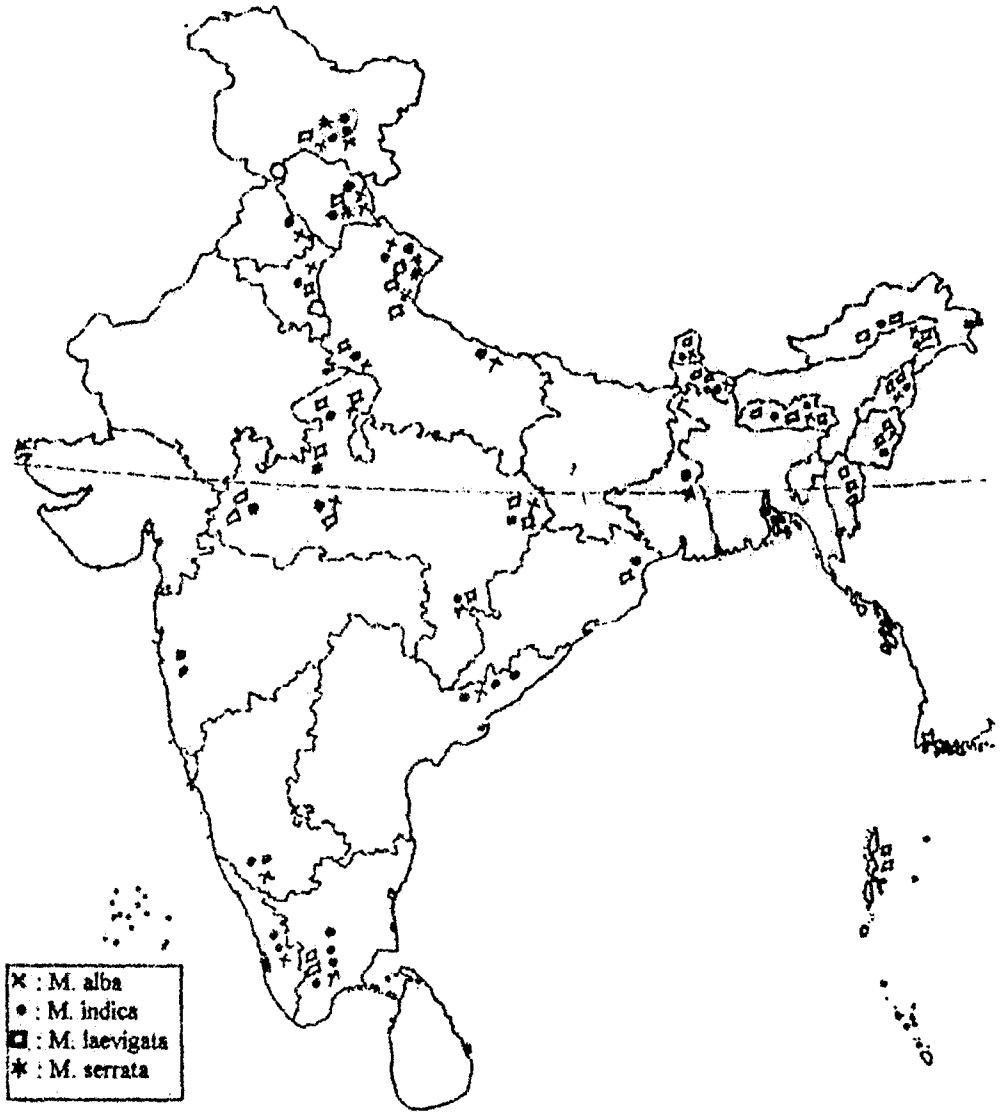

Fig. 2. Distribution of Morus species in India

Morus alba is known as white mulberry for its white fruit colour. The species is cultivated mainly for silkworm rearing. The species has small to medium leaves. The leaf apex is acuminate and leaf texture smooth. The style is short, minute hairy and united partly at the base. Fruiting spikes are dark purple or white when ripened and very sweet to taste.

Morus serrata is called the Himalayan mulberry as it is confined to North-western Himalayan belt. The bark colour varied from red brown to dark brown and blackish brown. Phyllotaxy is mixed type i.e. *½. 1/3* and *2/5*. Internodal distance varied from 3.5 to 7.5 cm. Fruit colour ranged from black to pink, very sweet to taste and mucilage (Tikader *et al.*, 1999, Tikader *et al.*, 2000).

All over India a good number of mulbery varieties have been introduced replacing the traditional ones. In eastern India the improved variety S1, S1635, Tr10, BC 259 have replaced the traditional varieties. In South India, the improved variety K2, S13, S36, V1 have replaced the traditional varieties. In North-West India, S146, Chinese white have replaced the local varieties. Till date about 60% area are covered by improved varieties. In the present circumstances, more germplasm is required for evolving new varieties. The collected germplasm (367) includes different species which were not collected earlier. The collections are being maintained in field genebank for characterization, evaluation and further utilization in crop improvement.

Table 2. Characteristic features of different mulberry germplasm collected from different zones of India

No.	Characters	*M. laevigata*	*M. indica*	*M. alba*	*M. serrata*
1	Bark colour	Brown, grey, grey white, greenish grey, grey blackish	Brown, dark brown, blackish brown	Brown, dark brown	Brown, dark brown, blackish brown
2	Leaf lobation	Lobed, unlobed, mixed	Lobed, unlobed, mixed	Unlobed	Lobed, unlobed, mixed
3	Leaf texture	Chartaceous, coriaceous	Chartaceous, coriaceous	Chartaceous, coriaceous	Chartaceous, coriaceous, leathery
4	Leaf shape	Ovate, long ovate, wide ovate	Ovate, narrow ovate	Ovate, narrow ovate	Ovate, narrow ovate, wide ovate
5	Leaf margin	Serrate, minute serrate,	Serrate, crenate, dentate	Serrate	Serrate, dentate
6	Leaf surface	Smooth, slightly rough, rough	Smooth, slightly rough, rough	Smooth	Smooth, slightly rough, rough
7	Leaf size Range (LxB)cm	15 x 11-32x16	10 x 8-20x12	14 x 12-15x12	15 x 10-20x20
8	Sex	Male, female	Male, female	Male, female	Male, female
9	Catkin length (cm)	4.0-10.0	1.5-3.5	1.5-2.5	2.5-3.5
	Male,				
	Female	5.0-12.0	1.5-3.5	1.2-2.5	3.0-4.0
10	Fruit length (cm)	6.0-12.0	1.2-4.0	1.8-2.6	3.5-4.5
11	Fruit colour	Green, pink, white, black	Black	Pink, white	Black, pink
12	Phyllotaxy	1/2	1/2,1/3,2/5	1/2,1/3	1/2,1/3,2/5
13	Internodal distance (cm)	4.0-10.0	3.8-5.5	3.5-4.5	4.0-7.0
14	Altitude (m)	150-1350	350-1340	400-1350	750-2200

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