FLORAL VARIATION IN SELECTED SPECIES OF THE GENUS *FICUS* L. (MORACEAE): A COMPARATIVE STUDY

Dissertation submitted in partial fulfilment of the requirements for the award of the degree of
'Bachelor of Science'
in Botany

BY

ANITTA P B
REG NO: AB22BOT003

DEPARTMENT OF BOTANY AND CENTRE FOR RESEARCH
ST TERESA'S (AUTONOMOUS)
ERNAKULAM
2024- 25

CERTIFICATE

This is to certify that the dissertation entitled "**Floral variation in selected species of genus *Ficus* L. (Moraceae): A comparative study**" submitted in the partial fulfilment of the requirement for the ward of the degree of bachelor of Science in Botany is an authentic work carried by Anita P B (Reg no: AB22BOT003) under the supervision and guidance of Dr. Sreehari S Nair

Supervising Teacher

Dr. Sreehari S Nair
Assistant Professor
Department of Botany
St. Teresa's College (Autonomous)
Ernakulam

Smt. I K Nishitha
Head of the Department
Department of Botany
St. Teresa's College (Autonomous)
Ernakulam

Place: Ernakulam
Date: 2/05/25

External Examiners

1. 2/5/25
Jess Mary Jame.
Maharajas College
Ekm

2.
Dr. LINS Simon
BMC, Thaikkahara

DECLARATION

I hereby declare that the dissertation **Floral variation in selected species of genus *Ficus* L. (Moraceae): A comparative study**, entitled submitted to Mahatma Gandhi University in partial fulfilment of requirements for the award of the Degree of Bachelor of Science in Botany is a record of original research work done by me under the guidance of Dr Sreehari S Nair, Department of Botany, St. Teresa's College, Ernakulam.

ERNAKULAM. ANITTA B

DATE 02/05/25

1. INTRODUCTION

FLORAL DIVERSITY OF WESTERN GHATS

Western Ghats, being one of the global hotspots of biodiversity, supports an enormous vegetal wealth. The entire Western Ghats biogeographic region is a major genetic estate with an enormous biodiversity of ancient lineage. Nearly 5800 species of flowering plants occur here of which 56 genera and 2100 species are endemic (Gunawardene, 2007).

Kerala, located in the southern Western Ghats, is home to 95% of the Western Ghats' flowering plants and 90% of its vertebrate fauna. Kerala alone is estimated to have about 400 species of grasses. There are endemic and rare flowering plants seen in the Western Ghats in Kerala including Neelakurinji (*Strobilanthes kunthiana*), Vellarakanni (*Impatiens scapiflora*), Mishmi Teeta (*Coptis teeta*) etc. In this region some families show high diversity for example Orchidaceae (Orchids) which have over 200 species, including *Vanda*, *Dendrobium*, and *Habenaria* species. Zingiberaceae (Ginger family) which includes wild turmeric (*Curcuma* spp.) and wild cardamom (*Elettaria* spp.), Fabaceae (Legumes) are diverse in lower altitudes, including *Dalbergia*, *Pterocarpus*, and *Crotalaria* species and Rubiaceae (Rao, 2008).

FAMILY MORACEAE

The family Moraceae is often called the mulberry family or fig family. It is a family of flowering plants comprising about 38 genera and over 1100 species. Most of them are widespread in tropical and subtropical regions, less so in temperate climates however, their distribution is cosmopolitan overall. The characteristic features of Moraceae family are the presence of laticifers and milky sap in all parenchymatous tissues, compound inconspicuous

flowers, and compound fruits. The family includes well-known plants such as the fig, banyan, breadfruit, jackfruit, mulberry, and Osage orange. The 'flowers' of Moraceae are often pseudanthium (reduced inflorescences) (Judd *et al.,* 2008)

The family varies from colossal trees like the Indian Banyan (*Ficus benghalensis*) which can cover five acres of ground, to *Dorstenia barnimiana* which is a small stemless, bulbous succulent. These two species have an approximately one-billion-fold difference in weight (Andrews, 1952).

Plant species in the Moraceae are best known for their fruits. Overall, most species produced a fleshy fruit containing seeds. Examples include the breadfruit from *Artocarpus altilis*, the mulberry from *Morus rubra*, the fig from *Ficus carica*, and the jackfruit from *Artocarpus heterophyllus*. In addition to the living species, a number of fossil genera have been ascribed to the family (Datwyler & Weiblen, 2004).

DIVERSITY OF THE GENUS FICUS

Ficus species are considered keystone species in tropical rainforest ecosystems, playing a vital role in the food web and habitat structure. Their fruits are a food source for a wide variety of animals, including insects, birds, and mammals. The highest concentration of species is found in the Asian-Australian region, with around 500 species, representing about 66% of the world's *Ficus* species. *Ficus carica* (the common fig) is native to southwest Asia and the Mediterranean region. *Ficus benghalensis* (the banyan tree) is native to the Indian subcontinent. (Eisen, 1901)

In India, the genus is distributed throughout the country from South to North up to the Himalayas at about 2,000 m elevations. India is home to 115 taxa of *Ficus*, including 89

species and 26 infraspecific taxa. Out of these, 10 taxa are endemic to India. Some notable species include *Ficus benghalensis* (banyan tree), *Ficus religiosa* (peepal tree), and *Ficus carica* (common fig). Total 97 species of *Ficus* genus are naturalized in Indian states. (Chaudhary *et al.*, 2012). Indian *Ficus* species possess anti-inflammatory, antimicrobial, antioxidant, antidiabetic, antiarthritic, antistress, anticancer, hepatoprotective, neuroprotective and wound healing properties. The genus is well-represented in the state, occurring in forests, riverbanks, sacred groves, and even urban areas. These species play a crucial role in forest ecology, supporting pollinators (fig wasps) and frugivores (birds, bats, and primates) (Singh & Sharma, 2023)

FLORAL CHARACTERISTICS OF FICUS

Ficus plants have a distinctive inflorescence called a hypanthodium, which is a fleshy, hollow receptacle that houses the flowers. The hypanthodium itself depicts a small angiosperm fruit. The flowers themselves are tiny and located inside. The syconium develops into the fig fruit, and the syconium has a small opening called the ostiole, through which pollinators can enter (Berg & Corner, 2005)

Ficus flowers are unisexual, meaning they are either male or female. Some species are monoecious (having both male and female flowers on the same plant) or functionally dioecious (having separate male and female plants). It has 3 type of flowers, mainly male, female, and gall flowers. Male flowers are small, near the ostiole, 1 stamen, and an oblong anther. Female flowers are numerous, sessile, with an ovary, and a style. Gall flowers are sterile and nourish the wasp. The interaction between figs and fig wasps provides a striking example of obligate brood site pollination mutualism. Monoecious figs, constituting independent radiations in each tropical biome, are present in significant proportions

worldwide, but in continental Asia, dioecious figs have diverged into various niches, making the region's assemblage remarkably diverse (Herre., 2008).

Figs are considered to be a keystone species in many ecosystems. Many insects, birds and mammals depend on the figs for their food and shelter. Most of the plants flower throughout the year and can meet the needs of its ecosystem. Figs are very attractive and many species of birds and animals depend on figs for their staple food. The figs are good avenue trees and are planted as shade trees and also as ornamental trees (Shanahan *et al.*, 2001).

The floral characters are highly diverse that makes the identification of the taxa highly problematic. Many of the species show various complexity with respect to the morphology and floral characters. The availability of mature syconium is also a major hurdle for the taxonomists. The present study focuses to carry out a detailed study on the floral variations on some of the common species of *Ficus* (Berg & Corner, 2005).

OBJECTIVES

1. To study the floral characters of the species belonging to the genus *Ficus* L.
2. To understand the floral variations within the collected species of *Ficus* L.

2. REVIEW OF LITERATURE

The Moraceae family, also called the mulberry family is one among the most widely distributed angiosperm families. The family includes about 37 genera and the genus *Ficus* L. is the largest genus with more than 750 species (Berg & Corner, 2005). The genus is largely diverse in the habit ranging from trees, shrubs, climbers to creepers and in its habitats as epiphytes, semi epiphytes and lithophytes. The members of the genus *Ficus* L. is mainly distributed in the tropics and in the subtropics (Berg, 1989; Berg & Corner, 2005). The Asian- Australian region has the maximum concentration with 500 species accounting to 66% of the total world species (Chaudhary *et al.*, 2012). The members are commonly known as 'figs'. The figs provide food for many birds and mammals. The 'figs' are hence considered as a keystone species in many ecosystems.

Preliminary accounts for the genus were made in '*The Flora Indica'* by Roxburgh in 1832. In India, the first systematic treatment for the genus was made by King in the year 1888 in *'The Flora of British India'* (Sudhakar, 2017). The works stands outdated with the current records as only 75 species and 16 infraspecific taxa is reported from the present political boundary of India, while King reported 113 species and 47 infraspecific taxa from whole British India (Chaudhary *et al.*, 2016). The only complete revision work from Asia credited for the work by Corner in 1965 along with some scattered works from various parts of India. Hence it made a possible task to bring about a complete revisionary work in the genus from India. BSI initiated the revisionary work in 2008 and as per the details in India the genus *Ficus* L. has about 115 species including 24 infraspecific taxas (Chaudhary *et al.*,

2012). In India, *Ficus* L. is more diverse in the North Eastern regions. Meghalaya is considered as a hot spot for the genus in the country.

Cavero *et al.,* (2013) explained the common fig as an old food that accompanied man from early time. The importance of *F. carica* to human race can be exemplified by its presence in the Gospels, the sacrum book of Christians. He studied that either cultivated or wild, the varieties of common fig continue currently, as in the past, providing nourishment to people around the world. A large proportion of the rural population, mainly from developing countries uses traditional medicine, alone or in combination with drugs to treat a wide variety of ailments.

Lansky *et al.,* (2008) explored medieval, ancient and modern sources for ethnopharmacological uses of *Ficus* (fig) species, specifically for employment against malignant disease and inflammation. The close connection between inflammatory/infectious and cancerous diseases is apparent both from the medieval/ancient merging of these concepts and the modern pharmacological recognition of the initiating and promoting importance of inflammation for cancer growth. They considered the chemical groups and compounds underlying the anticancer and anti-inflammatory actions, the relationship of fig wasps and fig botany, extraction and storage of fig latex, and traditional methods of preparing fig medicaments including fig lye, fig wine and medicinal poultices.

The current knowledge of ethnomedicinal uses, phytochemistry, pharmacological activities, bioavailability, and pharmacokinetic profiles of 31 Indian *Ficus* species were studied (Singh, 2023). Moreover, it included clinical and toxicological studies with an aim to explore their potential in the pharmaceutical industries.

Sasidharan (1999) studied about the morphology of *F. racemosa*. He described that the tree was about 20 m tall rarely with aerial roots, bark whitish-brown, smooth, Leaves

grooved minutely hairy, lamina lanceolate, tri-ribbed, 8-10 pairs of lateral pairs from broad to narrowly cuneate, oblique base, margin entire, acuminate at apex, glabrous on both sides, stipules brown, sub-persistent, cystoliths present only on lower side. Hypanthodium on long peduncles, leafless branches, green, broadly triangular-ovate brownish brads, bracts, apical orifice sunken, closed by brown bracts without internal bristles. Male flowers sessile, ostiolar in 2-3 whorls, united, lobes dentate, stamens 2. Gall flowers pedicellate, dispersed among female. Female flowers sessile or subsessile, ovary sub stipitate, glabrous style, stigma simple. Seeds lenticular 1 mm. syconus fruit.

Nigar *et al.*, (2025) the phytochemicals, antioxidants, and antinutrients content of *Ficus racemosa* and *Ficus hispida* with *Ficus carica* and assessed the effects of two drying methods, oven drying (50–55 °C for 24 h) and sun drying. Total phenolic (TPC) and flavonoid content (TFC) were quantified using Folin-Ciocalteu and aluminum chloride colorimetric assays.

Hussain *et al.*, (2021) conducted the study on *F. Carica* and its morphology, taxonomy, composition and health benefits. Fig fruit is a well-known nutritious and delicious fruit of the Indian subcontinent. Its cultivation is restricted and done locally, which makes it an underused fruit crop. Fig fruit is attractive, energy dense and rich in nutritive value. Dried figs have sweet, chewy taste. Figs are relished as dried fruit due to characteristic detectable flavour. It also helps to regulate blood pressure and blood cholesterol due to the presence of potassium, omega 6 and omega 3 fatty acids.

The study by Mostafa *et al.* (2020) documented seventeen *Ficus* species grown in Egypt, collected from two botanical gardens. They studied twenty leaf morphological characters based on the Fig (*Ficus carica* L.) with IPGRI descriptor, and seven AFLP primer combinations. The morphological characters, included four measured and sixteen descriptive

characteristics. The one-way ANOVA test for the measured traits showed significant differences among the seventeen *Ficus* species. *F. microcarpa* showed the lowest value for both leaf length and leaf width, while the highest leaf length and leaf width were revealed by *F. hispida* and *F. carica*, respectively

Deng *et al.* (2023) studied the interaction between figs and fig wasps and provided a striking example of obligate brood site pollination mutualism. Monoecious figs, constituting independent radiations in each tropical biome, are present in significant proportions worldwide, but in continental Asia, dioecious figs have diverged into various niches, making the region's assemblage remarkably diverse.

The possible antioxidant, antimicrobial and hemolytic potential of Ficus benjamina in different parts (leaves, stem and root) were studied by Imran *et al.* (2014). They examined extracts and fractions were significantly rich in antioxidants and exhibited potent antimicrobial activity. GC/MS analysis of essential oil identified four compounds in stem and eight compounds in root, respectively.

Jadhav *et al.* (2021) investigated the pharmacology of *Ficus benjamina* leaf extracts. Physicochemical review identified full ash, water insoluble ash, and limit insoluble ash *in Ficus benjamina* plant extracts. Extracts tested for Triterpenoid, Hormone, Glycoside, Saponin, Alkaloid, Flavonoid, Tannin, Free Amino, Carbon, and Vitamin C. Most drugs contain pharmacologically and physiologically active chemicals. Qualitative chemical test for pharmaceutical purity and uniformity. *Ficus benjamina* phytochemical investigations have found higher steroidal flavonoids, alkaloids, hormones, tannins, and terpenoids

Shi *et al.* (2018) evaluated the uses of *Ficus* species in the human diet have been extensively documented by ethnobotanical field surveyors. Overlap commonly exist between the dietary and medicinal selection of *Ficus* species but not for choices of the plant parts and

development stages, which leave a large space for ethnopharmacological study. They demonstrate that throughout its area of distribution, the genus *Ficus* is generally used as a dietary plant, although use of an individual species seems uncommon. Furthermore, we highlight the diet-medicine overlap of the uses of this genus, which should enable further understanding of the potential for broader health benefits, rather than limiting studies in this genus to its only-medicinal properties.

Ficus (Moraceae) is arguably one of the most important plant genera of tropical forests of southern Western Ghats (Vanitharani *et al*., 2009). A brief review of tropical flora also demonstrates that *Ficus* is the only ubiquitously diverse genus under the family Moraceae in the forest ecosystem. Monoecious hemi-epiphytic figs, constituting independent in each tropical biome, make up a significant proportion of species everywhere. Pioneer attributes figs species are endowed with tremendous evolutionary flexibility. Vegetation sampling at various forest types has shown that a high proportion of variety of fig species coexist from lower to higher elevations of southern Western Ghats. This factor is important for biodiversity conservation in all the forest types

Harrison *et al.* (2005) studied figs and diversity of tropical rainforest. *Ficus* (Moraceae) is arguably one of the most important plant genera in lowland tropical rainforests. A brief review of tropical florals also demonstrates that *Ficus* is the only ubiquitously diverse genus in lowland rainforests. Monoecious hemi-epiphytic figs, constituting independent radiations in each tropical biome, make up a significant proportion of species everywhere, but in Asia dioecious figs have diversified into a variety of niches, making the assemblages of this region especially speciose. Pioneer attributes have endowed figs with tremendous evolutionary flexibility.

Large numbers of Ficus species are able to coexist because many are extremely rare as a result of limited recruitment opportunities, which limits competition. They are nevertheless able to breed at low densities because they possess an efficient, long-range pollination system. These factors are likely to be important in the diversity of other plant groups in the tropics.

3. MATERIALS AND METHODS

The following methodology was used to carry out the work.

Field visits and collection of specimens:

Field visits were conducted for the collection of specimens. The syconium samples were collected from the plants which were in fruiting condition and they were stored in FAA solution. Geo tagged photographs of the specimens were taken and the field characters were also noted.

Identification of the species:

The collected samples were identified using authentic literature (Fischer, 1928) and the identity was confirmed by expert authentication. A list of the taxa of *Ficus* studied is provided in the table 1.

Sl No	Species
1	*Ficus auriculata* Lour.
2	*Ficus benjamina* L.
3	*Ficus hispida* L.f.
4	*Ficus racemosa* L.
5	*Ficus tsjahela* Burm. f.

Table 1: List of *Ficus* studied

Observation of the morphological characters of syconium:

The collected samples of the syconium were taken out from the FAA solution. The morphological features of the syconium (nature, shape and size of the syconium) were noted. The size of the syconium was measured using a scale and the observations were noted in a data sheet prepared (Table 2).

Observation of the floral characters of syconium:

The syconium was longitudinally cut into two parts. The floral characters of the species were observed using a digital microscope and the images of the floral parts were taken. The observed floral details were noted in the data sheet prepared (Table 2). The variations in the floral characters between the species were recorded (Fig. 1). The correct

binomial, description of the floral features, phenology, habitat and distribution of the species were studied and recorded.

Character		***Ficus auriculata***	***Ficus benjamina***	***Ficus hispida***	***Ficus racemosa***	***Ficus tsjahela***
Receptacles						
Syconium	**Size**					
	Shape					
Size of ostiole						
Sexuality						
Male flower character	**Size**					
	Attachment					
	No: tepals					
	No: stamen					
	Length of anther					
	Length of filament					
Female	**Size**					

flower	**Attachment**					
	No: of tepal					
	Length of stigma					
	Length of style					
	Length of ovary					
Gall flower	**Size**					
	Attachment					
	No: of tepal					
	Length of stigma					
	Length of style					
	Length of ovary					

Table 2. Data sheet prepared for recording the floral details

4. RESULT

1. *Ficus auriculata* Lour.

Local name: Atthi.

Common name: Roxburgh fig.

Receptacles cauliflorous, dioecious. Syconium green when young, orange to red then to dark crimson with spots when mature, 60 mm across, turbinate; Ostiole 2mm wide. Male flowers near ostiole, 3.0 mm long, sessile; tepal 3, stamen 1, anther 2.0 mm, filament 1.0 mm long. Female flowers at the base 3.5 mm long, sessile; tepal 3, stigma 0.5 mm, style 1.5 mm, ovary 1.5 mm. Gall flowers in the middle 4.0 mm long, pedicellate; tepal 3, stigma 0.5 mm, style 1.0 mm long, ovary 1.5mm long.

Phenology: It produces fruit throughout the year

Habitat: Usually planted.

Distribution: It is a plant native to South China and Malaysia It is distributed throughout India.

2. *Ficus benjamina* L.

Local name: Vellal.

Common name: Weeping fig

Receptacles axillary, monoecious. Syconium green when young, orange to red then to dark crimson with spots when mature, 10 mm across, globose. Ostiole 3mm wide. Male flowers near ostiole, 2.0 mm long, pedicellate; tepal 3-4, stamen 1, anther 0.4 mm, filament 0.6 mm long. Female flowers at the base 2.0 mm, sessile; tepal 3, stigma 0.3 mm long, style 0.7 mm,

ovary 1.2 mm. Gall flowers in the middle, 2.0 mm long, sessile; 3 tepal, stigma short, style 0.8 mm long, ovary 1.2 mm long.

Phenology: December to April

Distribution: Native in India, Assam, Bangladesh and China, introduced to other parts of the world as an avenue tree

Habitat: Found in the plains, usually planted. One among the widest spread species of *Ficus.*

3. *Ficus hispida* L.f.

Local name: Therakam.

Common name: Devil fig

Receptacles cauliflorous, dioecious. Syconium green when young, orange to red then to dark crimson with spots when mature, 20 mm across. Ostiole 5.0mm wide. Male flowers near ostiole, 4.5 mm long, pedicellate; tepal 3, stamen 1, anther 0.5 mm, filament 0.5 mm long. Female flowers at the base 3.0 mm long, pedicellate; tepal 3, stigma 0.2 mm long, style 1.0 mm, ovary 1.0 mm. Gall flowers in the middle, 5.0 mm, pedicellate; tepal 3, stigma short, style 0.2 mm long, ovary 2.0mm long.

Phenology: Flowering and fruiting are about two to three times a year

Habitat: Found in semi evergreen and moist deciduous forests. Also seen in plains and in waste lands.

Distribution: China, India, Nepal, Australia, Sri Lanka, Sumathra, Thailand. The species is distributed all throughout India.

4. *Ficus racemosa* L.

Local name: Atti.

Common name: Cluster fig, Indian Fig.

Receptacles cauliflorous, monoecious. Syconium green when young, orange to red then to dark crimson with spots when mature, 20 mm across, globose. Ostiole 4 mm wide. Male flowers near ostiole, 4.0 mm long, sessile; tepal 3–4; stamen 1, anther 2.0 mm, filament 2.0 mm long. Female flowers at the base 3.0 mm long, pedicellate; tepal 3, stigma 0.2 mm long, style 1.5 mm, ovary 1.3 mm. Gall flowers in the middle, 5.0 mm long, pedicellate; tepal 3, stigma short, style 0.2 mm long, ovary 2.0 mm long.

Phenology: Flowering in February-March and fruiting in May-June.

Habitat: Semi-evergreen and deciduous forests, as well as plains

Distribution: Widely distributed throughout Indo-Malaysia and Australia, it is also commonly found in the Indian subcontinent, Sri Lanka, Pakistan, China, and New Guinea

5. *Ficus tsjakela* Burm.f

Local name: Chela

Common name: Nil

Receptacles Axillary, monoecious. Syconium green when young, orange to red then to dark crimson with spots when mature, 5mm across, globose. Ostiole 2mm wide. Male flowers near ostiole, 1.5 mm long, sessile; tepal 4, stamen 1, anther 1.0 mm, filament 0.5 mm long. Female flowers at the base 1.5 mm, sessile; tepal 3-4, stigma 0.25 mm long, style 0.75 mm, ovary 0.5 mm. Gall flowers in the middle 2.0 mm long, sessile; tepal 4, stigma short, style 0.5 mm long, ovary 1.5 mm long.

Phenology: Two to three times a year
Habitat: Common in moist deciduous and semi evergreen forests.
Distribution: The plant is native to India, Myanmar, Pakistan, Sri Lanka and Vietnam

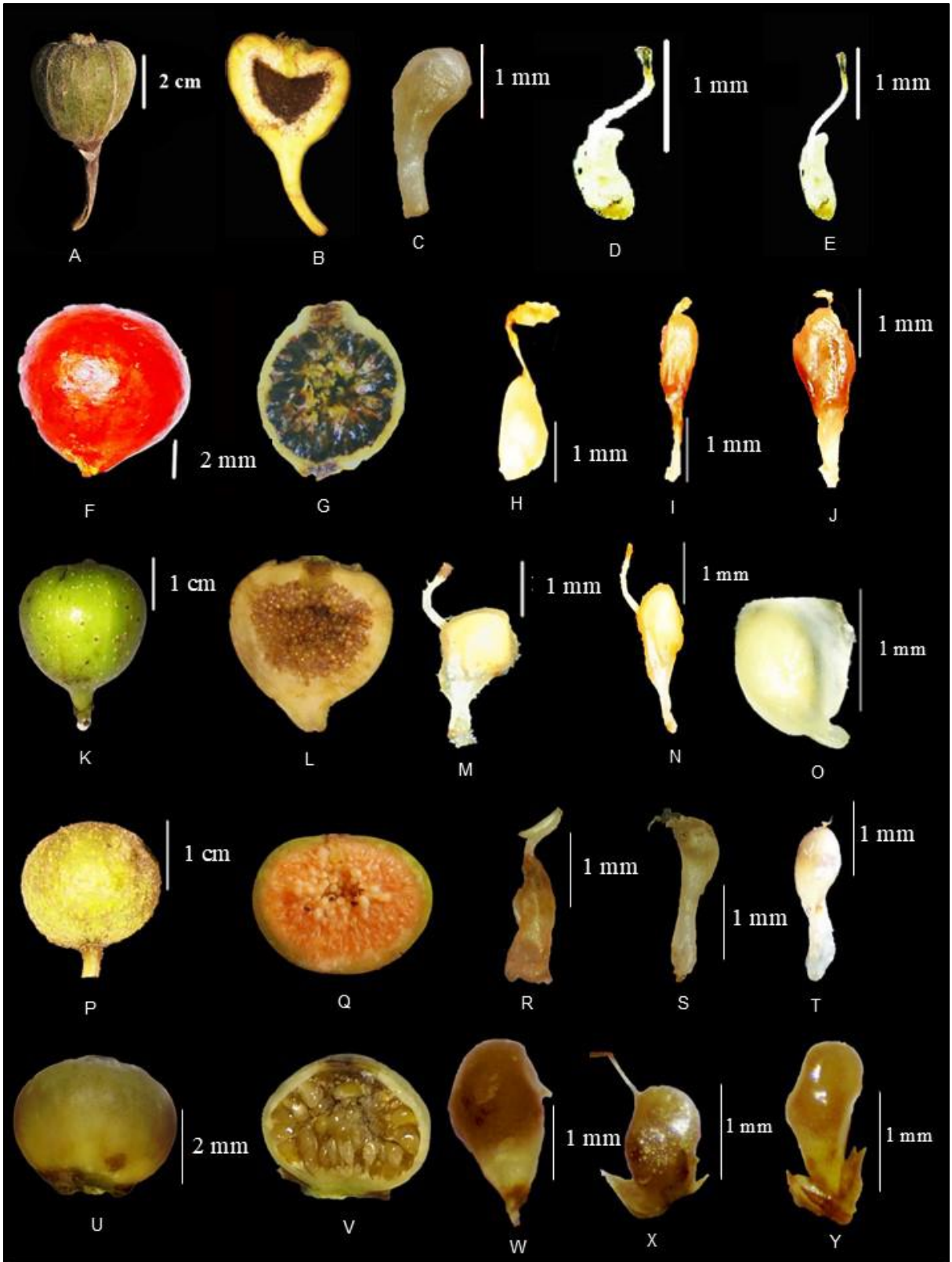

Fig 1: ***F. auriculata*** (A-E); ***F. benjamina*** (F-J); ***F. hispida*** (K-O); ***F. racemosa*** (P-T); ***F. tsjakela*** (U-Y). **Syconium** (A, F, K, P, U); **Syconium L S** (B, G, L, Q, V); **Male flower** (C, H, M, R, W); **Female flower** (D, I, N, S, X); **Gall Glower** (E, J, O, T, Y)

5. DISCUSSION

The receptacles of *Ficus auriculata, Ficus hispida,* and *Ficus racemosa* were cauliflorous, whereas those of *Ficus benjamina* and *Ficus tsjahela* were axillary. The size of the syconium varied among species: *Ficus auriculata* had the largest syconium at 60 mm; Ficus racemosa, 20 mm; *Ficus benjamina*, 10 mm; *Ficus tsjahela,* 5 mm; and *Ficus hispida* had the smallest at 4.5 mm. The syconium was turbinate in *Ficus auriculata*, while it was globose in *Ficus benjamina, Ficus hispida, Ficus racemosa,* and *Ficus tsjahela*.

The size of the ostiole also differed among species: it was 2 mm in *Ficus auriculata* and *Ficus tsjahela*, 3 mm in *Ficus benjamina*, 4 mm in *Ficus racemosa*, and 5 mm in *Ficus hispida. Ficus auriculata* and *Ficus hispida* were dioecious, whereas *Ficus benjamina, Ficus racemosa,* and *Ficus tsjahela* were monoecious.

The size of the male flower was as follows: *Ficus hispida* – 4.5 mm, *Ficus racemosa* – 4.0 mm, *Ficus auriculata* – 3.0 mm, *Ficus benjamina* – 2.0 mm, and *Ficus tsjahela* – 1.5 mm. The male flowers of *Ficus auriculata, Ficus racemosa,* and *Ficus tsjahela* were sessile, while those of *Ficus benjamina* and *Ficus hispida* were pedicellate. The number of tepals in *Ficus auriculata* and *Ficus hispida* was 3; in *Ficus benjamina* and *Ficus racemosa,* 3–4; and in *Ficus tsjahela,* 4. All five species had one stamen each. The length of the anther was 2.0 mm in *Ficus auriculata* and *Ficus racemosa*, 0.5 mm in *Ficus hispida*, 0.4 mm in *Ficus benjamina*, and 1.0 mm in *Ficus tsjahela*. The filament measured 2.0 mm in *Ficus racemosa,* 1.0 mm in Ficus auriculata, 0.6 mm in *Ficus benjamina*, and 0.5 mm in *Ficus hispida* and *Ficus tsjahela*.

The female flower measured 3.5 mm in *Ficus auriculata*, 3.0 mm in *Ficus hispida* and *Ficus racemosa*, 2.0 mm in *Ficus benjamina,* and 1.5 mm in *Ficus tsjahela.* Female flowers of *Ficus auriculata, Ficus benjamina,* and *Ficus tsjahela* were sessile, while those of

Ficus hispida and *Ficus racemosa* were pedicellate. The number of tepals was 3 in Ficus auriculata, *Ficus benjamina, Ficus hispida,* and *Ficus racemosa,* and 3–4 in *Ficus tsjahela*. The length of the stigma was 0.5 mm in *Ficus auriculata,* 0.3 mm in *Ficus benjamina,* 0.25 mm in *Ficus tsjahela,* and 0.2 mm in *Ficus hispida* and *Ficus racemosa*. The style measured 1.5 mm in *Ficus auriculata* and *Ficus racemosa,* 1.0 mm in *Ficus hispida,* 0.75 mm in Ficus tsjahela, and 0.7 mm in *Ficus benjamina.* The ovary length was 1.5 mm in *Ficus auriculata,* 1.3 mm in *Ficus racemosa,* 1.2 mm in *Ficus benjamina,* 1.0 mm in *Ficus hispida,* and 0.5 mm in *Ficus tsjahela*.

The gall flowers were largest in were *Ficus hispida* and *Ficus racemosa* at 5.0 mm, followed by *Ficus auriculata* at 4.0 mm, and were smallest in *Ficus benjamina* and *Ficus tsjahela* at 2.0 mm. The gall flowers of *Ficus auriculata, Ficus hispida*, and *Ficus racemosa* pedicellate, whereas those of *Ficus benjamina* and *Ficus tsjahela* were sessile. The number of tepals was 3 in *Ficus auriculata, Ficus benjamina, Ficus hispida,* and *Ficus racemosa, and 4 in Ficus tsjahela. The stigma was* short in *Ficus benjamina, Ficus hispida, Ficus racemosa*, and *Ficus tsjahela,* while in *Ficus auriculata* it measured 0.5 mm. The style length was 1.0 mm in *Ficus auriculata,* 0.8 mm in *Ficus benjamina, 0*.5 mm in *Ficus tsjahela,* and 0.2 mm in *Ficus hispida* and *Ficus racemosa.* The ovary length was 2.0 mm in *Ficus hispida* and *Ficus racemosa*, 1.5 mm in *Ficus auriculata* and *Ficus tsjahela,* and 1.2 mm in *Ficus benjamina*.

Character	***Ficus auriculata***	***Ficus benjamina***	***Ficus hispida***	***Ficus racemosa***	***Ficus tsjahela***
Receptacles	Cauliflorous	Axillary	Cauliflorous	Cauliflorous	Axillary

Syconium	**Size**	60 mm	10mm	20 mm	20mm	5 mm
	Shape	Turbinate	Globose	Globose	Globose	Globose
Size of ostiole		2 mm	3mm	5.0 mm	4mm	2 mm
Sexuality		Dioecious	Monoecious	Dioecious	Monoecious	Monoecious
Male flowers	**Size**	3.0 mm	2.0 mm	4.5 mm	4.0 mm	1.5 mm
	Attachment	Sessile	Pedicellate	Pedicellate	Sessile	Sessile
	No: tepals	3	3–4	3	3–4	4
	No: stamen	1	1	1	1	1
	Length of anther	2.0 mm	0.4 mm	0.5 mm	2.0 mm	1.0 mm
	Length of filament	1.0 mm	0.6 mm	0.5 mm	2.0 mm	0.5 mm
Female flowers	**Size**	3.5 mm	2.0 mm	3.0 mm	3.0 mm	1.5 mm
	Attachment	Sessile	Sessile	Pedicellate	Pedicellate	sessile
	No: of tepal	3	3	3	3	3–4
	Length of stigma	0.5 mm	0.3 mm	0.2 mm	0.2 mm	0.25 mm
	Length of style	1.5 mm	0.7 mm	1.0 mm	1.5 mm	0.75 mm
	Length of ovary	1.5 mm	1.2 mm	1.0 mm	1.3 mm	0.5 mm

	Size	4.0 mm	2.0 mm	5.0 mm	5.0 mm	2.0 mm
	Attachment	Pedicellate	Sessile	Pedicellate	Pedicellate	Sessile
	No: of tepal	3	3	3	3	4
Gall flowers	**Length of stigma**	0.5 mm	Short	Short	short	Short
	Length of style	1.0 mm	0.8 mm	0.2 mm	0.2 mm	0.5 mm
	Length of ovary	1.5 mm	1.2 mm	2.0 mm	2.0 mm	1.5 mm

Table 2: Variation in the floral features of the species of *Ficus* studied.

6. CONCLUSION

Ficus L., commonly known as Fig, is a member of the family Moraceae (mulberry family) comprises 37 genera and approximately 1,100 species distributed in diverse ecosystems, especially in tropical and temperate regions of the world (POWO, 2025). According to the current records, Kerala has a distribution of about 32 species of *Ficus* L. (Sasidharan & SIvarajan, 2004). *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 nutritional rewarding fruit crops (Harrison, 2005). The genus *Ficus* exhibits significant morphological variability, which is influenced by environmental and ecological conditions. The taxonomic complexity of *Ficus* species steps from several factors, including overlapping morphologies, incomplete genetic differentiation, and the emergence of various speciation processes. This makes accurate identification challenging, especially for certain species complexes. Additionally, uniparental reproduction in some *Ficus* species further complicates their classification, which is influenced by environmental and ecological conditions. This makes it difficult to distinguish between species based solely on their physical characteristics, especially within species complexes. The genus *Ficus* has evolved through various speciation processes, some of which led to the formation of species complexes with indistinct boundaries.

The genus *Ficus* exhibits significant taxonomic complexity due to factors like intraspecific variation, hybridization, and the influence of symbiotic pollinators. These factors can make it difficult to distinguish species, leading to species complexes. Additionally, the unique syconium structure which shows variation within each species and its role in pollination with specialized fig wasps further contribute to this complexity.

The comparative analysis of reproductive structures among five *Ficus* species—*Ficus auriculata*, *Ficus benjamina*, *Ficus hispida*, *Ficus racemosa*, and *Ficus tsjahela*—reveals considerable variation in their syconium morphology and floral traits. While *Ficus auriculata*, *Ficus hispida*, and *Ficus racemosa* exhibit cauliflorous receptacles, *Ficus benjamina* and *Ficus tsjahela* possess axillary ones. *Ficus auriculata* showed the largest syconium with a distinct turbinate shape, contrasting with the globose syconia observed in the other species.

Differences were also evident in reproductive biology, with *Ficus auriculata* and *Ficus hispida* being dioecious, unlike the monoecious nature of the remaining species. Floral characteristics such as the size, attachment, and morphology of male, female, and gall flowers varied significantly across species, particularly in terms of tepal number, anther and ovary dimensions, and stigma and style lengths. Notably, gall flowers were largest in *Ficus hispida* and *Ficus racemosa*, whereas *Ficus benjamina* and *Ficus tsjahela* exhibited the smallest. These variations not only reflect species-specific adaptations but also underscore the morphological diversity within the genus *Ficus*, which may play a crucial role in their reproductive ecology, pollination strategies, and evolutionary differentiation.

7. REFERENCES

Andrews, F.W. D.Sc. (1952). The Flowering Plants of the Anglo-Egyptian Sudan – Volume 2. Arbroath, Scotland: T. Buncle and Co. p. 260.

Berg, C. C. (1989). Classification and distribution of *Ficus.* Experientia, 45, 605-611

Berg, C. C., & Corner, E. J. H. (2005). Moraceae — *Ficus*. In Flora Malesiana, Series I, Volume 17, Part 2 (pp. 1–730). National Herbarium of the Netherlands.

Cavero, R. Y., Akerreta, S., & Calvo, M. I. (2013). Medicinal plants used for dermatological affections in Navarra and their pharmacological validation. *Journal of ethnopharmacology*, 149(2), 533-542.

Chaudhary, L. B., Cottee Jones, H. E. W., Bajpai, O.& Whittaker, R. J. (2016). The importance of *Ficus* (Moraceae) trees for tropical forest restoration. *Biotropica*, 48(3), 413-419

Datwyler, S. L. and Weiblen G (2004). "On the origin of the fig: Phylogenetic relationships of Moraceae from ndhF sequences". *American Journal of Botany*. 91

Deng, X., Liao, Y., Liu, W., & Yu, H. (2023). The coexistence of two related fig wasp species sharing the same host fig species across a broad geographical area. *Acta Oecologica*, 118, 103885.

Eisen, G. A. (1901). *The Fig: Its History, Culture, and Curing: With a Descriptive Catalogue of the Known Varieties of Figs* (No. 9). US Government Printing Office.

Fischer, C.E.C. (1928). In Gamble, J.S. *Flora of the presidency of Madras*. Vol. 3. (pp. 1353–1371). Adlard & Son, Limited.

Gunawardene, N. R., Daniels, A. E., Gunatilleke, I. A. U. N., Gunatilleke, C. V. S., Karunakaran, P. V., Nayak, K. G., & Vasanthy, G. (2007). A brief overview of

the Western Ghats--Sri Lanka biodiversity hotspot. *Current Science (00113891)*, *93*(11).

Harrison, R. D. (2005). Figs and the diversity of tropical rainforests. *Bioscience*, 55(12), 1053-1064.

Herre, E. A., Jandér, K. C., & Machado, C. A. (2008). Evolutionary ecology of figs and their associates: Recent progress and outstanding puzzles. *Annual Review of Ecology, Evolution, and Systematics*, 39, 439–458

Hussain, S. Z., Naseer, B., Qadri, T., Fatima, T., & Bhat, T. A. (2021). Fig (*Ficus carica*)—Morphology, taxonomy, composition and health benefits. In Fruits grown in highland regions of the Himalayas: Nutritional and health benefits (pp. 77-90). *Cham: Springer International Publishing.*

Imran, M., Rasool, N., Rizwan, K., Zubair, M., Riaz, M., Zia-Ul-Haq, M., ... & Jaafar, H. Z. (2014). Chemical composition and biological studies of *Ficus benjamina. Chemistry central journal*, 8, 1-10.

Jadhav, M. M., Chhajed, M., & Saluja, M. S. (2021). Phytochemical, pharmacological investigation and isolation of various extracts fractions of *Ficus benjamina* leaves. *Neuro Quantology*, 19(11), 401.

Judd, W.S., Campbell, C. S., Kellogg, E. A., Stevens, P. F., & Donoghue, M. J. (2008). Plant Systematics: A Phylogenetic Approach. Sunderland, MA: Sinauer Associates.

Kumar, M., Sharma, I., Verma, P. K., Singh, B. J., Singh, R., & Upadhyay, S. K. (2021). A study on diversity and distribution of *Ficus* L. (Dicotyledonae: Moraceae) species at Forest Research Institute (FRI), Dehradun (Uttarakhand), India. *Journal of Applied and Natural Science*, 13(2), 552-560.

Lansky, E. P., Paavilainen, H. M., Pawlus, A. D., & Newman, R. A. (2008). *Ficus* spp. (fig): Ethnobotany and potential as anticancer and anti-inflammatory agents. *Journal of Ethnopharmacology*, 119(2), 195-213

Mostafa, S., Hussein, B. A., Sayed, H. A., ElItriby, H. A., & Hussein, E. H. (2020). Genetic diversity assessment among some *Ficus* species using morphological characters and AFLPS. *Plant Archives*, 20(1), 1395-1404.

Nigar, S., Shimul, I. M., Hossain, M. S., Sultana, R., Asha, S., & Huq, A. O. (2025). Comparative analysis on phytonutrient properties of different fig varieties (*Ficus* spp.). *Food Chemistry Advances*, 6, 100878.

POWO. (2025). Plants of the World Online. http://powo.science.kew.org/. (2025).

Rao, R. R. (2008). Floristic diversity in Western Ghats: Documentation, conservation and bioprospection – A priority agenda for action. In A. R. R. Menon (Ed.), Proceedings of the National Seminar on Western Ghats: Biodiversity, Conservation and Sustainable Development (pp. 23–38). Kerala State Council for Science, Technology and Environment (KSCSTE).

Sasidharan, N. & V. V. Sivarajan. (2004). *Biodiversity Documentation of Kerala. Part 6.*

Sasidharan, N. (1999). Floristic Diversity of Shenduruny Wildlife Sanctuary, southern Western Ghats, Kerala. *Biodiversity, Taxonomy and Conservation of Flowering Plants.* Mentor Books, Calicut, 261-273.

Shanahan, M., So, S., Compton, S. G., & Corlett, R. (2001). Fig-eating by vertebrate frugivores: A global review. *Biological Reviews*, 76(4),

Shi, Y., Mon, A. M., Fu, Y., Zhang, Y., Wang, C., Yang, X., & Wang, Y. (2018). The genus *Ficus* (Moraceae) used in diet: Its plant diversity, distribution, traditional uses and ethnopharmacological importance. *Journal of ethnopharmacology*, 226, 185-196.

Singh, B., & Sharma, R. A. (2023). Updated review on Indian *Ficus* species. *Arabian Journal of Chemistry*, 16(8), 104976.

Singh, P., Dhankhar, J., Kapoor. R. K. & Sharma, A. (2023). A comparative study on GC-MS analysis and antimicrobial activity of bioactive compounds present in aerial

parts (leaf and fruit) of *Ficus benghalensis* L. *Journal of Applied and Natural Science*, 15(2), 870.

Sudhakar, J. V., & Murthy, G. V. (2017) Taxonomy and distribution of Ficus talbotii (Moraceae) in India. Rheedea, 27(1), 16-19

Vanitharani, J., Bharathi, B. K., Margaret, I. V., Malleshappa, H., Ojha, R. K., & Naik, K. G. A. (2009). *Ficus* diversity in Southern Western Ghats: a boon for biodiversity conservation. *Journal of Theoretical Experimental Biology*, *6*(1), 69-79.