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Journal of Threatened Taxa

Building evidence for conservation globally

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

COMMUNICATION

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Smita Debbarma, Biplob Banik, Biswajit Baishnab, B.K. Datta & Koushik Majumdar

26 August 2020 | Vol. 12 | No. 11 | Pages: 16548–16570

DOI: 10.11609/jott.4975.12.11.16548-16570



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Diversity and distribution of figs in Tripura with four new additional records

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Abstract: The genus *Ficus* L., commonly known as Fig plays an important role in the forest ecosystem, being a keystone species. Taxonomic revision, habitat assessment, and floristic study of the genus *Ficus* of northeastern region are scanty and still lacking. As the genus is rich in diversity, this region possesses tremendous scope for utilisation of its members, as many species belonging to this genus carry good properties for diverse uses for the benefit of mankind. Therefore, the present study has been undertaken for identification of the collected taxa, diversity assessment of the wild as well as planted species, distribution throughout the state and preparation of a comprehensive checklist along with measures of diverse functions and ecological role of the genus *Ficus* in Tripura, North-East India. Field survey was conducted between April 2017–August 2018 throughout Tripura and all the locations were marked with GPS which is given in the present distribution map of *Ficus* in Tripura. This study is based on extensive field survey and specimen collection. Key taxonomic description, both accepted and vernacular names, phenology, and diverse habitat function of all species have been provided. Based on the available literatures, distribution information of the present records were calculated. Evaluation of diverse ecological role were scored based on the published literature and field observations. In the present study, 23 taxa of *Ficus* have been reported from the study area including four new distribution records. Most of the *Ficus* species recorded in this study were from moist mixed deciduous and secondary forests. Out of 23 species of *Ficus* recorded in the present study, seven (7) species belong to evergreen small tree to shrub (*F. benghalensis*, *F. drupacea*, *F. elastica*, *F. microcarpa*, *F. racemosa*, *F. sarmentosa* and *F. semicordata*); three (3) species recorded are large deciduous tree (*F. racemosa*, *F. religiosa* and *F. rumpfi*). Fleshly fruited trees are the most preferable option for survival of frugivores over diverse habitats and thus, plays major role for entire ecosystem restoration. The present work will be useful to understand the critical interactions between plants and frugivore at different trophic levels. Further, *Ficus* groups tend to have multiple ecological roles, and as a result there exists huge scope to understand the mechanisms of plant functional traits for conservation of threatened frugivore diversity.

Keywords: Conservation, ecological roles, *Ficus*, frugivore, northeastern India.

Editor: K. Haridasan, Palakkad, Kerala, India.

Date of publication: 26 August 2020 (online & print)

Citation: Debbarma, S., B. Banik, B. Baishnab, B.K. Datta & K. Majumdar (2020). Diversity and distribution of figs in Tripura with four new additional records. *Journal of Threatened Taxa* 12(11): 16548–16570. <https://doi.org/10.11609/jott.4975.12.11.16548-16570>

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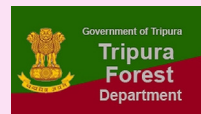
Funding: DBT Sanction Order No.: BT/01/17/NE/TAX; 29th March, 2018; 3 years.

Competing interests: The authors declare no competing interests.

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Author contribution: All authors have contributed equally. This is a collaborative work and have been modified by authors from time to time wherever required.

Acknowledgements: We are grateful to the Department of Biotechnology (DBT), Govt. of India for grant received through DBT Network Project (BT/01/17/NE/TAX) and Implementing Agency Ashoka Trust for Research in Ecology and the Environment (ATREE). We would like to thank Sri Jitaditya Debnath and Sri Jewel Saha for their consistent supports during field survey. We are also thankful to Principal Chief Conservator of Forest (PCCF), Tripura Forest Department, Govt. of Tripura for cooperation.



INTRODUCTION

The genus *Ficus* L. (commonly known as Fig; Moraceae) or fig trees are being considered as keystone species and ecologically important because they sustain populations of the many seed-dispersing animals that feed on their fruits throughout the year (Chaudhary et al. 2012; Krishnan & Borges 2018). *Ficus* is considered the most conspicuous and elusive genus due to its minute flowers present inside the closed fleshy receptacle (scyconium). The genus comprises about 750 species throughout the world (Corner 1965; Berg 1989; Berg & Corner 2005; Ronsted et al. 2008; Pederneiras et al. 2015). Furthermore, Adebayo et al. (2009) reported occurrence of 800 species in tropical and subtropical regions of the world and about 115 species in India (Chaudhary et al. 2012). *Ficus* is one of the largest genera of angiosperms comprising terrestrial trees (deciduous and evergreen trees), shrubs, hemi-epiphytes, climbers, and creepers occurring in the tropics and subtropics of the world (Frodin 2004; Berg & Corner 2005).

The first systematic account of the Indian *Ficus* L. is available in King (1887–88, 1888); therein he recorded 113 species and 47 infraspecific taxa from whole of the then British India out of which only 75 species and 16 infraspecific taxa were reported from present-day political boundary of the country. There are many published works on the genus by various authors who have contributed in the field of identification, classification, and nomenclature (Corner 1961, 1965, 1969, 1975, 1981; Berg 1986, 2003, 2006, 2007, 2010, 2012; Chantarasuwan & Kumton 2005; Whitfeld & Weiblen 2010; Kumar et al. 2011; Murugan et al. 2013; Dhungana et al. 2015) and new records from different regions of the world have contributed to the knowledge on taxonomy and distribution of this genus.

Ficus is readily distinguished by the highly characteristic fruits and has often been recognized by the milky juice, the prominent stipule that leaves a scar on falling and the minute unisexual flowers often arranged on variously shaped receptacles (Hutchinson & Dalziel 1958). *Ficus* includes a large number of indoor ornamental plants and garden and roadside trees such as *F. benjamina*, *F. elastica*, *F. pumila*, *F. religiosa*, and *F. microcarpa*. The genus has followed several curious lines of evolution (Weiblen 2001). The main concentration of the species lies in Asian-Australian region with about 500 species which is about 66% of the world species. *Ficus* is also considered one of the most diversified genera with regard to its habits and life forms (free standing tree, epiphytes, semi-epiphytes in the crevices, Rheophytes,

and Lithophytes). Some of the species of *Ficus* are used as food (e.g., *F. auriculata*, *F. semicordata*), fodder (e.g., *F. hispida*), and as medicine (e.g., *F. elastica*, *F. religiosa*). Moreover, *F. religiosa* and *F. benghalensis* are considered sacred to Buddhists and Hindus (Wilson & Wilson 2013).

It was reported that globally biodiversity is changing at an unprecedented rate as a complex response to several human-induced changes (Vitousek et al. 1997) and forest restoration is an increasingly important tool to offset and indeed reverse global deforestation rates (Cottee-Jones et al. 2016). One low cost strategy to accelerate forest recovery is conserving scattered native trees that persist across disturbed landscapes. *Ficus* trees, which are considered to be critically important components of tropical ecosystems, may be particularly attractive to seed dispersers in that they produce large and nutritionally rewarding fruit crops (Cottee-Jones et al. 2016) and in case of forest restoration studies seed dispersal has been frequently referred (Cole et al. 2010; Holl et al. 2013; Zahawi et al. 2013).

Fleshy-fruited trees are believed to be the most effective species at attracting frugivores over disturbed habitats and thus prove to be more effective restoration nuclei than other species (Slocum 2001). *Ficus* in particular is believed to be a very important genus of fleshy-fruited tree for a wide range of frugivores (Leighton & Leighton 1983; Terborgh 1986; Janzen 1988; Lambert & Marshall 1991; Shanahan et al. 2001; Kinnaird et al. 2005). Within intact forests, the unusual asynchronous fruiting cycle, large crop sizes, and pan-tropical availability of *Ficus* means that over 1,200 tropical birds and mammals have been recorded consuming *Ficus* fruit (Shanahan et al. 2001).

Taxonomic revision, habitat assessment, and floristic study of the genus *Ficus* of northeastern region are scanty and still lacking; however several studies were conducted from the region, viz.: Cottee-Jones et al. (2016) evaluated importance of *Ficus* trees for tropical forest restoration; medicinal uses *Ficus* by Sharma & Pegu (2011); figs as wild vegetables by Dutta (2012); a rare and lesser known species of India by Buragohain et al. (2012); and fig morphological characters and distribution by Dhungana et al. (2015). In Tripura such type of study and analysis was not done until date except for a few new reports (Majumdar et al. 2012a); however, efforts were made to quantify some *Ficus* tree species along with other trees in the forests of Tripura (Majumdar et al. 2012b; Majumdar & Datta 2014). As the genus is rich in diversity, this region possesses tremendous scope for utilisation of its members, as many species belonging to this genus carry good properties for

use for the benefit of mankind. Therefore, the present study has been undertaken for identification of the collected taxa, diversity assessment of the wild as well as planted species, distribution throughout the state and preparation of a comprehensive checklist along with measures of diverse functions and ecological role of the genus *Ficus* in Tripura, North-East India.

MATERIALS AND METHODS

Study area

Tripura is a state of northeastern India. It is the third-smallest state in the country bordered by Bangladesh to the north, south, west, and the Indian states of Assam and Mizoram to the east. There are five hill ranges in Tripura, these are, Baramura, Atharamura, Longtarai, Sakhan, and Jampui run north to south, parallel to each other. Forests cover more than half of the area, in which bamboo and cane tracts are common. Like most of the Indian subcontinent, Tripura lies within the Indo-Malaya eco-zone. According to the bio-geographic classification of India, the state is in the North-East bio-geographic zone (Champion & Seth 1968). The state has a geographical area of 10,491km². As per the report of the Forest Survey of India (FSI 2015) total forest and tree cover in the state is 8,044km², i.e., 76.71 % of the total state's geographical area.

Field survey, data collection and species identification

Field survey was conducted between April 2017–August 2018 throughout Tripura and all the locations were marked with GPS which is given in the present distribution map of *Ficus* in Tripura (Fig. 1). Survey was also conducted in each locality including discrete forest area. The occurrences of the *Ficus* plants were recorded and specimens were collected from the field for taxonomical study as well as made into standard mounted herbarium sheets following the standard procedure (Jain & Rao 1977). As far as possible, specimens were collected with reproductive parts for the morphological studies and preparation of herbarium sheets. Reproductive parts were preserved in FAA solution for further microscopic studies in the laboratory.

The taxonomic identification of tree species and their geographic distribution ranges were based on the information of Hooker (1890), Kanjilal et al. (1940), Haridasan & Rao (1987), and Deb (1981). The identity of collected specimens was also determined by study of detailed taxonomic descriptions in different e-floras. The voucher specimens were deposited in the herbarium of

the Department of Botany, Tripura University.

Species distribution

Based on the available literatures, distribution information of the present records were calculated on a scale of 1–6 (smaller to larger) to derived geographic distribution ranges score from numerical scale by slightly modified methods of Spitzer et al. (1993), i.e., (1) Eastern Himalaya, Yunnan and northern Indochina, (2) Bangladesh, northeastern India and northern Myanmar, (3) Indo-Burma (India including Andaman Island, Burma, Thailand and up to Vietnam), (4) Indo-Australian (India including Western Ghats, Sri Lanka, Indonesia and up to Australasian tropics), (5) Paleotropic (up to Baluchistan), (6) Cosmopolitan (Majumdar et al. 2012a).

Data analysis

Local occurrence and distribution in different forest habitat as well as non-forest land was typically recorded based on Frequency classes (Raunkiaer 1934), indicates the number of sampling units in which a given species occurs (Mishra 1968). Frequency of *Ficus* species in different locations of refers to the degree of dispersion of individual species in an area and is usually expressed in terms of percentage of occurrence.

Frequency and relative frequency of species in the study area are measured by using the formulae of Curtis & McIntosh (1950), which are given below.

$$\text{Frequency} = (\text{No. of occurrences of a species} \times 100) / \text{Total No. of site samples taken}$$

$$\text{Relative Frequency} = (\text{No. of occurrence of particular species} \times 100) / \text{Total no. of occurrences of all the species}$$

The values of relative frequency are calibrated on a 10-point scale to assign a status to the species in each region, however in this study we have not laid any quadrat and in this concern availability of a species was ranked based on their occurrence throughout the state Tripura. Four distinct groups are derived from this 10-point scale and each group in each region is designated as follows: 7–10 Very Frequent, 5–7 Frequent, 3–5 Less Frequent, <3 Rare.

Evaluation of diverse ecological role

Major uses of *Ficus* species found in Tripura were scored based on the published literature and field observations, which were prioritized for their various medicinal uses and diverse ecological role.

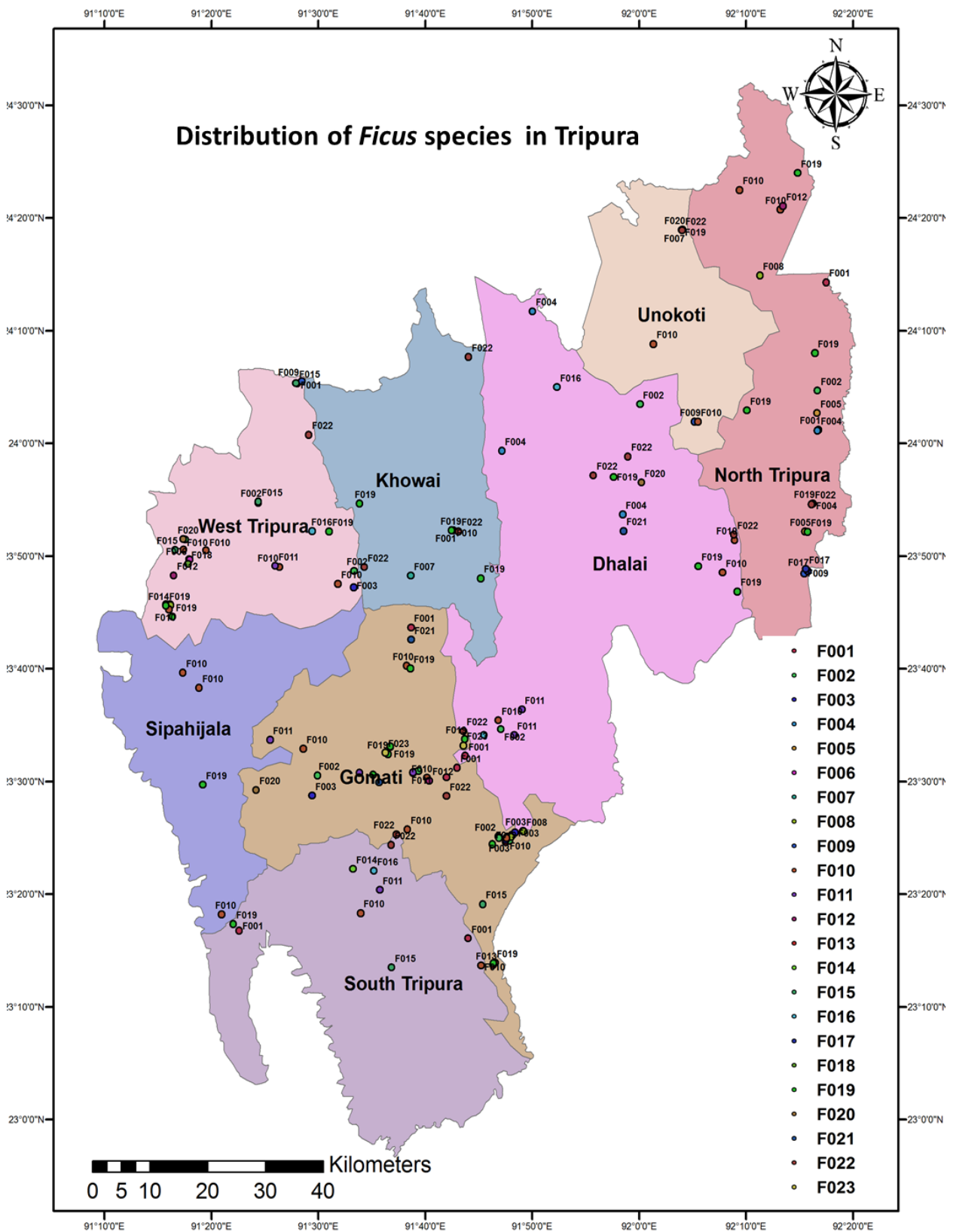


Figure 1. The location of field study and distribution of 23 *Ficus* species in Tripura.

RESULTS

Taxonomic treatment and species enumeration

Ficus auriculata Lour.

Fl. Cochinch. 2: 666. 1790; Kanjilal et al. Fl. Assam 4: 263. 1940; Deb, Fl. Tripura State 1:217.1981. (Image 1; F001).

Vernacular name: Durumpui (Kokborok), Elephant Ear Fig, Theibal.

Trees small, evergreen, young parts pubescent. Leaves 7.8–22 × 2.7–7.7 cm, elliptic or ovate-elliptic, serrate, subcoriaceous, glabrescent, lateral nerves 3–7 on each side, base subcuneate, 3–5 nerved; petiole 2.5–7.5 cm long; stipule ovate-lanceolate. Figs peduncled, subglobose, pyriform, red when ripe. Male flowers: perianth segments 3, stamens 2. Gall flowers: perianth 3 toothed, style short, stigma dilated. Female flowers: perianth 3 toothed, style long, stigma clavate.

Flowering & fruiting: August–March.

Global distribution: India, Bangladesh, Malesia, Myanmar, Pakistan to southern China, Thailand.

Distribution in India: Outer Himalaya ascending up to 2,000m, Arunachal Pradesh, Assam, Bihar, Jammu & Kashmir, Jharkhand, Maharashtra, Manipur, Meghalaya, Mizoram, Odisha, Sikkim, southern India, West Bengal

Distribution in Tripura: Taidu, Simna, Vanghmun. Baramura-Debtamura R.F., Atharamura R.F., Trishra R.F., Damcherra, Paschim Kalajari R.F. part.

Uses: Fruit is edible.

Ecology: Frequently found in evergreen forest, and mostly occur along the hill tract.

Ficus benghalensis L.

Sp. Pl. 1059. 1753; Kurz, For. Fl. Brt. Burma 2:440. 1877; King in Ann. Roy. Bot. Gard. Calcutta. 1: 18, t. 13 & 81c.1887 & in Hook.f., Fl. Brit. India 5: 499. 1888; Brandis, Indian Trees 600. 1906; Kanjilal et al., Fl. Assam 4:240.1940; Corner, Gard. Bull. Singapore 17: 381. 1960; Deb, Fl. Tripura State 1:211. 1981; Harridasan & Rao, For. Fl. Megh.2:820. 1987; (Image 1; F002).

Vernacular name: Bargad, Banyan, Bor.

Trees large, evergreen. Leaves 12–20 × 7–12 cm elliptic to ovate, apex mucronate, coriaceous, base rounded, sub-cordate or slightly narrowed at the base, green and glossy above, glabrescent or pubescent beneath, lateral nerves 4–7 on each side, looped near the margin, base 3–7 nerved, petiole 1.2–5 cm long; stipules deltoid. Figs in auxiliary pairs, 1.5cm, with three large rounded basal bracts, red when ripe. Male flowers: numerous near the mouth of the receptacle; perianth segments 3; stamen one. Gall flowers: similar with a short style. Female

flower: with smaller perianth and longer style.

Flowering & fruiting: April–July.

Global distribution: Bangladesh, India, Malaysia, Nepal, Pakistan, Sri Lanka, widely cultivated in tropics.

Distribution in India: Throughout India, northeastern region, sub-Himalayan forest, Andaman Islands

Distribution in Tripura: Tripura University Campus, G.B. Bazar, Paschim Kalajari R.F. part, Jatanbari, Dumbur, and scattered throughout the state.

Uses: Wood moderately hard, used as timber for miscellaneous purposes (Deb 1981). *F. benghalensis* is considered greatly sacred to Hindu as well as to the Buddhists and worshiped in diverse ways at a variety of occasions. *F. benghalensis* is also reported to cure many diseases ethnomedicinally such as leucorrhoea, anti-emetic, cutsand wounds, joint pains.

Ecology: Naturally scattered in the state and planted on road side as an avenue tree. The aerial root is styptic and aphrodisiac. Tips of the hanging roots are given for obstinate vomiting.

Ficus benamina L.

Mant. Pl. 1: 129. 1767; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 43, t. 52, 83h. 1887 & in Hook. F., Fl. Brit. India 5: 508. 1888; Brandis, Indian Trees 604. 1906; Deb, Fl. Tripura State 1:212. 1981. (Image 1; F003).

Vernacular name: Biriphang topsi (kokborok), Golden Fig, Weeping Fig, Java Fig, Pukar.

Trees large, main branches producing aerial roots which can develop into new trunks. Leaves 3.7–10 × 1.3–5 cm, leaf blade ovate to broadly elliptic, entire, coriaceous, glabrous, lateral nerves numerous, slender, anastomosing into an intramarginal nerve; petiole 1–2 cm long; stipules lanceolate. Figs axillary, often in pairs, globose or ovoid, about 2.2cm across. Male flowers few, scattered, pedicellate. Perianth segments 2, spatulate. Gall flowers: perianth 3–4 segmented. Female flowers: sessile. Perianth spatulate, stigma enlarged.

Flowering & fruiting: January–March

Global distribution: India (cultivated, avenue plants), China, Malaysia to the Solomon Islands and northern Australia.

Distribution in India: Throughout the north-eastern region, sub-Himalayan forest, Andaman Islands.

Distribution in Tripura: Balipur chhara, Tirthamukh, Dumboor; Purba Kalajhari R.F.

Uses: Milky juice and leaves are medicinal and trees are ceremonial and used as fodder (Rijal 1994; Thapa et al. 1997; Panthi & Chaudhary 2002).

Ecology: Sacred tree and mostly occurs on the roadside.

Ficus curtipes Corner

Gard. Bull. Singapore 17: 397. 1960 & 21 (1): 22. 1965; Roy et al., J. Econ. Taxon. Bot. Vol 22: 49-63. 1998; Deb, Fl. Tripura State 1:212. 1981; (Image 1; F004).

Vernacular name: Eastern Laurel Fig

Trees large, epiphytic when young. Branchlets green, glabrous. Leaves 6.2–19 × 3–3.7 cm oblong-elliptic or obovate-elliptic, entire, obtuse, coriaceous, lateral nerves 10–12 on each side; base 3–7 nerved, cuneate; petiole 0.8–1.7 cm long, stout; stipules ovate-lanceolate, acuminate. Figs axillary on leafy branchlets, paired, dark red to purplish red when mature, globose to depressed globose, 1–1.5 cm across, inside without bristles. Male flowers: numerous, scattered, perianth segments 3; Gall flowers: perianth segments; style subterminal. Female flowers: sessile, style lateral, stigma funnel shaped.

Flowering & fruiting: August–October

Global distribution: Bangladesh, Bhutan, India, Indonesia, Malaysia, Malay Peninsula (Langkawi Island), Myanmar, Nepal, Sikkim, Thailand, Vietnam.

Distribution in India: Northern and northeastern India.

Distribution in Tripura: Hmonpui, Tlakchi, Tlangsang, Jampui Hills, Kamalpur.

Uses: Yields an inferior rubber (Deb, 1981), used as an ornamental tree.

Ecology: Found in moist deciduous forest.

Ficus drupacea Thunb.

Diss. *Ficus* 6, 11. 1786; Miq., Ann. Mus. Bot. Lugd.-Bat. 3: 286. 1867; Corner, Gard. Bull. Singapore 17: 380. 1960 & 21 (1): 13. 1965; Deb, Fl. Tripura State 1:213. 1981; (Image 1; F005).

Vernacular name: Mysore Fig, Brown Woolly Fig, Paras Peepal.

Trees large. Bark grayish-white. Branches without aerial roots; densely yellowish-brown woolly. Leaves 14.8–25 × 6–13 cm elliptic to ovate-elliptic, entire bluntly acuminate, coriaceous, glabrous, dotted above, glabrescent beneath, lateral nerves 12–20 on each side, anastomosing into an intramarginal nerve, tertiaries very finely reticulate, base slightly cordate or rounded, 3–7 nerved, petiole 2–3.5 cm long; stipules deltoid, rusty tomentose. Figs axillary, 3.5cm across, globose, rusty tomentose when young, glabrous, orange when ripe. Male flowers: long pedicellate, perianth segments 4, stamen 1. Gall flowers: with 4 perianth lobes. Female flowers: perianth lobes 4, style lateral.

Flowering & fruiting: January–March.

Global distribution: India, Bangladesh, China, Indonesia, Malesia, Myanmar, Nepal, Sri Lanka, Thailand,

Vietnam, Laos, Bhutan.

Distribution in India: Maharashtra, Goa, Karnataka, Kerala, Tamil Nadu, Andhra Pradesh, northeastern India.

Distribution in Tripura: Hmonpui, Sabual, Jampui Ranges.

Uses: The figs are edible but rather tasteless.

Ecology: Found mostly in evergreen and rarely in deciduous forests.

Ficus elastica Roxb.

(Hort. Beng. 65. 1814, nom. Nud.) ex Hornem., Hort. Bot. Hafn. Suppl. 7. 1819; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 45, t. 54. 1887 & in Hook. F., Fl. Brit. India 5: 508. 1888; Brandis, Indian Trees 603. 1906; Deb, Fl. Tripura State 1:213. 1981 (Image 1; F006).

Vernacular name: Indian Rubber Tree, Rabar Gach, Atha bor

Trees large, evergreen, epiphytic when young. Bark pale gray, smooth.

Leaves 12–28 × 5–14 cm elliptic to oblong, entire, coriaceous, caudate at apex, rounded at base, glabrous; lateral nerves many, inconspicuous, petiole 1.3–6 cm long; stipules large, lanceolate, flaccid, reddish. Figs axillary on leafless branchlets, paired, yellowish-green, ovoid-ellipsoid, about 1.2cm long, sub-sessile, involucre bracts hood like at an early stage, caducous, scar conspicuous. Male flowers: scattered among other flowers, pedicellate, perianth lobes, anther ovoid-ellipsoid. Gall flowers: perianth lobes 4; style subterminal. Female flowers: style long; stigma subcapitate.

Flowering & fruiting: Fl. March–April, Fr. June–October.

Global distribution: Bhutan, Indonesia, Myanmar, Nepal, native to tropical Asia, India, and Malaysia and has been introduced in several countries.

Distribution in India: Assam, Meghalaya, Sikkim, Tripura, Karnataka, eastern Himalayas, and also widely cultivated throughout the country.

Distribution in Tripura: Planted at MBB College garden, growth is luxuriant

Uses: Yields the India rubber of commerce. Bark is astringent and used as styptics for wounds. Latex used for parasitic worms. Decoction of aerial rootlets used for wounds, cuts and scores.

Ecology: Planted in garden and luxuriant growth was found to very prominent. The species is not wind-tolerant and tends to break apart in strong winds.

Ficus hederacea Roxb.

Fl. Ind., ed. 1832, 3: 538. 1832. *F. scandens* Roxburgh

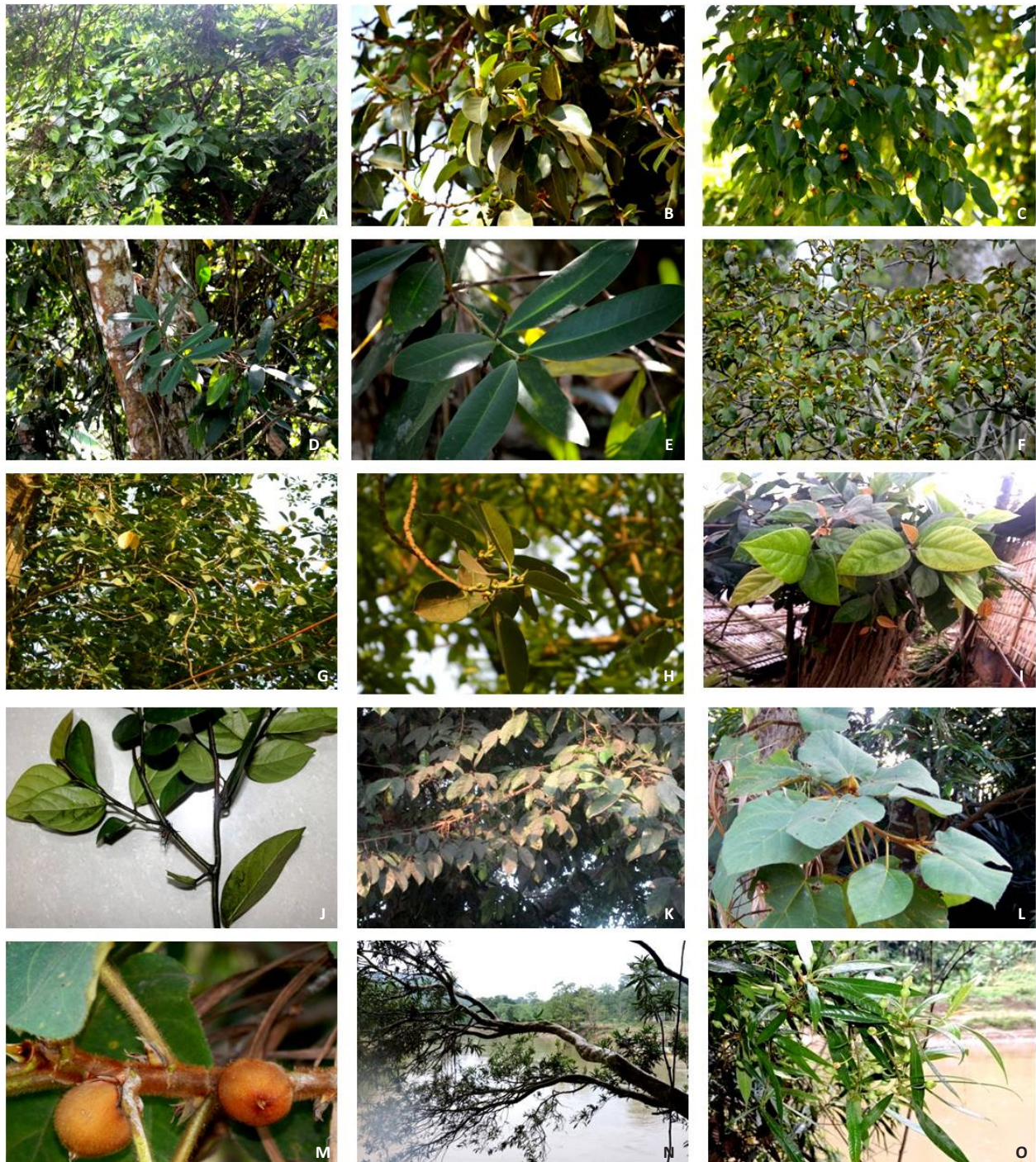


Image 1. A—Habitat of *Ficus auriculata* Lour. (F001) | B—*F. benghalensis* L. (F002) | C—drooping branches of *F. benjamina* L. (F003) | D—E—habitat and twig showing apical bud of *F. curtipes* Corner (F004) | F—*F. drupacea* Thumb. (F005) | G—H—complete tree of *F. elastica* Roxb. ex Homem. (F006) | I—J—habitat and twig with aerial adventitious root on branches of *F. hederacea* Roxb. (F007) | K—complete tree of *F. heteropleura* Blume. (F008) | L—M—habitat and fig bearing twig of *F. hirta* Vahl. (F009) | N—O—habitat of *F. ischnopoda* Miq. (F011).

(1832); Deb, Fl. Tripura State 1:214. 1981; King in Hook. F. Fl. Brit. Ind. 5: 526. 1888; Kanjilal et al. Fl. Assam 4: 260. 1940. (Image 1; F007).

Vernacular name: Climbing Fig, Ivy Fig, Dudhe lahari (Nepali).

Shrubs, scandent. Stems and branchlets with aerial roots at nodes. Stipules caducous, ovate. Leaves 5–7 × 3–4.8 cm, alternate, ovate or elliptic, thickly leathery, entire, acute at apex, rounded at base, scabrid above, pubescent beneath; lateral nerves 5–6 on each side,

base 3 nerved, petiole 0.8–1.2 cm long; stipules ovate, acuminate. Figs axillary on leafy or on leafless branchlets, solitary or paired, yellowish green to red when mature, globose, 0.8–1.2 cm across, with thick and short hairs when young, inside without bristles, apical pore navel-like, slightly convex. Male flowers: few, scattered, sessile; perianth lobes 4; lanceolate, style subterminal, stamens 2. Gall flowers: pedicellate; calyx lobes 4, lanceolate; ovary obovate, hard, black; style subapical, short; stigmas curved. Female flowers: flowers on separate figs, perianth 4, style elongate, stigma subcapitate, linear.

Flowering & fruiting: August–March.

Global distribution: Myanmar, India, southern China, Tonkin, Laos, Annam, and northern Thailand

Distribution in India: Northern India, Andaman Islands, Mizoram.

Distribution in Tripura: Uttar Unakuti R.F., Khasiamangal, Teliamura R.F. part.

Ficus heteropleura Blume

Bijdr. Fl. Ned. Ind. 9: 466. 1825 Kanjilal et al. Fl. Assam 4: 239. 1940; Deb, Fl. Tripura State 1:214.1981; (Image 1; F008).

Vernacular name: Unknown.

Erect Shrubs or small trees. Leaves 5–10.2 x 3–6.8 cm, elliptic or ovate, undulate, abruptly caudate, attenuated at the base, coriaceous, glabrous; lateral nerves 2–4 on each side, more prominent beneath; stipules minute, subulate. Figs pedunculate, axillary, subglobose, 0.5–8 cm, scabrid, reddish-yellow when ripe; peduncle short, hispid. Male flowers: perianth segments 4, stamen one, joined to a pistilode. Female flowers: perianth 3 fid, style short.

Flowering & fruiting: January–August.

Global distribution: Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Malaysia, Myanmar, Philippines, Thailand, Vietnam.

Distribution in India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bengal, Tripura.

Distribution in Tripura: Purba Kalajhari R.F., Suryamaninagar, Shilachari, Panisagar.

Uses: Unknown.

Ecology: Found in evergreen forest and hilly tract.

Ficus hirta Vahl

Enum. Pl. 2: 201. 1805; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 149, t. 188, 189. 1888 & in Hook. F., Fl. Brit. India 5: 531. 1888; Brandis, Indian Trees 608. 1906; Deb, Fl. Tripura State 1:215. 1981; (Image 1; F009).

Trees or Shrubs, branches hollow; young parts pubescent. Leaves 12–30 x 10–20 cm, suborbicular,

ovate or ovate-elliptic, serrate, acuminate, sometimes 3–5 lobed, scabrid above, hirsute or tomentose beneath, lateral nerves 4–7 on each side, base cordate or rounded, 3–7 nerved, petiole 2.4–16 cm long, hirsute, stipules ovate-lanceolate, acuminate. Figs axillary, in pairs, globose, 0.7–2.5 cm across, covered with long rufescent hairs. Male flowers: perianth segments 4; stamens 2. Gall flowers: perianth segments 4; style lateral, stigma funnel shaped. Female flowers: perianth segments 4, linear, lanceolate, style filiform.

Flowering & fruiting: August–September.

Global distribution: Asia: Bhutan, China, India, Indonesia, Myanmar, Nepal, Thailand, Vietnam.

Distribution in India: Arunachal Pradesh, Assam, Meghalaya, Sikkim, Tripura, West Bengal.

Distribution in Tripura: Betlingshib, Deo Reserve Forest part, Manu, Purba Simna.

Uses: Edible (Manandhar 2002).

Ecology: Scattered in moist deciduous mixed forest.

Ficus hispida L. f.

Suppl. Pl. 442. 1782; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 116, t. 154, 155. 1888 & in Hook. F., Fl. Brit. India 5: 522. 1888; Brandis, Indian Trees 606. 1906; Kumar et al., American J. Pl. Sci. 2: 83, f. 4. 2011. Kanjilal et al. Assam 4:253.1940; Deb, Fl. Tripura State1:215.1981. (Image 2; F010).

Vernacular name: Domur, Daduri, Khohota dimoru, Hairy Fig, Devil Fig, Khamta (kokborok), Kagsha, Kala umbar, Kharvoti.

Trees small, with fistular branches. Leaves 10–28 x 5.4–10 cm, opposite, obovate, obovate-oblong, elliptic or oblong, acute or acuminate, serrate or dentate, subcoriaceous, scabrid above, hispid, pubescent beneath, lateral nerves 6–10 on each side, petiole hispid, 1.2–5 cm long; stipules ovate-lanceolate, pubescent outside. Figs in pairs or clusters on short tubercles from old wood or on long branches, obovoid or turbinate, narrowed to a short stalk, hispid, greenish yellow and faintly ribbed when ripe, basal bract 3. Male flowers: perianth lobes 3; stamen one. Gall flowers: pedicellate, perianth rudimentary, style short, stigma dilated. Female flowers: perianth rudimentary, style one, hairy.

Flowering & fruiting: April–September.

Global distribution: India, Bhutan, China, Indochina, Malesia, Nepal, Sri Lanka, Australia.

Distribution in India: Andaman Islands, throughout northeastern India.

Distribution in Tripura: Scattered throughout the state.

Uses: Leaves are used as fodder; immature



Image 2: A–B—Habitat of *F. hispida* L.f. (F010) | C–D—a complete tree and fig bearing twig of *F. microcarpa* L.f. (F013) | E–F—Habitat of *F. nervosa*.and fig bearing twig(F014) | G—habitat of *F. pumila* L. (F016) | H—*F. rumphii* Blume (F019) | I—a complete tree of *F. racemosa* L. (F017) | J—*F. religiosa* L. (F018) | K—habitat of *F. lamponga* Miq. (F012) | L—*F. obscura* Blume (F015) (Source: Majumdar et al. 2012a) | M—habitat of *F. sarmentosa* Buch.-Ham.ex (F020) | N—habitat of *F. semicordata* Buch.-Ham.ex (F021) | O—habitat of *F. squamosa* Roxb. (F022) | P—*F. virens* Aiton. (F023).

inflorescence is used as a vegetable. Fruits are prescribed for diabetic patients. Ethno-medicinally, fruits, leaves and sticky latex are used for the treatment of liver ailments, urinary diseases and inflammatory conditions. In diabetes root exudates is taken even as for curing jaundice, curry prepared from leaf is taken (Borah et al. 2012). Young shoots, leaves and green fruits are eaten as vegetable and even the ripe receptacle is also eaten which is considered as food for liver (Dutta 2012). Fruits

are also eaten cooked or pickled, leaves are used for making dishes and twigs are lopped for fodder (Chhetri 2010).

Ecology: Mostly found in deciduous forest.

***Ficus ischnopoda* Miq.**

Ann. Mus. Bot. Lugd.-Bat. 3: 229, 294. 1867; Kurz, Fl. Burma 2: 456. 1877; Kanjilal et al. Assam 4:257.1940; Deb, Fl. Tripura State 1:216.1981. (Image 1; F011).

Trees small, bark gray, with winglike ridges. Branchlet internodes red, short. Leaves clustered apically on branchlets, base cuneate, margin entire, apex acuminate, lateral nerves 6–12 on each side, base 3 nerved, petiole hispid, 1.5–2.2 cm long, reddish-brown; stipules ovate-lanceolate, pubescent outside. Figs pedunculate, axillary, solitary, pyriform, 1–2 cm across, constricted at the base into a strip, reddish-brown when ripe. Male flowers: perianth segments 3; stamen 2. Gall flowers: pedicellate, perianth segments 4, style short, lateral. Female flowers: on separate figs, perianth segments 5, style long, , subterminal, persistent.

Flowering & fruiting: May–August.

Global distribution: India, Bangladesh, Bhutan, China, Indochina, Malesia, Myanmar, Thailand.

Distribution in India: Arunachal Pradesh, Assam, Meghalaya, Tripura, West Bengal.

Distribution in Tripura: Deb Bari, Silachari.

Ecology: River banks, scrub.

Ficus lamponga Miq.

Fl. Ind. Bat. Supple. 431. 1861 & Ann. Mus. Bot. Lugd.-Bat. 3: 294. 1867; Kurz, For. Fl. Brit. Burma 2: 451. 1877; (Image 2; F012).

Vernacular name: Lampung Fig, Dimoru, Dieng-kajapo, Dieng-thalliang, Mumukichok

Tree. Bark brownish-grey, faintly reticulately fissured. Leaves ovate to ovate-elliptic, 10–24 by 4–12 cm long, margin entire, acute or acuminate at apex, membranous, glabrous above, lateral nerves 8–12 on each side, reticulation fine, distinct, petiole 1–2.5 cm long, stipules lanceolate. Figs axillary on leafless and leafy branchlets, solitary or paired, peduncled, ellipsoid, globose or sub-pyriform, reddish orange when ripe about 1 cm across. Male flowers calyx lobes 4, stamens 1, filament adnate. Gall flowers ovary smooth, globose, style lateral, stigma tubular. Female flowers calyx lobes 4–5, style sub-terminal, stigma cylindrical.

Flowering & fruiting: October–January.

Global distribution: Bangladesh, Bhutan, India, Indonesia, Myanmar.

Distribution in India: Andaman Islands, Arunachal Pradesh, Cachar in Assam, Manipur, Meghalaya, West Bengal.

Distribution in Tripura: Agartala, Suryamani nagar.

Remarks: This taxon was recorded as new distribution of extensions in Tripura based on specimens collected from the field. The detailed description of the species with photographs and collection number are provided here to authenticate the record.

Ficus microcarpa L. f.

Suppl. Pl. 442. 1782; Kanjilal et al. Fl. Assam 4 : 245. 1940; Deb, Fl. Tripura State 1:216.1981. (Image 2; F013).

Vernacular name: Pakar, Laurel Fig, Chinese Banyan, Indian Laurel, Curtain Fig

A large evergreen tree. Leaves 3.7–13 x 2.2–6.1 cm, ovate or rhomboid, bluntly acute or obtuse at the apex, cuneate at the base, entire, coriaceous, glabrous; lateral nerves 8–10 on each side, 3 nerved at the base, stipules lanceolate. Figs 0.5–0.9 cm across, globose, sessile, in axillary pairs, yellowish when ripe. Male flowers numerous; perianth segments 3, stamen one. Gall flowers numerous; perianth segments 3, stamen one. Female flowers: perianth minute, style short, stigma clavate.

Flowering & fruiting: February–March.

Global distribution: India, Australia, Bhutan, China, Indochina, Japan, Malesia, Nepal, Sri Lanka, Taiwan.

Distribution in India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Peninsular region, Punjab, Rajasthan, Sikkim, Karnataka, Tamil Nadu, Kerala, Tripura, Assam.

Distribution in Tripura: Abhicharan bazaar, Krishna Nagar, Agartala, Purba Simna, Jalaya Bazaar, Ichhachhari, Jolaibari.

Uses: Its figs are consumed by several frugivorous vertebrate species, primarily birds, but also bats, rodents, other small mammals, and ants, which act as secondary dispersal agents (Kaufmann et al. 1991; Shanahan et al. 2001).

Ecology: Mostly grown in roadside and designated as sacred tree, however it was also found in moist deciduous mixed forest with very low species density.

Ficus nervosa B. Heyne ex Roth in Nov. Pl. Sp. 388. 1821; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 53, t. 65A. 1887 p. p. & in Hook. F., Fl. Brit. India 5: 512. 1888 p. p.; Brandis, Indian Trees 600. 1906; Lakshminarasimhan & Roy, J. Econ. Taxon. Bot. 20: 373. 1996. (Image 2; F014).

Vernacular name: Mai-hong, Nyaung-peinne

Trees. Branchlets wrinkled when dry. Leaves elliptic, oblong, or obovate-lanceolate, leathery, glabrous, abaxially dark coloured with small scattered tubercles, adaxially dark green but brown when dry and shiny, base rounded to cuneate and with two glands, margin entire, apex obtuse and mucronate; basal lateral veins short, with axillary glands, secondary nerves 7–12 on each side and abaxially prominent, petiole 1–2 cm. Figs axillary on normal leafy stem, paired or solitary, globose, 1–1.2 cm in diameters, tuberculate when young, base attenuate



Image 3: A–B—Clusters of figs and LS of Fig of *F. auriculata* Lour. | C–D–E—figs, LS of figs and magnified view (LS) of fig of *F. benghalensis* L. | F—LS of Fig *F. benjamina* L. | G—Figs of *F. heteropleura* Blume. | H—LS of figs of *F. hirta* Vahl. | I–J—Figs and TS of fig of *F. hispida* L.f. | K—LS of fig of *F. ischnopoda* Miq. | L—Figs of *F. lamponga* Miq.

into an apparent stalk, sessile, pubescent. Male, gall, and female flowers within same fig. Male flowers: near apical pore, pedicellate; calyx lobes 2, spatulate,

unequal in size; stamen 1. Gall flowers: pedicellate or sessile; calyx lobes 3, elongated, apex acuminate; style lateral; stigma clavate.

Flowering & fruiting: January–August.

Global distribution: China (Fujian, Guangdong, Guangxi, Guizhou, Sichuan, Yunnan), Taiwan, Bhutan, India, Myanmar (Bago, Kachin, Sagaing, Taninthayi), Sikkim, Sri Lanka, Vietnam, Nicobars, Nepal, Laos, Thailand.

Distribution in India: Andaman & Nicobar Islands, Arunachal Pradesh, Assam, Bihar, Jharkhand, Meghalaya, Peninsular region, Sikkim.

Distribution in Tripura: Mandai, Purba Kathalia and scattered in Dhalai District of Tripura.

Uses: Bark contains Secondary metabolites and they are responsible for therapeutic effects (Devi et al. 2013).

Ecology: Canopy trees in evergreen forests.

Remarks: This taxon was recorded as new distribution of extensions in Tripura, Northeast India; based on specimens collected from the field. The detailed description of the species with photographs and collection number are provided here to authenticate the record.

***Ficus obscura* Blume.**

Bijdr. Fl. Ned. Ind. 9: 474. 1825; King, Ann. i.t. 102, 103. *F. microtus* Miq. Var. *borneensis* Miq., Ann. Mus. Bot. Lugd.-Bat. 3: 273. 1867. *F. pisifera* Wall. Ex Voight, Hort. Suburb. Calc. 285. 1845; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 3, t. 1. 1887 & in Hook. F., Fl. Brit. India 5: 496. 1888. (Image 2; F015).

Small tree, branchlets rough with short stiff hairs and scales; leaves 3.4–25 x 2.7–8.8 cm thinly membranous, very unequal-sided, unequally serrate and rough with raised dots and minute stiff hairs, chiefly along the nerves; stipules 1.2–1.4 cm long. Figs 0.7–1.2 cm across, flower with 1 or 2 bract-like warts on the outer surface, reddish or orange when ripe.

Flowering & fruiting: May–September.

Global distribution: India and Myanmar.

Distribution in India: Northeastern India.

Distribution in Tripura: Betlingshib, Jampui Hills.

Ecology: Evergreen Forest and rare.

Remarks: This taxon was also recorded as new addition to the flora of Tripura by Majumdar et al. (2012a). The detailed description of the species with photographs and collection number are provided here to authenticate the record.

***Ficus pumila* L.**

Sp. Pl. 1060. 1753; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 124, t. 158. 1888; (Image 2; F016).

Vernacular name: Creeping Fig, Climbing Fig.

Shrubs, climbers or scandent. Rooting branchlets

sterile. Leaves distichous, leaf blade on fertile branchlets different in shape than ones on sterile branches, ovate-cordate, ovate-elliptic, abaxially pubescent, margin entire, apex obtuse, acute, or acuminate; lateral nerves conspicuous, honeycomblike; basal nerves elongated, secondary nerves 3 or 4, abaxially prominent, and adaxially impressed; stipules lanceolate, with yellow brown silk like hairs. Figs axillary on normal leafy branches, solitary, yellowish green to pale red when mature, pear-shaped to globose or cylindrical, shortly yellow pubescent when young, basally attenuate into a short stalk, apical pore truncate, densely covered with long pubescence, persistent. Male flowers: many, in several rows near apical pore, pedicellate; calyx lobes 2 or 3, linear; stamens 2; filaments short. Gall flowers: pedicellate; calyx lobes 4, linear; style lateral, short. Female flowers: pedicel long; calyx lobes 4.

Flowering & fruiting: May–August.

Global distribution: India, China, Japan, Korea, Malesia, Taiwan, Vietnam (Cultivated).

Distribution in India: Cultivated.

Distribution in Tripura: Cultivated.

Uses: Used for the production of jams and jellies. The fruits and the leaves are considered to be galactagogue and tonic. They are used in cases of impotence, lumbago, rheumatism, anaemia, haematuria, chronic dysentery and haemorrhoids. The latex is reported to have anthelmintic properties.

Ecology: Cultivated outdoors, this plant is a popular cover for stone walls or rock outcroppings. Grow as a houseplant or garden annual.

Remarks: This taxon was also recorded as new addition to the flora of Tripura. In Tripura it is known as an ornamental plant and is used widely for covering walls, somewhere introduced, however edible fruits are not consumed by local people. The detailed description of the species with photographs and collection number are provided here to authenticate the record.

***Ficus racemosa* L.**

Sp. Pl. 1060. 1753; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 183. 1888; Deb, Fl. Tripura State 1: 217. 1981. (Image 2; F017).

Vernacular name: Cluster Fig, Gular Fig, Redwood Fig, Udumbara, Janja dumur.

A large deciduous tree; young parts pubescent, bark greyish brown. Leaves 10–17.5 x 3.8–8 cm, ovate-elliptic, ovate-oblong or oblong-lanceolate, entire, bluntly acuminate, membranous, glabrous, with minute dots on the lower surface; lateral nerves 4–10 on each side; base 3 nerved; petiole 1.4–2.4 cm long; stipules

small ovate-lanceolate. Receptacles peduncled, in short paniced fascicles from the trunk and larger branches, sometimes axillary, subglobose or pyriform, 2.5–3.8 cm across, reddish when ripe; basal bracts 3. Male flowers: perianth 3–5 lobed; stamens of gall flowers pedicellate. Female flowers: perianth 4–5 toothed, style subterminal, stigma clavate.

Flowering & fruiting: March–May and again September–November.

Global distribution: India, Australia, Bangladesh, China, Indochina, Malesia, Myanmar, Nepal, Pakistan, Sri Lanka.

Distribution in India: Almost throughout from the outer Himalaya to plains and low hills.

Distribution in Tripura: Throughout the state.

Uses: The fruit is edible, the leaves are used as fodder (Chaudhary et al. 1999), and the bark is used for tanning. Latex is aphrodisiac and vulnerary, useful in inflammations, piles, diarrhea and in combination with sesamum oil in cancer. The mature fruits are astringent, stomachic and carminative. They are eaten by local communities. A decoction of the bark is used as a wash for wounds. Fruits are edible when ripe. Ethno-medicinally, boiled fruits are given in diabetes (Buragohain 2011).

Ecology: Moist areas, beside rivers and streams, and scattered throughout the state.

***Ficus religiosa* L.**

Sp. Pl. 2: 1059. 1753; King, Ann. Roy. Bot. Gard. (Calcutta) 1:55. 1888; Hook f., Fl. Brit. India 5:513.1888; Kanjilal et al., Fl.Assam.4:246.1940; Brandis, Indian Trees. 601.1906; Deb, Fl. Tripura State 1:218. 1981. (Image 2; F018).

Vernacular name: Pipal Tree

A large deciduous tree; bark greyish with brownish specks. Leaves 10–18 x 8–12 cm, orbicular-ovate, undulate, caudate, long acuminate, coriaceous, glabrous, tubercled beneath, lateral nerves 6–8 on each side, tertiaries closely reticulate; base 5–7 nerved, shallow cordate, rounded or truncate, petiole 7–10 cm long, slender, stipules minute. Receptacle sessile in axillary pairs, 1.3–1.5 cm across, subglobose, bark purple when ripe; basal bracts 3, pubescent. Male flowers very few, sessile, perianth segments 3, ovate, stamen one, filament short. Gall and female flowers: perianth segments 5, lanceolate, style short.

Flowering & fruiting: Mar–April, and again May–June.

Global distribution: India, Burma, Ceylon, Bangladesh, China, Myanmar, Pakistan and Thailand;

introduced and cultivated in southeastern Asia, Middle East, northern Africa (Egypt, Libya), USA and elsewhere.

Distribution in India: Kerala, Assam, Tripura, Odisha.

Distribution in Tripura: Kunjaban, G.B. Bazar, Uttar Unakuti R.F., Kakraban and mostly scattered throughout the state.

Uses: This is considered as a highly sacred tree in Hindu & Buddha religions since ancient time and worshiped in different ways at various occasions. The juice of bark is used for the treatment of ulcer, liver, spleen and skin diseases. The wood is moderately hard and durable so used in packing materials; the leaves are used as a fodder and it is planted as an avenue or road side tree.

Ecology: Roadside as sacred tree.

***Ficus rumphii* Blume**

Bijdr. Fl. Ned. Ind. 437. 1825; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 54, t. 67b, 84t. 1887 & in Hook. F., Fl. Brit. India 3: 512. 1888; Watt., Dict. Ec. Prod. Ind. 3: 361. 1890; Brandis, Indian Trees 601. 1906; Deb, Fl. Tripura State 1:218. 1981; (Image 2; F019).

Vernacular name: Pilkhan, Khabar, Gajhar.

A large deciduous tree; bark greyish, smooth. Leaves 7.4–15 x 3.5–7.8 cm ovate or ovate-oblong, entire, shortly acuminate, glabrous, lateral nerves 3–6 on each side, base 3–5b nerved, cordate, truncate or narrowed into the petiole; petiole 3.8–7.5 cm long, jointed with the blade; stipules small, ovate-lanceolate, black when ripe, basal bracts 3, orbicular. Male flowers few near the osteole, perianth segments 3, stamen one. Gall and female flowers: perianth segments 3, lanceolate, style elongate, stigma clavate.

Flowering & fruiting: April–July and again December–January

Global distribution: Nepal, Bhutan, China, Myanmar, Indochina, Malaysia, India.

Distribution in India: North-west to north-east & central states, Andaman and Nicobar Island. From sub Himalayan tract and outer hills.

Distribution in Tripura: Bagafa, Bagma, Amarpur, Jirania, Maharani Bazar, Kalajhari Bazar, Gandachhara.

Uses: Used as fodder tree (Manandhar 2002). Foot and mouth disease of cattle is treated by feeding *F. rumphii* (Manandhar 1992, 2002).

Ecology: Mostly grows as an epiphytic while young.

***Ficus sarmentosa* Buch.-Ham. ex. J.E.Sm.,**

Rees. Cyclop. 14: *Ficus* no. 45. 1810; King, Ann. Roy. Bot. Gard. (Calcutta) 1: 184. 1888 (Image 2; F020).

Shrubs or woody vines. Branchlets grayish-white

when dry, rugose, glabrous, subglabrous, or densely white-hairy. Leaves 7.5–15 × 2.3–4.5 cm, distichous, subglabrous leaf blade ovate, ovate-elliptic, elliptic-lanceolate, both surfaces glabrous, base rounded to broadly cuneate, margin entire, apex acute to acuminate; secondary nerves 4–12 on each side of midvein, tertiary veins honeycomblike, petiole 1.2cm long, hairy; stipules lanceolate-ovate. Figs axillary on leafy or on leafless branchlets, solitary, glabrous, sparsely pubescent, or densely covered with brown hairs, inside with bristles, apical pore slightly concave, sessile. Male flowers: pedicellate; calyx lobes 3 or 4, oblanceolate; stamens 2; filaments very short; anthers mucronate. Gall flowers: pedicellate; calyx lobes 4, obovate-spatulate; ovary elliptic; style short; stigma shallowly funnelliform. Female flowers: pedicellate; calyx lobes spatulate; ovary obovate; style subapical; stigma thin and long.

Flowering & fruiting: May–July.

Global distribution: Bangladesh, Pakistan, China, Bhutan, Indochina, Japan, Korea, Myanmar, Nepal, Taiwan.

Distribution in India: Arunachal Pradesh, Assam, Jammu & Kashmir, Himachal Pradesh, Mizoram, Meghalaya, Punjab, Sikkim, Tripura, Uttar Pradesh, West Bengal.

Distribution in Tripura: Gandhari, Dakshin Taidu, Sadhujan Para.

Ecology: This taxon naturally spread their branches along the ground, but readily takes advantage of any shrub or tree in their path over which they can ascend. Evergreen species and traced in several semi evergreen forest patches.

Ficus semicordata Buch.-Ham. ex J.E.Sm.

Rees Cyclop. 14: *Ficus* no. 71. 1810; Corner, Gard. Bull. Singapore 17: 449. 1960 & 21 (1): 62.1965; Deb, Fl. Tripura State 1:219. 1981; (Image 2; F021).

A small tree, young parts hirsute. Leaves 10–25 × 6–18 cm, alternate, oblong or elliptic-lanceolate, serrate or crenate, acute or acuminate, scabrid; nerves 7–14 on either side, base unequal semi-sagittate or subcordate; petiole short, 0.5–1.5 cm long, scabrid; stipules lanceolate. Receptacles in pairs or in clusters on drooping mostly leafless branches, sometimes near the base of the tree or from larger branches, 1–2 cm across, globose or pyriform, hispid, reddish brown when ripe. Male and gall flowers in short peduncled set.

Flowering & fruiting: May–September.

Global distribution: Nepal, Bhutan, China, Bangladesh, Myanmar, Thailand, Vietnam, Pakistan, Malaysia, India.

Distribution in India: Jammu & Kashmir, Uttar Pradesh, Jharkhand, Madhya Pradesh, Sikkim, Assam, Meghalaya, Manipur.

Distribution in Tripura: Atharamura R.F., Subal singh, Hawaibari, Uttar Unakuti R.F., Tlangsang, Shakhan Sermon, Manu Chhailengta R.F., Longtarai R.F., Paschim Daluma, Dakshin Baramura Deotamura R.f., Uttar Debipur, Paschim Kalajari R.F. part.

Uses: The figs are sweet and eaten by locals as fruit. The juice from the roots is given in bladder complaints and visceral obstructions (Kirtikar & Basu 2001). The leaves are use as fodder for cattle.

Ecology: Characteristics species of semi evergreen forests and mostly occurring in hilly tract of Tripura. Furthermore moist mixed deciduous forest at comparatively higher elevation also supports this taxon.

Ficus squamosa Roxb.

Fl. Ind. 3: 531. 1832; Harridasan & Rao, 2:833.1987; Kanjilal *et al.*, Fl. Assam 4:252.1940; Deb, Fl. Tripura State 1:220.1981. Joseph, Fl. Nongpoh Vicinity 251.1982; Image 2; F022).

Vernacular name: Dimoru, Jamynrei, Phukhu-jhola.

Shrubs bushy, young shoots rusty hirsute. Leaves 2.5–12 × 0.8–2.8 cm, opposite, crowded at the ends of branches, lanceolate or oblanceolate, acuminate, entire or serrate along the upper half, membranous when young, subcoriaceous when mature, glabrous above, scabrid beneath, strigose along midrib and nerves, lateral nerves 6–8 on each side, base acute, 3 nerved; petiole upto 2.5cm long ; stipules scarious, glabrous. Receptacles pedunculate, solitary, axillary or in cluster on old stem, pyriform, globose, 2–2.5 cm across, hispid, verrucose, ribbed, brown when ripe. Male flowers: perianth segments 3–4; stamen one. Gall flowers: perianth hyaline, style lateral. Female flowers: style hairy, long, slender.

Flowering & fruiting: Almost throughout the year.

Global distribution: India, Nepal, Bhutan, China, Myanmar, Thailand.

Distribution in India: Arunachal Pradesh, Assam, Bihar, Meghalaya, Odisha, Tripura, Uttarakhand, West Bengal.

Distribution in Tripura: Paschim Kalajari R.F. part, Dumbur, Debbari.

Ecology: Key species of riparian habitat and restricted in specific areas of Tripura.

Ficus virens Aiton

Hort. Kew. 3: 451. 1789; Kanjilal *et al.* Fl. Assam 247.1980; Deb, Fl. Tripura State 1:216.1981. (Image 2; F023).

Key to the species

- 1a. Male, female and gall flowers in the same receptacle, male flowers without rudimentary pistil
- 1b. Male, female and gall flowers not in the same receptacle, male flowers with a rudimentary pistil, monandrous
- 2a. Leaves coriaceous, 10–20 × 7–12 cm, ovate, base cordate, 3–7 nerved
- 2b. Leaves 6–18 × 3–3.8 cm, coriaceous, elliptic or oblanceolate, glabrous; base 3 nerved, cuneate; lateral nerves 10–12 on each side
- 3a. Receptacle globose, pubescent; lateral nerves 4–7 on each side of the leaf *F. benghalensis*
- 3b. Receptacle oblong or ovoid, tomentose; lateral nerves 12–20 on each side *F. drupacea*
- 4a. Bark smooth, leaves coriaceous, secondary nerve less than 12; figs warty, orange or reddish..... *F. curtipes*
- 4b. Bark brownish-grey, fissured reticulate, inside yellowish-brown, leaves membranous, lateral nerves less than 14 on each side. Figs globose, smooth, red *F. lamponga*
- 5a. Leaves more or less coriaceous
- 5b. Leaves membranous on long slender petiole; leaves cordate, acuminate
- 6a. Lateral nerves closely parallel, inconspicuous, numerous, nearly at right angles to the midrib, anastomosing little except at the margin
- 6b. Lateral nerves conspicuous, 5–8 on each side of midvein, nervules and reticulations minute but distinct *F. virens*
- 7a. Stipules large, sub-persistent; receptacles greenish-yellow when ripe *F. elastica*
- 7b. Stipules small, caduceus; receptacle yellow or red when ripe *F. benjamina*
- 8a. Leaves leathery, glabrous; basal veins conspicuously raised; base truncate or rounded, 3-5 nerved; figs purplish-red when mature
- 8b. Leaves leathery, not glabrous; basal veins not raised; cuneate at the base; base 3 nerved; figs yellow to slightly red when mature...*F. microcarpa*
- 9a. Leaves 7.5–15 × 3.8–7.5, shortly acuminate *F. rumphii*
- 9b. Leaves 10–18 × 7–12, long acuminate *F. religiosa*
- 10a. Male flowers monandrous
- 10b. Male flowers diandrous
- 11a. Receptacles mostly axillary
- 11b. Receptacle mainly in fascicles from stem or branches
- 12a. Erect shrubs or trees; rooting branched fertile, stipule without hair, 4–8 nerved; receptacles 7.5mm or more across
- 12b. Climber or scandent shrubs, rooting branchlets sterile, stipule with yellow brown silky hair; 3–4 nerved *F. pumila*
- 13a. Leaves mostly opposite
- 13b. Leaves mostly alternate
- 14a. Leaves narrow, linear, oblanceolate, cuneate at the base *F. squamosa*
- 14b. Leaves ovate-oblong or elliptic-oblong; base sub-cordate or rounded *F. hispida*
- 15a. Receptacle globose, glabrous, 1.5–2.5 cm across; leaves granulate beneath
- 15b. Receptacle hispid and verrucose when ripe, 1–1.8 cm across; leaves unequally subauriculate *F. semicordata*
- 16a. Receptacle mostly axillary
- 16b. Receptacles mostly in fascicles from stem or branches
- 17a. Erect shrubs or trees
- 17b. Creeping or epiphytic
- 18a. Young parts sparsely hairy; leaves entire or nearly so; receptacle pedunculate, lengthening out into a stalk, gradually constricted
..... *F. ischnopoda*
- 18b. Young parts densely tomentose; leaves not entire; receptacle sessile with long rufescent hairs, globose *F. hirta*
- 19a. Leaves ovate *F. hederacea*
- 19b. Leaves oblong *F. sarmentosa*
- 20a. Leaves unequal at the base, margin serrate, style lateral, persistent, fruit orange *F. obscura*
- 20b. Leaves cuneate base margin entire, style terminal, caudaceous, fruit reddish *F. nervosa*
- 21a. Leaves ovate-elliptic, serrate, subcoriaceous *F. auriculata*
- 21b. Leaves ovate, ovate-oblong, entire, membranous *F. racemosa*
- 22a. Stipules long, ovate-lanceolate; leaves unequal lateral, lanceolate to elliptic ovate; female sepals 4
- 22b. Stipules minute; leaves broadly ovate or ovate elliptic; female sepals 3 *F. heteropleura*



Image 4: A—LS of fig of *F. lamponga* Miq. B—C—fig bearing twig and magnified view (LS) of fig of *F. racemosa* L. | D—E—F—Figs, LS of figs and magnified view (LS) of fig of *F. religiosa* L. | G—Figs of *F. rumphii* Blume | H—I—J—fig bearing twigs and TS of fig of *F. semicordata* Buch.-Ham. ex | K—LS of fig of *F. squamosa* Roxb. | L—Figs on twig of *F. virens* Aiton.

Vernacular name: White Fig, Sandpaper Fig, Pilkhan, Ching Heibong

Trees large, with buttress or prop roots, deciduous or semideciduous. Leaves 7.5–20 × 3.6–8 cm, leaf blade ovate to elliptic, oblong ovate or ovate narrowly, base bluntly rounded, cuneate, or cordate, margin entire, apex acuminate to shortly acuminate; lateral nerves 6–9 on each side, base 3 nerved, cuneate, petiole up to 7.8 cm long; stipules ovate, pubescent. Figs axillary on leafy branchlets, paired or solitary or in clusters on leafless older branchlets, subglobose, 6–8 cm across, with conspicuous interfloral bristles. Male flowers: few, near apical pore, sessile; perianth segments 4, lanceolate; stamen 1; filament short; anther broadly ovoid. Gall flowers: pedicellate; perianth segments 4; style lateral, shorter than ovary. Female flowers: similar to gall flowers; style longer than ovary.

Flowering & fruiting: April–August.

Global distribution: Bhutan, Bangladesh, Pakistan, China, Cambodia, India, Indonesia, Japan, Laos, Malaysia, Myanmar, New Guinea, Philippines, Sikkim, Sri Lanka, Thailand, Vietnam; northern Australia.

Distribution in India: India (Throughout up to 1,700 m, also frequently planted), Uttar Pradesh, Punjab.

Distribution in Tripura: Paschim Daluma, Amarpur Rangtang Bari, Ramthakur College, Agartala.

Uses: Foliage buds are eaten as vegetable and pickle.

Ecology: Roadside.

DISCUSSIONS

Most recently, 115 taxa of *Ficus* have been recorded from India out of which 89 are species and remaining 26 taxa fall under different infra-specific categories (six subspecies and 20 varieties), with maximum diversity in the north-east (61 spp.) and peninsular regions and Andaman & Nicobar Islands with ca. 35 species each (Chaudhary et al. 2012). Kanjilal et al. (1940) reported 42 species of *Ficus* from undivided Assam in “Flora of Assam”. In Meghalaya alone about 43 species of *Ficus* are found and considered as the hotspot region for the genus in India (Chaudhary et al. 2012).

In the present study, 23 taxa of *Ficus* have been reported from the study area including four new distribution records (Table 1). The increase in the number of species has been observed in the present study when compared to the earlier report of 23 taxa including one variety in the “Flora of Tripura State” from the same geographical extent (Deb 1981), which was based on survey of literature, author’s own collection

and consultation of herbaria, however, while working on the morpho-taxonomy of figs in Tripura, we could collect only 19 species out of 23 species reported by Deb (1981).

Out of 23 species of *Ficus* recorded in the present study, seven species belong to evergreen small tree to shrub (*F. benghalensis*, *F. drupacea*, *F. elastica*, *F. microcarpa*, *F. racemosa*, *F. sarmentosa* and *F. semicordata*); three (3) species recorded are large deciduous tree (*F. racemosa*, *F. religiosa* and *F. rumphii*). Among all species *F. hispida* and *F. racemosa* show a wide range of distribution in all the eight districts of the study area and variations in its habit which range from small shrub to medium-sized tree, however, *F. hispida* has been found more commonly especially in lowland and moist areas in mixed deciduous forest. The most common is the *F. hispida* which is present throughout except inside the deep forest. Apart from forest areas, *F. benghalensis* and *F. religiosa* are commonly visible on walls, temples and old buildings. *F. benjamina*, *F. religiosa*, *F. curtipes*, *F. virens* are epiphytic when young and free standing later. The *Ficus* species recorded occurs in mixed deciduous forest, moist deciduous forest, tropical semi-evergreen forest, and secondary forest.

Species distribution and conservation status

The information on geographic extensions of *Ficus* species is important from taxonomical and phytogeographical point of view and will also contribute towards the conservation of those restricted species. Although, it is difficult to quantify the total number of additional species that still exist in different forests of Tripura without comprehensive reassessments of the flora. Furthermore, present effort has been focussed on geographical distribution of collected species (Fig.2) with their regional distribution. Tripura possesses special significance in the biogeography of the North-eastern region due to its unique location and habitat heterogeneity. This region is part of Indo-Burma hotspot which is one of the 35 biodiversity hotspots in the world (Myers et al. 2000). The undulating topography, high rainfall and varied altitudes are main factors that have contributed to its rich hilly ecosystem and habitat diversity (Majumdar et al. 2012b). Many *Ficus* species are fast declining in the wild due to habitat changes, forest fragmentation, road construction and clearance of virgin forests for shifting cultivation, plantation and due to other developmental activities. Out of the present checklist, *F. drupacea* was assigned as Least Concern (ver. 3.1) in the IUCN Red List of Threatened Species (<https://www.iucnredlist.org>). Besides *Ficus*

Table 1. Checklist of *Ficus* species along with their current status on availability, distribution ranking and collection number/field number deposited at Tripura University Herbarium (TUH) with their voucher specimens at Central National Herbarium (CAL).

Sp. Id	Name of species	Species abbreviation	Species Code	Habit	Status	Distribution Range Score	Collection number (TUH)	Voucher specimens (CAL)
1.	<i>Ficus auriculata</i> Lour.	Fau	F001	Small evergreen tree	Less Frequent	5	Banik & Datta, TUH-2301	Deb 27103.
2.	<i>Ficus benghalensis</i> L.	Fbe	F002	Evergreen tree	Very Frequent	4	Banik & Datta, TUH-2000	–
3.	<i>Ficus benjamina</i> L.	Fben	F003	Large tree, with drooping branches.	Frequent	4	Banik & Datta, TUH-2302	Deb 1174.
4.	<i>Ficus curtipes</i> Corner	Fcu	F004	Large tree (epiphytic when young)	Rare	4	Banik & Datta, TUH-2074	Biswas 5047; Deb 1207; Deb 2336; Deb 2786
5.	<i>Ficus drupacea</i> Thunb.	Fdr	F005	Evergreen tree (sometimes epiphytic)	Less Frequent	5	Banik & Datta, TUH-2306	Biswas 5077.
6.	<i>Ficus elastica</i> Roxb. ex Hornem.	Fel	F006	Large evergreen tree (sometimes epiphytic when young)	NA (Cultivated)	3	Banik & Datta, TUH-2311	Deb Burman 832.
7.	<i>Ficus hederacea</i> Roxb.	Fhe	F007	Shrub scandent, often rooting at the nodes, sometimes climbing.	Rare	4	Banik & Datta, TUH-2317	Deb 2339; Deb 2582.
8.	<i>Ficus heteropleura</i> Blume	Fhet	F008	Shrub or small trees.	Less frequent	4	Banik & Datta, TUH, 1995	Deb 2062.
9.	<i>Ficus hirta</i> Vahl	Fhir	F009	Tree/Shrub	Less Frequent	3	Banik & Datta, TUH-2318	Deb 2671; Deb 27302.
10.	<i>Ficus hispida</i> L.f.	Fhis	F010	Small tree with fistular branches.	Very Frequent	5	Banik & Datta, TUH-1999	Deb Burman 23,835 ; Deb 1968; Deb 2271.
11.	<i>Ficus ischnopoda</i> Miq.	Fis	F011	Small tree, young parts pubescent.	Frequent (restricted to riparian habitat)	4	Banik & Datta, TUH-1994	Deb 2059.
12.	<i>Ficus lamponga</i>	Fla	F012		Less Frequent	4	Debbarma & Datta, TUH2325	–
13.	<i>Ficus microcarpa</i> L.f.	Fmi	F013	Large evergreen tree	Less Frequent	3	Banik & Datta, TUH-2001	Deb 2095.
14.	<i>Ficus nervosa</i>	Fne	F014	Small tree	Less Frequent	4	Banik & Datta, TUH-2094	–
15.	<i>Ficus obscura</i> Blume	Fob	F015	Shrubby or subarboreous	Rare	2	Banik & Datta, TUH-1996	–
16.	<i>Ficus pumila</i>	Fpu	F016	Evergreen, climber.	NA (Cultivated)	3	Banik & Datta, TUH-2095	–
17.	<i>Ficus racemosa</i> L.	Fra	F017	Large deciduous tree	Very Frequent	6	Debbarma & Datta, TUH-1992	Deb 2447.
18.	<i>Ficus religiosa</i> L.	Fre	F018	Large deciduous tree	Very Frequent	5	Banik & Datta, TUH-1993	–
19.	<i>Ficus rumphii</i> Blume	Fru	F019	Large deciduous tree	Very Frequent	4	Banik & Datta, TUH-2326	Deb Burman 424.
20.	<i>Ficus sarmentosa</i> Buch.-Ham. ex Sm.	Fsa	F020	Evergreen shrub	Very Frequent	5	Debbarma & Datta TUH 1997	Deb Burman 1152.
21.	<i>Ficus semicordata</i> Buch.-Ham. ex Sm.	Fse	F021	Small tree	Frequent	5	Banik & Datta, TUH-2327	Deb 1317; Deb 26895; Deb 27433
22.	<i>Ficus squamosa</i> Roxb.	Fsq	F022	Shrub	Rare (restricted in riparian habitat)	3	Banik & Datta, TUH-2334	Deb 1259; Deb 2009.
23.	<i>Ficus virens</i> Aiton	Fvi	F023	Large tree	Frequent	5	Banik & Datta, TUH -1998	Deb Burman 869.

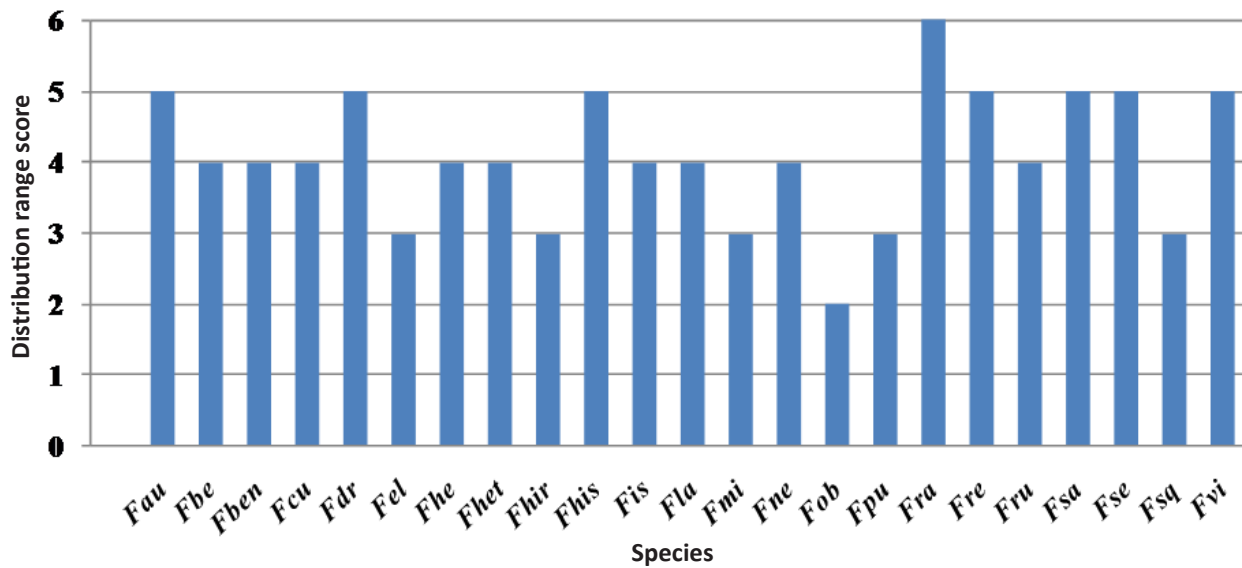


Figure 2. Geographical distribution of selected *Ficus* species based on distribution range score.

drupacea, very recently few more species have been assigned as “Least Concern” and these are *F. auriculata*, *F. benjamina*, *F. hispida*, *F. ischnopoda*, *F. microcarpa*, *F. racemosa*, *F. semicordata*, and *F. virens*.

Distribution of species in different habitats reveals that forests ecosystems are the main habitat of recorded species broadly distributed in moist deciduous forest, riparian cover and semi-evergreen forest. In the recent exploration of *Ficus* species in Tripura, we did not find any occurrence of four species which may be due to the current rate of deforestation and habitat loss some of these species may have altered distribution and may no longer exist in a particular area (Krupnick & Kress 2003). The uneven distribution of these species and the absence of these species in many parts of the state can be attributed to various factors.

Review on potential ecological role by Ficus

Ficus is the most important plant genus for tropical frugivores. *Ficus* forms a uniquely important group within the subset of plants with bird-eaten fruit because of their numerical abundance, intra-crown synchrony of fruit ripening, relatively short intervals between fruiting, large crop sizes and intrapopulation fruiting asynchrony. These characteristics combined with their availability at times when other fruits are scarce, makes *Ficus* a most important keystone plant resource (Lambert & Marshall 1991). Worldwide, a large number of animals are known to feed on the syconia, including pigeons, parrots, hornbills, toucans, bats, monkeys, and squirrels (Shanahan et al. 2001). According to Shanahan et al.

(2001) 1,274 bird and mammal species in 523 genera and 92 families are known to eat figs. Figs are known to be eaten by 54 species but feature especially heavily in the diet of Asian hornbills. Brockelman (1982) noted that hornbills were the only birds capable of eating *Ficus drupacea* figs whole. *Ficus virens* ranks as one of the top 10 *Ficus* species that attract the most number of frugivorous species (Shanahan et al. 2001) and further can lead to improve frugivore biodiversity (Lee et al. 2013). Figs are among the most important food of specialized frugivores in Africa, southeastern Asia and Australia (Snow 1981). Khan & Ahsan (2015) reported that *Ficus benghalensis* was the top most preferred food plant. This plant species supported the diet of 13 (44.8%) species of birds. The birds have been shown to make long-duration feeding visits to fruiting trees and defecate fig seeds intact (Compton et al. 1996). The pigeon family (Columbidae) has a worldwide distribution and, after the parrots, has more fig-eaters than any other frugivore family which comprises 125 species in 25 genera (Shanahan et al. 2001). Invertebrates, including ants, dung beetles, snails and hermit crabs are known to consume fig fruits or seeds, thereby having impacts on *Ficus* seed dispersal. About 750 species of *Ficus* and the pollinating wasps resulted significant ecological interactions to complete their life cycle (Wiebes 1979; Grison-Pige et al. 2002; Harrison 2003; Castro et al. 2015). The figs (syconia) are pollinated entirely by specific wasps from the family Agaonidae (Chalcidoidea), which in turn reproduce by laying eggs in the fig’s flowers, where the larvae feed and expand

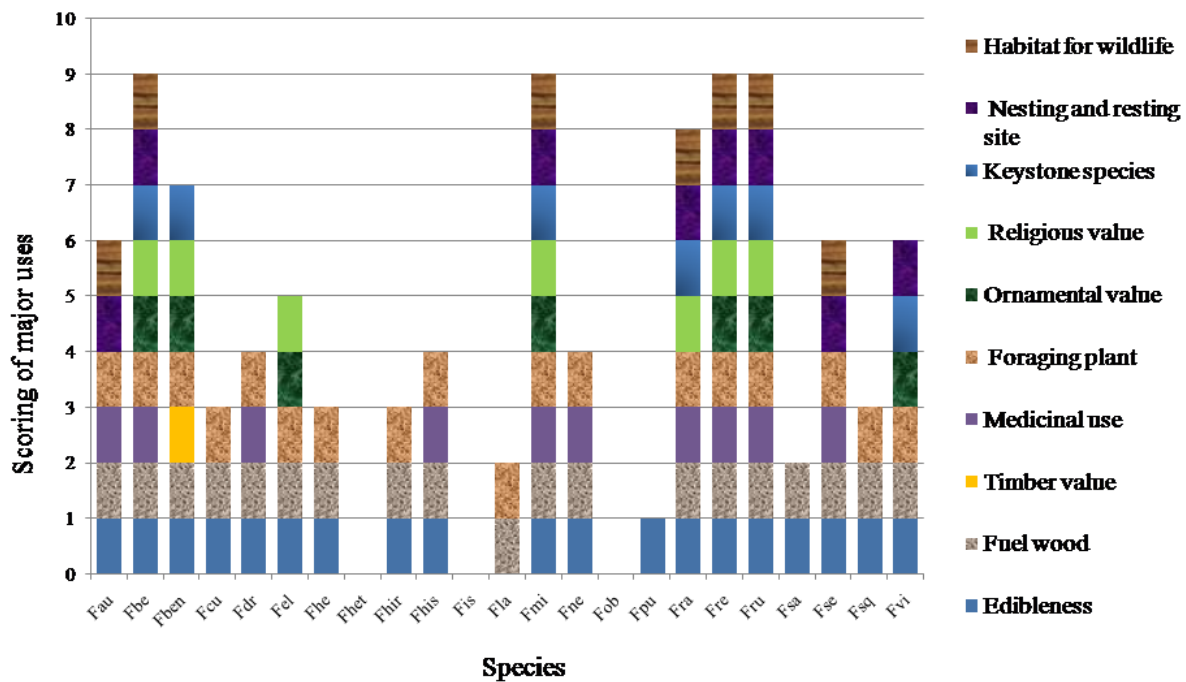


Figure 3. Scoring of major uses and ecosystem services of selected *Ficus* species.

their life cycle (Cook & Segar 2010). Such mutualism is exploited by a number of other parasitic non-pollinating wasps (Wiebes & Compton 1990) and by numerous species of ants, Homoptera, Coleoptera, Lepidoptera and Diptera (Bain et al. 2012).

Major uses of *Ficus* species found in Tripura were scored based on their earlier report and species were prioritized for their ecosystem services and medicinal uses (Fig. 3). Several species of *Ficus*, viz., *F. microcarpa*, *F. religiosa*, *F. auriculata*, *F. benjamina*, *F. racemosa*, *F. benghalensis* have been used in daily diet for nutrition as well as for medicinal usage and medicinal plants in the treatment of different diseases (Khan et al. 2011). Several species are indigenously used as food, fodder, fuel wood, vegetable, medicine, etc. They provide good fodder and various ecological services. They provide nectar, refuge habitat for several bird species and a wide variety of insects, and host orchids and mistletoes (Kunwar & Bussman 2006). *F. benghalensis*, *F. benjamina*, and *F. religiosa* have been reported as common host plants for orchids (Subedi & Paudyal 2001). *Ficus* is also important species in tropical forest restoration (Cottee-Jones et al. 2016). Higher species richness in Moraceae was recorded for all community types due to local availability of *Artocarpus chama*, *A. lacucha* and several other *Ficus* spp; their local adaptability and strong dispersal capability facilitated by several frugivorous birds and animals (Majumdar et al. 2012b). Due to high

FIV (Family Important Value) of Moraceae particularly in secondary Teak forest may shift the secondary Teak population by native species richness of Moraceae. In such cases, species of Moraceae may contribute maximum for both IVI (Importance Value Index), FIV and ultimately to be the top predominant family over the existing species of other families especially in case of Teak dominated community. Such competitions among the families may alter the present forest dynamics and simultaneously may increase with changing of disturbance intensity; which partially may be boosted by several seed dispersal agents during secondary forest formations (Majumdar et al. 2012b). Because, species belonging to Moraceae have the advantages of attractive colored figs, sweet taste, high seed production and stock, small achene, universally eaten by frugivore and high germination ability even on unsuitable habitat viz., tree hole, dead wood, stone and barren land. Especially Capped Langur *Trachypithecus pileatus*, (Red List status - Vulnerable A2cd+3cd ver 3.1) (Das et al. 2008) was observed feeding on tender leaves of *Aartocarpus chama*, *A. lacucha*, *Bombax ceiba*, *Garuga pinnata*, *Ficus glumerata*, and *Albizia lucida* during field study in *Shorea* dominated community. *Ficus* trees scored low in terms of economic value, and the main reason for them remaining in the landscape was because of religious attributes endowed upon them. Trees that had shrines were significantly larger than those that

did not. *Ficus* have been described as keystone species (Bleher et al. 2003; Eshiamwata et al. 2006) and provide connectivity for both tree and animal populations over a landscape scale (Manning et al. 2006). Further, figs often survive in human-dominated landscapes because of their cultural significance. *F. benghalensis*, *F. religiosa* have considerable religious associations in Hinduism and Buddhism and are also used as sites of worship (Barua 2009) and these cultural factors contribute to the safeguarding mature trees. They may be considered sacred groves at very local scales, and are working examples of how cultural practices might influence the existence of biodiversity outside protected areas.

With agricultural intensification, however, the number of mature *Ficus* trees declined and people cut down trees when they interfered with their daily activities. Extensive conversion of forests for cash crop plantation in this region has resulted in the emergence of landscape tracts that are a heterogeneous mixture of agriculture, human-settlement and forest fragments. Increased structural complexity and habitat for animals at local scales, and connectivity for both tree and animal populations over a landscape scale may result in ecosystem stability. It has been suggested that the establishment of *Ficus* is a critical phase in the reassembly of forests. Thus, they are an important resource for maintaining biodiversity outside protected areas, and their loss may result in undesirable ecological regime shifts. This account of *Ficus* diversity and distribution in the forest ecosystem may provide knowledge to the researchers about wildlife occurrence and their resource utilization in these subtropical regions.

CONCLUSION

The present study highlighted the taxonomy and diversity of the genus *Ficus* L. in Tripura, northeastern India, based on extensive field survey and exploration. The increase in the number of species has been observed in the present study when compared to the earlier report of 23 taxa including one variety in the "Flora of Tripura State" from the same geographical extent. As the genus is rich in diversity, this region possesses tremendous scope of exploitation of its members, as many species belonging to this genus have carried good properties beneficial to mankind as well as sustaining wildlife. Their importance for sustaining wildlife and the stability of interactions with several biological groups is an issue of considerable concern for conservation. Figs are tropical keystone resource and paramount to sustain

wildlife and the stability of interactions with several biological groups is an issue of considerable concern for conservation.

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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

August 2020 | Vol. 12 | No. 11 | Pages: 16407–16646

Date of Publication: 26 August 2020 (Online & Print)

DOI: 10.11609/jott.2020.12.11.16407-16646

www.threatenedtaxa.org

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