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PREFACE

The efforts of M/s Mazhar Masood, Divisional Forest Officer, Shahzad Khalid & Mrs. Nighat Mansoor Research Officers, in compilation of this book 'BANYAN TREE' are highly commendable.

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Chapter 1

Introduction

1.1 *Ficus benghalensis*

The banyan tree (*Ficus benghalensis*) is an evergreen tree with a wide, spreading crown; it can grow 20 - 30 meters or more tall. The giant banyans of India are the largest trees in the world by area of canopy coverage. The largest, known specimen of tree in the world in terms of the two dimensional area covered by its canopy is Thimmamma Marrimanu in Andhra Pradesh, India, which covers 19,107 m^2 (4.721 acres). This tree is also the largest, known specimen of tree in the world in terms of the length of its perimeter, which measures 846 m (2,776 ft).

The common name banyan comes from India, where early travellers observed that the shade of the tree was frequented by banias or Indian traders.

Nearchus, an admiral of Alexander the Great, described a large specimen on the banks of the Narmada River in contemporary Bharuch, Gujarat, India; he may have described the specimen presently named "Kabirvad". The canopy of the specimen which Nearchus described was so extensive that it sheltered 7,000 men. James Forbes later described it in his *Oriental Memoirs* (1813-5) as almost 610 m (2,000 ft) in circumference and having more than 3,000 trunks. Modernly the area of its canopy is circa 3 square kilometers.

Other notable Indian specimens include The Great Banyan in the Jagadish Chandra Bose Botanic Garden in Shibpur, Howrah, which has a canopy area of 18,918 m^2 (4.675 acres) and is about 250 years old, and Dodda Aladha Mara in Kettohalli, Karnataka, which has a canopy area of 12,000 m^2 (3.0 acres) and is about 400 years old.

The tree is harvested from the wild for its edible fruit and medicinal uses. It also supplies a timber and a material for tying. The tree is considered sacred by Hindus and is commonly planted for religious purposes; it is also grown as an ornamental and to provide shade along roads as well as in parks and large gardens.

1.2 Taxonomy and Nomenclature

The specific identification of many of the species can be difficult, but Ficuss as a group are relatively easy to recognize. Many have aerial roots and a distinctive shape or habit, and their fruits distinguish them from other plants. The Ficus fruit is an enclosed inflorescence, sometimes referred to as a syconium, an urn-like structure lined on the inside with the Ficus's tiny flowers. The unique Ficus pollination system, involving tiny, highly specific wasps, known as Ficus wasps that enter via ostiole these sub-closed inflorescences to both pollinate and lay their own eggs, has been a constant source of inspiration and wonder to biologists. Finally, there are three vegetative traits that together are unique to Ficuss. All Ficuss possess a white to yellowish latex, some in copious quantities; the twig has paired stipules or a circular stipule scar if the stipules have fallen off; and the lateral veins at the base of the leaf

are steep, forming a tighter angle with the midrib than the other lateral veins, a feature referred to as "tri-veined".

The Moraceae are monoecious or dioecious trees, shrubs, climbers, stranglers, and rarely herbs comprising about 39 genera and 1125 species distributed mostly in tropical to warm

temperate regions (Stevens, 2012; Flora of China Editorial Committee, 2014). Nearly all species within this family contain milky latex and have alternate or opposite leaves and small, unisexual, and minute flowers (Wilmott-Dear and Brummitt, 2007). The genus *Ficus* includes about 750 species of trees, shrubs, climbers, and hemiepiphytic stranglers with Pantropical distribution (Wagner *et al.*, 1999; Stevens, 2012). These species are recognized by a specialized inflorescence and pollination syndrome (Weiblen, 2000).

1.3 Scientific classification

Kingdom Plantae: – Plants
Subkingdom: Tracheobionta – Vascular plants
Superdivision: Spermatophyta – Seed plants
Division: Magnoliophyta – Flowering plants
Class: Magnoliopsida – Dicotyledons
Subclass: Hamamelididae
Order: Urticales
Family: Moraceae – Mulberry family
Genus: *Ficus* L.

Specie: F.bengalensis

(Banyan tree stem and aerial roots)

1.4 History of Banyan tree:

Ficus benghalensis has been widely introduced and cultivated in the tropics (Rojo *et al.*, 1999; Starr *et al.*, 2003). In Florida, seedlings were first observed in Miami in 1986 (Stange and Knight 1987). For Australia, the oldest herbarium collection was dated in 1899 (Atlas of Living Australia, 2014).

Ficus benghalensis (*Ficus benghalensis*) is known as a sacred tree frequently mentioned in Atharvaveda. The Atrey Bramha informed that it grew abundantly in region of Kurukshetra.

The life span of *Ficus benghalensis* tree is more than 100 years. Hence it is called as Akshay*Ficus benghalensis*.

1.5 Distribution

Ficus is a pan-tropical genus of trees, shrubs and vines occupying a wide variety of ecological niches; most are evergreen, but some deciduous species are endemic to areas outside of the tropics and to higher elevations.

Some better-known species that represent the diversity of the genus include the common Ficus, a small temperate deciduous tree whose fingered Ficus leaf is well known in art and iconography; the weeping Ficus (*Ficus benjamina*), a hemi-epiphyte with thin tough leaves on pendulous stalks adapted to its rain forest habitat; the rough-leaved sandpaper Ficuss from Australia; and the creeping Ficus (*Ficus pumila*), a vine whose small, hard leaves form a dense carpet of foliage over rocks or garden walls.

The common species of Genra *Ficus* in tropical thorn forest type found in Pakistan are as follows *Ficus benghalensis*, *F.elastica*, *F.relegiosa*, *F.infectoria*, *F.lyrata*, *F.macrophylla*, *F. benjamina*, *F.erecta* etc.

1.6 Habitat and Ecology

Ficus benghalensis grows from low altitudes to 600 meters principally in monsoon and rain forests. However, it is drought resistant and withstands mild frost (Oudhia 2004). In the Bahamas it is cultivated but occasionally escapes to coppiced forest areas (Smith, 2010). In Australia, it can be found in mixed eucalypt woodland with monsoon scrub species (Chew, 1989).

1.7 Environmental Requirements

Ficus benghalensis grows best in wet habitats on well-draining sandy loam soils, but it is drought-resistant (Starr *et al.*, 2003).

1.8 Longevity

Ficus benghalensis is a woody tree with long life span (i.e., >100yrs) that can attain large dimensions (perimeters >800 metres; Munshi *et al.*, 2004).

1.9 Morphology of *Ficus benghalensis*:

Banyan tree is a big tree distributed all over India in the temperate climate. Aerial roots are found hanging from the tree which, on touching the ground, gives support to the branches. The tree bark is thick, whitish colored. The leaves are thick, oval, 4-6 inches long. The fruits are red, round, about 0.5 to 0.75 inch in diameter and spongy. The flowers are not visible in the tree. The male and female flowers are enclosed in an axillary, sessile, depressed red fruits. New tender buds are seen in the summer season along with the fruits.

(Leaves and fruit of Banyan tree)

1.10 Cultural significance

Ficus benghalensis is the national tree of India. The tree is considered sacred in India, and temples are often built beneath. Due to the large size of the tree's canopy it provides useful shade in hot climates. In Theravada Buddhism, this tree is said to have been used as the tree for achieved enlightenment, or Bodhi by the twenty fourth Lord Buddha called "Kassapa". The sacred plant is known as "Nuga" or "Maha nuga" in Sri Lanka.

1.11 Genetics

The chromosome number reported for *Ficus benghalensis* is 2*n* = 26 (Ohri and Khoshoo, 1987).

1.12 Cultural and spiritual significance

Ficus trees have profoundly influenced culture through several religious traditions. Among the more famous species are the sacred Ficus tree (Pipal, bodhi, bo, or po, *Ficus religiosa*) and the banyan Ficus (*Ficus benghalensis*). The oldest living plant of known planting date is a *Ficus religiosa* tree known as the Sri Maha Bodhi planted in the temple at Anuradhapura, Sri Lanka by King Tissa in 288 BCE. In Asia, Ficuss are important in Buddhismand Hinduism. In Jainism, the consumption of any fruit belonging to this genus is prohibited. The Buddha is traditionally held to have found *bodhi* (enlightenment) while meditating under a sacred Ficus (*Ficus religiosa*). The same species was *Ashvattha*, the "world tree" of Hinduism. The *plaksa Pra-sravana* was said to be a Ficus tree between the roots of which the Sarasvati River sprang forth; it is usually held to be a sacred Ficus but more probably seems to be a wavy-leaved Ficus (*Ficus infectoria*). According to the Kikuyu people, sacrifices to Ngai were performed under a sycomore tree (Mũkũyũ) and if one was not available, a Ficus tree (Mũgumo) would be used. The common Ficus tree is cited in the Bible, where in Genesis 3:7, Adam and Eve covers their nakedness with Ficus leaves. The Ficus fruit is also included in the list of food found in the Promised Land, according to the Torah (Deut. 8). Jesus cursed a Ficus tree for bearing no fruit. The Ficus tree was sacred in ancient Cyprus where it was a symbol of fertility.

Chapter 2

Reproduction

2.1 Fruits and reproduction

Many Ficus species are grown for their fruits, though only *Ficus carica* is cultivated to any extent for this purpose. The Ficus fruits, important as both food and traditional medicine, contain laxative substances, flavonoids, sugars, vitamins A and C, acids and enzymes. However, Ficus's are skin allergens, and the latex is a serious eye irritant.

(Fruit of Banyan tree)

2.2 Means of Movement and Dispersal

Ficus benghalensis spreads by seeds, but it can also be propagated from cuttings or transplanting young trees (Starr *et al.,* 2003; Smith, 2010; PROTA, 2014). Seeds can remain up to two years in open storage at room temperature (PROTA, 2014).

The seeds of *Ficus benghalensis* are dispersed by fruit-eating birds and bats. Ficus seeds that pass through the digestive system of birds are more likely to germinate and sprout earlier.

2.3 Propagation in banyan tree

Banyan trees can be propagated from softwood cuttings or seeds. Cuttings can be taken from the tips and rooted or by eye cuttings, which require a piece of stem about a half inch below and above a leaf. Insert cuttings into a suitable rooting medium, and within a couple of weeks, roots (or shoots) should begin to develop. As parts of the banyan tree plant are poisonous (if ingested), caution should be used while handling it, as sensitive individuals may be susceptible to skin irritations or allergic reactions. If choosing to grow banyan from seed, allow seed heads to dry on the plant before collecting. Keep in mind, however, that a growing banyan tree from seed can take some time.

Chapter 3

Uses of *Ficus benghalensis*

Ficus benghalensis is often planted as an ornamental. The bark, leaves, root-fibres, and milky juice (latex) are used in the preparation of traditional medicines. The tree is also planted for soil conservation, timber and pulp paper. The leaf is used in the preparation of fodder. It is also cultivated as a shade tree along streets, in parks and gardens, and grown as a host plant for lac insects. The fruit is edible, but is eaten only in famine times (Rojo *et al.*, 1999; Oudhia 2004; Smith, 2010; PIER, 2014; PROTA, 2014).

3.1 Medicinal Importance of *Ficus benghalensis*

Ficus benghalensis plant is an ever green plant of family Moraceae having many chemicals compounds present in this plant. There are so many workers work out on this plant. Patil *et al.*, (2010) described that in leaves, stem, bark, root and aerial root have different chemicals so this plant is having medicinal importance. Some chemicals are described as: In *Ficus benghalensis* leaves have quercetin-3-galactoside, rutin, friedelin, taraxoseterol, lupeol, Bamyrin along with psoralen, bergapten and B-sisterol. The bark of *Ficus benghalensis* present of 5,7 Dimethyl ether of lucope-largonidin 3-0-∝-L rhamnoside and 5, 3, dimethyle ethar of leucocynidin 3-0-∝-D galactosyl cellobioside, glycoside, 20-tetra-triaconthene-2-one, 6- heptatriacontene-10-one, pentatriacontan-5-one, beta Sitosterolalpha-D-glucose and meso-inositol Earlieds, glucoside, 20 tetrattriaconthene-2-one, 6-heptaria contene-10-one, pentatriacontan-5-one, β sitosterol-alpha-D-glucose, and me-so-inositol, Leucodelphinidinderivative, bengalenoside: Aglucoside, Leucopelargonin derivative, Leucocynidin derivative, glycoside of leucopelargonidin have been isolated from the bark of *Ficus benghalensis*. Ficus compound showed significant antioxidant effect, which may be attributed to their polyphenolic nature Patil *et al.*, (2010). The stem bark of *Ficus benghalensis* L. and Ficus reacemosa L. are used in India for the treatment of diabetes and a number of other diseases. Bark of *Ficus benghalensis* decreased fasting blood Sugar and glycosylated haemoglobin. The fruit of *Ficus benghalensis* traditional use of folk medicine for respiratory disorders and certain skin disease.

According to Ayurvedic system of medicine *Ficus benghalensis* linn (Banyan tree) is well known to be useful in diabetes. This attracted the attention of many earlier workers who studied the hypoglycemic effect from the bark of *Ficus benghalensis*. *Ficus benghalensis* Linn is a large evergreen tree found throughout forest tracts of India. It is popular Indigenous system of medicine like Ayurveda, Siddha, Unani and Homeopathy. In traditional system of medicine various plant parts such as stem, bark, root bark aerial roots, vegetative buds, leaves, fruits and latex are used in dysentery, diarrhea, diabetes leucorrhoea, menorrhagia, nervous disorders, tonic and astringent. According to Ayurvedic system of medicine *Ficus benghalensis* Linn (Banyan tree) is well known to be useful in diabetes. It is an effort to give a detailed survey of the literature on its pharmacognosy, phytochemistry, pharmacological, traditional uses as antioxidant, antiatherogenic, antitumor, anthelmintic, anti-inflammatory, analgesic, anti-stress, antipyretic, anti-allergic, antidiarrhoeal, antidiabetic, ameliorative, hypoglycemic, hypoglydemic,

immunomodulatory and wound healing properties are present in *Ficus benghalensis* plant.

According to (Patil & Patil, 2010) the evaluation of these drugs is primarily based on photochemical pharmacological and allied approaches including various instrumental techniques such as chromatography. Microscopy and others with the emerging worldwide interest in adopting and studying traditional system and exploiting their potential based on different health care systems, the evaluation of the rich heritage of traditional medicine is essential. In this regard, on such plant as *Ficus benghalensis* Linn. Syn. Ficus banyana Oken.

a) Improving Fertility: Buds of *Ficus benghalensis* have been taken for improving fertility.

b) Leucorrhoea: Bark, fruit and milk of *Ficus benghalensis* is useful for Leucorrhoea. ϖ Bark of *Ficus benghalensis* with 'Triphla' powder has been taken up 20 days with the help of honey to cure Leucorrhoea. ϖ The bark of this plant after boiling with water locally used to cure leucorrhoea.

c) Toothache: Bark of *Ficus benghalensis* and gum of *Acasia catachu* with black Pepal locally use as a pest is cure tooth problem, Pyria problem and clean teeth clearly.

d) Improving Memory: Bark of *Ficus benghalensis* after drying and cruising take 5 to 6g powder with cow milk it improved memory. The bark of *Ficus benghalensis*, whole plant of Bramhi (B.N.) and after cruising take 21 days daily it improved memory power. The young twigs of *Ficus benghalensis* cruised and prepare 21 tablets take one tablets daily with cow butter. It improved memory power.

e) Dysentery: The extracted drop of *Ficus benghalensis* arial roots with honey daily three times it care dysentery. The young twigs of *Ficus benghalensis* cruised and take twice a day with the help of cure dysentery.

f) Pimples: The milk of *Ficus benghalensis* is useful to cure pimples. Arial root of *Ficus benghalensis* and puls of (masoor) greed with milk and put locally on pimples it cure pimples. Leaf extract of *Ficus benghalensis* with butter potted on pimples it cure pimples. Arial roots of *Ficus benghalensis* with gulab jal potted locally on pimples it cure pimples.

g) Piles: The bark of *Ficus benghalensis* after boiling with water mixed sugar and cow butter take 10 to 20 days early morning to cure piles.

h) Arthritis: The milk of *Ficus benghalensis* locally use for Arthritis.

i) Hair fallings: Arial roots of *Ficus benghalensis* with black til (B.N.) after cruising mixed in coconut oil use locally in hairs it cures hair falling.

j) Gyanic disorder: 5 to 10 drops of *Ficus benghalensis* milk with take with sugar candy up to 20 days before sunrise.

3.2 Ayurvedic Medicines containing ***Ficus benghalensis*:**

a) Paranthyadi taila: It is an herbal medicine, used mainly in the treatment of dermatitis, spider bite, etc. It is usually prepared in sesame oil / Coconut oil base.

b) **Swarna sindhura:** It is an Ayurvedic medicine, with herbal and mineral ingredients, in powder / tablet form. It is used treatment of oligospermia, emaciation, etc.

c) **Ushirasava:** It is a liquid Ayurveda medicine used in treating bleeding disorders, skin diseases, intestinal worms, inflammatory conditions and piles.

d) **Nyagrodhadi kashayam:** It is a decoction useful to treat skin diseases, wounds, vaginal diseases, thirst and burning sensation.

e) **Sarivadyasava:** It is a liquid formulation useful to treat diabetes, diabetic carbuncles and related skin complications, gout, skin infections and in rheumatism.

f) **Dermosooth ointment:** It is a proprietary Ayurvedic medicine, useful in the treatment of rheumatoid arthritis, burning sensation and improves the complexion of skin.

g) **Diabac tablet:** It is a proprietary Ayurvedic medicine, useful in the treatment of non- insulin dependent diabetes.

(Aerial roots become the part of the main stem)

3.3 Other Uses of Banyan tree:

- The milky latex of *Ficus benghalensis* is applied directly over the wound and swelling for quick relief.
- The decoction of the bark of *Ficus benghalensis* is given in a dose of 50-70 ml to treat vaginal diseases.
- To control diabetes, the decoction of the bark of *Ficus benghalensis* or the fruit is given.
- In order to strengthen the uterine muscles during pregnancy, the tender leaves of *Ficus benghalensis* are given the form of decoction.
- The latex of Banyan tree is called Bargad ka doodh in Hindi. It is used to treat cases of premature ejaculation.
- Latex of *Ficus benghalensis* is applied locally in dental caries, conjunctivitis and skin diseases as part of treatment.
- For the firmness of the breasts in females, the paste of the aerial roots is applied locally.
- To treat diarrhea, the buds of *Ficus benghalensis* is added with *Ficus religiosa* and *Ficus glomerata* and processed with ghee and mixed with honey and sugar candy for consumption.
- To treat nausea and vomiting, the decoction prepared from leaf bud of *Ficus benghalensis*, Jambu and Ushira is taken with honey in a dose of 40-50 ml.
- Person affected with viper snake poisoning, paste of root of banyan tree is mixed with juice of Durva, Manjishta, Jivaka and Kashmarya and consumed.
- In excessive sweating, cold infusion from the tender buds of *Ficus benghalensis* is given in a dose of 40-50 ml.

3.4 Environmental Impact

Ficus benghalensis is a fast-growing tree with the potential to invade both disturbed and native ecosystems. This species is capable of germinating in native host trees, where it grows as an epiphyte, eventually killing the host-trees. The root system can damage buildings and sidewalks. The tree can also germinate in fence-posts, rocks, bridges, buildings, and other structures, eventually engulfing the hosts (Starr *et al.*, 2003; PIER, 2014; PROTA, 2014).

(Banyan tree aerial roots touching ground)

Chapter 4

Diseases of ***Ficus benghalensis***

4.1 Bacterial diseases

a) Bacterial leaf Spot

Casual bacteria: Pseudomonas cichorii, Xanthomonas campestris

b) Crown gall

*Causal agent: Agrobacterium tumefaciens***.**

4.2 Fungal Diseases

a) Cercospora leaf spot

Causal agent: Cercospora spp.

b) Phomopsis dieback

Causal agent: Diplodia spp.

c) Southern blight

Causal agent: Sclerotium rolfsii

d) Verticium wilt

Causal agent: Verticillium alboatrum

4.3 Nematodes and Parasitic

a) Lesion nematodes

Causal agent: Pratylenchus spp.

4.4 Prevention and Control

Ficus trees appear to be particularly sensitive to triclopyr herbicides as a basal or cut-stump treatment. However, extreme caution is needed when applying herbicide to Ficus species growing as epiphytes to ensure that the herbicide does not contact the host tree (Starr *et al.*, 2003).

Chapter 5

Trees Age

5.1 Estimation of Trees Age

Foresters determine tree ages by counting the growth rings of a severed tree stump or by taking a core sample using an increment borer. Still, it is not always appropriate to use these invasive methods to age a tree. There is a noninvasive way to estimate tree age in common trees where they are grown in a forest environment.

Trees have different growth rates, depending on their species. Trees, by species, are genetically coded to grow at about the same rate under similar conditions.

A formula was previously developed and used by the International Society of Arboriculture (ISA) to predict and determine a forestland tree's age. Running the calculations and comparing them to a species growth factor is regionally and species specific so these should be considered very rough calculations and can vary by region and site index.

The ISA says that "tree growth rates are affected tremendously by conditions such as water availability, climate, soil conditions, root stress, competition for light, and overall plant vigor. Further, the growth rates of species within genera can vary significantly." So, only use this data as a very rough estimate of a tree's age.

The term ‘growth factor’ refers to a numerical factor (a simple number such as ‘5’) that you multiply times a tree’s diameter to estimate the tree’s age. The ‘growth factor’ of a tree species is generated by dividing the diameters of many individual trees by their actual age determined by counting their growth rings.

As a cautionary note, growth factors are simply an average estimate of growth over time for a tree, and trying to apply a growth factor across a range of environmental conditions or geographical locations will certainly result in a large amount of estimation error. If you establish your own growth factors for the trees you study, and keep the environmental conditions and tree densities similar across survey areas you might find this method of tree aging to be useful. But as tree’s age their radial growth will decline even if they are adding the same amount of total wood each year, so using the growth factor method is no longer common for this and other complicating reasons.

5.2 Estimated Age of ***Ficus benghalensis*** (Banyan) trees in the premises of Lahore High Court, Lahore

A bill for the formation of the Chief Court of the Punjab was introduced on 16 February 1866 and the Chief Court Act-IV of 1866 was promulgated by the Governor General on 17.02.1866. In 1919, by King-Emperor George V the letters patent also appointed a Chief Justice and six justices, and declared the Court's jurisdiction over the Punjab and Delhi provinces.

As reported in Punjab Administration Report 1887-88, the Chief Court was completed in the year 1887. The Banyan trees present in the Lahore High Court were planted in different years. The estimated age of banyan trees taken during the month of December 2017 is as under:

Sr. No.	Tree Location	Estimated year of planting	Estimated Age (Years)
1	Opposite Chamber of Honorable Chief Justice and Registrar office	1893	124
2	In front of Chief Justice Court	1892	125
3	In front of Court No.18	1935	82
4	Opposite to Court No.20	1913	104
5	Inside Bar Room	1874	143
6	Inside the office of building department	1870	147
7	Inside the Motorcycle Stand	1953	64

5.3 Other tree species present in the Lahore High Court

Sr. No.	Botanical Name	Local Name
1	*Ficus Benghalensis*	Barh,Banyan tree
2	*Ficus Relegiosa*	Peepul tree
3	*Polyalthia longifolia*	Ashoka
4	*Aegle marmelos*	Bilgri
5	*Alstonia scholaris*	Blackboard tree, devil tree
6	*Diospyros blancoi*	Ghab, velvet apple, mabola tree
7	*Araucaria heterophylla*	*Araucaria*
8	*Putranjiva roxburghii*	*Potajan*

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