

A Threatened Introduced Species (*Ficus benghalensis* L.) in Ismailia, Egypt

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Abstract

The genus *Ficus* belongs to *Moraceae* (Mulberry family). It is comprised of around 1000 species from pantropical and subtropical origins; plants of the family are on the whole woody, ranging from trees and shrubs to climbers. *F. benghalensis* has many common names as Indian banyan tree, East Indian fig tree, and vada tree, banyan tree is considered sacred by Hindus and is largely grown near temples. It is a large and extensive growing tree of the Indian subcontinent. *Ficus* compound showed significant antioxidant effect, which might be ascribed to their polyphenolic nature. The stem bark of *Ficus benghalensis* L. and *Ficus racemosa* L. are utilized in India for the treatment of diabetes and various different illnesses. The bark of *Ficus benghalensis* decreased fasting blood sugar and glycosylated hemoglobin. The fruit of *Ficus benghalensis* is used in folk medicine for respiratory disorders and certain skin disease.

Keywords: *F. benghalensis*, banyan tree, antioxidant effect, folk medicine, age dating

1. Introduction

The genus *Ficus* belongs to *Moraceae* (Mulberry family). It is comprised of around 1000 species from pantropical and subtropical origins [1]. Plants of the family are on the whole woody, ranging from trees and shrubs to climbers [2]. *Ficus benghalensis* is an evergreen tree with a wide, spreading crown; it can grow 20–30 m or more tall. The plant usually begins life as an epiphyte, growing in the branch of another tree; as it grows older it sends down aerial roots which, when root reach the ground become much thicker and more vigorous. They supply nutrients to the fig, allowing it to grow faster than the host tree. Finally, the host dies, leaving the fig to carry on growing without competition. It can become a huge, spreading tree in time, with some specimens several hundred meters across and producing aerial roots from the spreading branches that in the long run become new trunks and enable the crown to spread considerably further.

F. benghalensis has many common names as Indian banyan tree, East Indian fig tree, and vada tree [2, 3]. Its name has been derived from the Hindu traders, called banyans, who favored the tree [2]. Banyan tree is considered sacred by Hindus and is largely grown near temples. It is a large and extensive growing tree of the Indian subcontinent. The wood is grey, moderately hard and durable under water. The wood of the “props” is stronger than that of the main trunk. The timber is used for making well-curbs, furniture, crates, door panels and cart-shafts. The props are

used for tent poles and umbrella handles. The leaves are used as fodder for cattle and elephants.

The tree is harvested from the wild for its edible fruit and medicinal uses. 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.

Ficus compound showed significant antioxidant effect, which might be ascribed to their polyphenolic nature. The stem bark of *Ficus benghalensis* L. and *Ficus racemosa* L. are utilized in India for the treatment of diabetes and various different illnesses. The bark of *Ficus benghalensis* decreased fasting blood sugar and glycosylated hemoglobin. The fruit of *Ficus benghalensis* is used in folk medicine for respiratory disorders and certain skin disease.

According to Edlin and Nimmo [4] proved that the latex (source of rubber) has been found in large quantity in the wood of *Ficus* genus, which is representing one of the largest economical uses of *Ficus* in Egypt. *Ficus benghalensis* is thought to be cultivated 150 years ago in Ismailia during the process of digging the Suez Canal back in 1859–1869.

These days, *Ficus* trees are subjected to many threats affecting the presence of main populations. These threats comprised by the following points: (a) human cutting for general purposes, (b) cutting by council city for shifting landscape of the city, and (c) absence of a specific pollinating wasp in order to reproduce and spread [5]. For these reasons and subsequently results, it is very hard to find a new tree individuals coming up to these areas of *Ficus*. These threats will change the landscape of the whole area in the next few years.

The present study is aimed to anticipate a strategic conservation plan for landscape construction primed by *Ficus* trees in Ismailia, Egypt and discuss the age structure of this species.

2. Distribution

Ficus benghalensis is native to South Asia particularly India, Sri Lanka and Pakistan (**Figure 1**). It is often planted around temples and a place of religious interest. It is considered as sacred tree by both Hindus and Buddhists.

Banyan tree is widely cultivated in city parks and botanical gardens throughout the New World and Old World tropics. It grows well in tropical, semi-tropical areas, monsoon and rain forests with moderate to ample rainfall. Humid air and moist soil and is hardy, drought resistance and withstands mild frost is well suited for its growth [6].

Ismailia governorate is located in the eastern part of Egypt at the middle part of Suez Canal. It is bounded from the East by Suez Canal (that penetrates Tamsah Lake and Bitter Lakes), from the West by the eastern borders of Delta along Damietta Nile branch, from the South by Suez-Cairo high way, Port Said and Manzala Lake from the North (**Figure 2**). It was established as a separate governorate by the declaration law number 24 in 1960. Its area is 5067 km² and has seven main cities, Ismailia (the capital), Fayed, El-Tal El-Kber, El-Kantara east, El-Kantara west, El-Ksasen and Abo Souer. Human population of Ismailia governorate reaches 1.4 million individuals.

3. Description

F. benghalensis, frequently very large, up to 30 m length, have numerous aerial roots which can extend into new trunks so that the tree goes on thinning out laterally



Figure 1.
 Distribution of *Ficus benghalensis* in South Asia according to <https://media4.picsearch.com/is?JAgdqscN1wEM9xqDeneyt8fKM0NfgxAyKwy5aPsy1qo&height=301>.

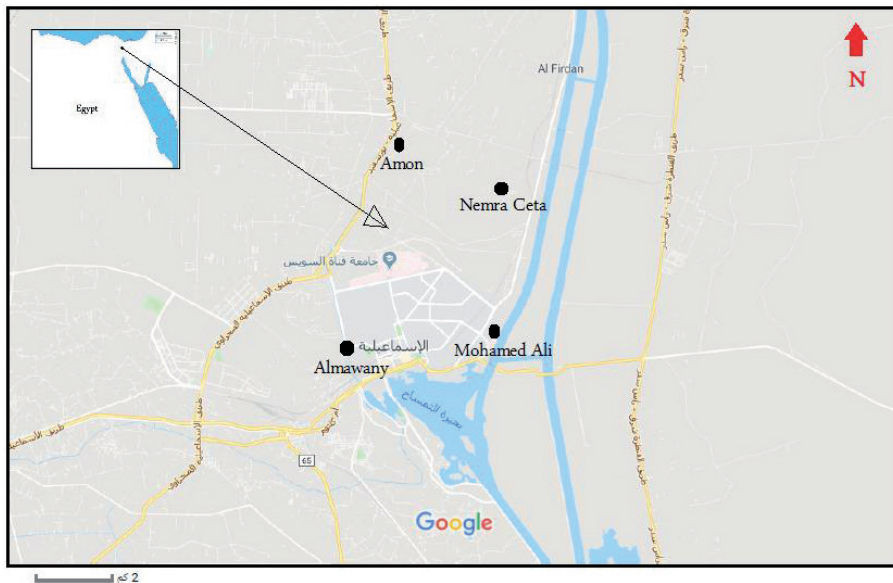


Figure 2.
 Map showing the four studied localities of *F. benghalensis* chosen for study in Ismailia.

indefinitely; a single tree can thus cover a very wide area. The leaves are leathery, entire, ovate or elliptic, 20–40 cm long with prominent lateral veins. The figs are 1–2 cm in diameter, without stalks, in pairs in leaf axils, and when ripe are bright red.

Leaves are glossy, leathery and glabrous when mature, approximate near the end of branches, ovate, mostly obtuse, base cordate or rounded, thickly coriaceous, basal nerves 3–7, the midrib with 4–6 pairs of secondary nerves, blade 10–20 cm, petiole 2–5 cm long, shoot pubescent, 1.5–2 cm in diameter, sessile, scarlet, red once ripe [7].

A flower has very small, separate, male and female flowers. The male flowers crowded near the mouth of the receptacle, whereas female flowers with shorter perianth, style long, male and female in the same receptacle [8].

Fruits are globular, sessile in axillary pairs, fleshy pericarp and with achenes in the center. When mature, they are dark red in color, 1.5–2.0 cm diameter, red to dark purple when ripe; seeds are tiny. Fruit is not edible for humans but is eaten by birds and monkeys [8].

4. Ecology

In Egypt, various *Ficus* species are established in streets, gardens, parks and outside the canal banks. Two of the most favorable fruits are eaten by Egyptian people (*F. carica* and *F. sycomorus*) and also they use *Ficus* in their traditional uses in folk medicine respiratory disorders and certain skin diseases [9, 10].

Mousa et al. [9, 10] detailed that there are about 20 species of *Ficus* native to Egypt; most of them are cultivated as street trees for providing shade (e.g., *F. retusa*) as in Alexandria city, while other species used as ornamental plants (e.g., *F. religiosa*). Edlin and Nimmo [4] proved that the latex (source of rubber) has been found in large quantity in the wood of *Ficus* genus, which is representing one of the largest economical uses of *Ficus* in Egypt.

5. Field visits and sampling

Four main localities characterized by large number of *F. benghalensis*, trees were selected in Ismailia city for the present study. These localities are: El-Mawany area comprises of 55 trees, Mohamed Ali area comprises of 5 trees, Amon area comprises of 16 trees, and Nemra Ceta comprise of 38 trees (**Figures 3 and 4**). In each locality, number of vegetation parameters was measured to describe the *Ficus* trees including; height, cover, circumference at base (CAB), circumference at breast height (CBH), number of aerial root and vitality. Tree vitality has also been measured using the visual assessment of crown conditions. Tree condition is often used in conjunction with other vitality assessments for verification purposes [11, 12]. However, vitality was measured according to the following scale: high, excellent healthy plant (vigor); medium, normal or some yellow leaflets and low, not healthy with yellow leaves [13].



Figure 3.
F. benghalensis trees in Ismailia roads.



Figure 4.
F. benghalensis aerial roots in one of the four studied areas in Ismailia.

6. Soil analysis

In each site, three soil samples (0–20 cm depth) were taken for soil chemical and physical analyses. Particle size analysis was done by dry sieving for the coarse sand and by pipette for fine sand, slit, and clay [14]. Soil aggregation was treated by 5% of sodium hexametaphosphate as a dispersing agent. Soil was classified based on the percentage of clay and sand using USDA limits of the basic soil textural classes [15]. Soil pH was measured electrometrically using pH meter model 1671 in soil suspension of ratio 1:2.5 soil to water. The soil-water mixture was first shaken for 2 hours, and then pH was measured [16].

The EC was measured in the soil water extract 1:1 using electrical conductivity meter model 4310 ENAWY [17]. Reported the degree of salinity for the course to loamy sand (1:1 soil water extract) as follows: 0.1–1 ds/m for non-saline, and 1.2–2.4 ds/m for slightly saline, 2.5–4.4 ds/m for modestly saline and 4.5–8.9 ds/m for strongly saline. Soil organic matter influences many soil properties including (i) the capacity of soil to supply, N, P and S and trace metals to plant's, (ii) infiltration and retention of water, (iii) degree of aggregation and overall structure that affect air and water relationships, (iv) cation exchange capacity, (v) soil color, which in turn affects temperature relationships [18]. Soil organic matter was measured using loss-on ignition (LOI) method carried out at a high temperature. This method gives quantitative oxidation of organic matter [18].

7. Age dating

Age dating of *Ficus* trees was assessed by counting the annual rings and measuring the circumference of the branches. To avoid destruction of *Ficus* trees, the counting procedure was applied to the already cut branches in each site. Annual

		Age dating scale (year)					
Site no.		<150	151–200	201–250	251–300	301–350	>350
1	(El Mawany)	1	7	12	14	4	1
2	(Mohamed Ali)	0	9	4	3	0	0
3	(Amon)	0	0	1	1	3	0
4	(Nemra Ceta)	3	10	7	6	6	1

Table 1.
Age dating scale of *F. benghalensis* for the four studied localities.

rings and circumference of the available 21 cross sections of *Ficus* trees were measured. Simple regression between annual rings as dependent variable and circumference as independent variable was carried out to have the regression equation that used to figure out the age dating of the main trunk of *F. benghalensis* trees.

To describe the age dating structure of *Ficus* trees at different sites, scale as follows: <150, 151–200, 201–250, 251–300, 301–350, and >350 years (**Table 1**).

8. Data treatment

Data were statistically analyzed [19] using SPSS software (statistical package for social sciences, version 8). One-way ANOVA was carried out to test the variation of different variables between different four sites. Linear correlation coefficient, r , was estimated to find out the relationships between age dating, height and tree cover.

9. Results

9.1 Vegetation parameters

The maximum tree height was 12.5 m recorded at site four (Nemra Ceta) while the minimum tree height was 1.70 m recorded at site two (Mohamed Ali). The circumference at base (CAB) ranged between 0.56 and 1.9 m found at Nemra Ceta, while the highest circumference at breast height (CBH) was 1.8 m and lowest value of 0.65 m, both found at site one (El Mawany). The crown cover of trees ranged between 3.70 and 268.67 m², whereas the highest value was found at site three (Amon area) and the lowest value at site four (Nemra Ceta) (**Table 2**). The number

Site no. one (El Mawany)						
	N	Minimum	Maximum	Mean		±SD
	Statistic	Statistic	Statistic	Mean	±SE	Statistic
Height	55	3.52	11.52	7.0907	0.2485	1.8428
CAB	33	70	170	121.1818	4.6857	26.9171
CBH	40	65	180.03	110.8703	3.966	25.0832
Cover	55	18.31	223.14	70.1522	5.6871	42.1767
Age	40	142	394	242.425	8.6843	54.9241
Valid N (listwise)	33					
Site no. two (Mohamed Ali)						
	N	Minimum	Maximum	Mean		±SD
	Statistic	Statistic	Statistic	Mean	±SE	Statistic
Height	16	1.7	12	6.6875	0.5972	2.3888
CAB	7	90	125	121.1818	5.101	13.496
CBH	16	80	135.02	110.8703	4.6881	18.7523
Cover	16	13.68	104.72	70.1522	8.2362	32.9447
Age	16	175	295	242.425	10.2881	41.1525
Valid N (listwise)	7					

Site no. three (Amon area)						
	N	Minimum	Maximum	Mean		± SD
	Statistic	Statistic	Statistic	Mean	±SE	
Height	5	8.5	11	10.1	0.4301	0.9618
CAB	0					
CBH	5	109.9	157	138.998	8.2311	18.4053
Cover	5	186.17	268.67	229.786	13.2333	29.5907
Age	5	240	344	304	18.1466	40.5771
Valid N (listwise)	0					
Site no. four (Nemra Ceta)						
	N	Minimum	Maximum	Mean		± SD
	Statistic	Statistic	Statistic	Mean	±SE	
Height	38	3	12.5	6.7629	0.3142	1.9368
CAB	28	56	190	111.8929	7.3868	39.0871
CBH	33	44	163.28	105.2173	5.6693	32.5675
Cover	38	3.7	180.89	84.3755	7.9385	48.9363
Age	33	96	357	229.9697	12.4407	71.4666
Valid N (listwise)	28					

Table 2.
Vegetation parameters for the studied four sites.

	Site one	Site two	Site three	Site four
	(El Mawany)	(Mohamed Ali)	(Amon)	(Nemra Ceta)
No. of trees	55	16	5	38
Mean height	7	60.68	10.1	6.76
Mean CAB	121.8	98.82	N. R	105.21
Mean age	242.42	216.06	138.99	229.96
Mean cover	70.15	51.65	229.786	84.37

Table 3.
Mean values of height, CAB, age and cover for the four studied localities.

of aerial roots that were recognized in the studied sites fluctuated from 1 to 183 roots. Mean values of four localities are shown in (Table 3).

9.2 Soil properties

Soils of the examination region have two diverse surface classes, sand and loamy sand. Soil of site one (El Mawany) is loamy sand, whereas soils of the other three sites are sandy soils. Soil pH ranged from 7.43 to 9.14. Soil of site one (El Mawany) has the highest value (pH = 9.14) whereas site three (Amon) shows the lowest value (pH = 7.43) (Table 4).

Site no.		pH	EC (ds\m)	OM (%)	Sand (%)	Silt (%)	Clay (%)	Soil type
1	(El Mawany)	9.14	4.52	4.18	89.33	5.67	5.00	Loamy sand
2	(Mohamed Ali)	7.88	7.84	6.6	91.33	4.00	4.67	Sandy
3	(Amon)	7.43	4.56	7.3	92.67	3.67	3.67	Sandy
4	(Nemra Ceta)	7.93	5.47	7.8	91.00	3.67	5.33	Sandy

Table 4.
Soil physical and chemical characteristics for the studied localities.

As appeared (**Table 4**) summarizing the soil properties of the four sites studied, site one (El Mawany) has the lowest EC (4.52 ds/m) whereas site two (Mohamed Ali) shows the highest EC (7.84 ds/m) and both EC values of sites three (Amon) and four (Nemra Ceta) were (4.56 ds/m) and (5.47 ds/m) respectively. Site four (Nemra Ceta) shows the highest content of organic matter (7.80%) whereas site one (El Mawany) show the lowest content (4.18%), while results for sites three (Amon) and two (Mohamed Ali) were 7.30 and 6.60%, respectively. Site one (El Mawany) shows the lowest content of sand was 89.33% whereas moderate content of clay 5% and highest content of silt 5.67%. Site three (Amon) shows highest content of sand 92.67% whereas the lowest silt content and clay 3.67%. Site four (Nemra Ceta) shows the highest content of clay 5.33% whereas moderate content of fine sand fraction 91% and lowest content of silt 3.67%.

9.3 Age dating

Diameter and annual rings of each branch were measured and regression equation was calculated using the data of diameter and number of growth rings in order to figure out the age dating of the main trunk of different *Ficus* trees. The regression equation is:

$$\text{No. of rings} = (-0.933 + 2.195 \text{ circumference}) \text{ (cm)} \text{ (Figure 5).}$$

$$r = 0.95 \quad r^2 = 0.90 \quad P \leq 0.0001$$

Age dating at El Mawany, ranged from 142 to 394 years. The oldest tree is 394 years, 10.51 m height and 106.73 m² cover while the youngest tree is 142 years, 3.52 m height and 20.58 m² cover. At site two (Mohamad Ali) which has 16 trees age dating of these trees ranges from 175 to 295 years, the oldest tree is 295 years, 7.50 m height and 59.42 m² cover, and whereas the youngest tree is 1.70 m height and 80.32 m² cover. Whereas site three (Amon) includes five trees, age of these trees range from 240 to 344 years, the oldest tree is 344 years, 10.50 m height and 268.67 m² cover; whereas the youngest tree which is 240 years old, 10 m height and 224.20 m² cover. Site four (Nemra Ceta) which has 38 trees, age of these trees ranges from 96 to 357 years, the oldest tree which is 357 years, 8 m height and 124.82 m² cover, whereas the youngest tree is 126 years, 5 m height and 13.72 m² cover.

Based on the regression results, the oldest *Ficus* tree is 394 years found at site one (El Mawany), followed by the second oldest tree about 357 years found at site four (Nemra Ceta).

9.4 Relationships between age and vegetation parameters

One way ANOVA (analysis of variance) of height, CAB, CBH, cover, and age have significant variation between the different sites. Multiple comparison of the

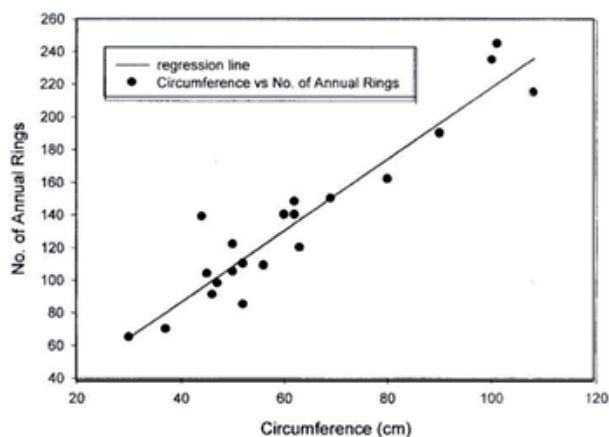


Figure 5.
 Relation between number of annual rings and circumference (cm).

		Sum of squares	Df	Mean square	F	Sig.
Height	Between groups	51.833	3	17.278	4.619	0.004
	Within groups	411.47	110	3.741		
	Total	463.304	113			
CAB	Between groups	2677.835	3	892.612	0.872	0.46
	Within groups	65528.45	64	1023.882		
	Total	68206.28	67			
CBH	Between groups	6725.245	3	2241.748	3.099	0.031
	Within groups	65107.9	90	723.421		
	Total	71833.15	93			
Cover	Between groups	131041.8	3	43680.6	23.502	0
	Within groups	204448.2	110	1858.62		
	Total	335,490	113			
Age	Between groups	32264.92	3	10754.98	3.092	0.031
	Within groups	313077.7	90	3478.641		
	Total	345342.6	93			

Table 5.
 ANOVA of vegetation parameters and age of *F. benghalensis* in four main sites.

significant variables using Duncan test showed that site three has the highest mean values of different parameters (height = 10.1, CBH = 138.9 m, cover = 229.8 m², and age = 304 years), followed by site number one and four. On the other hand, site number two showed the lowest mean values of these parameters (CBH = 9.8 m and cover = 51.6 m²) (Table 3). Analyses of variance of vegetation parameters and age for *F. benghalensis* in the four studies area are shown in (Table 5).

Correlation analysis of different parameters showed highly significant direct correlation between age dating, cover, height, CAB, and CBH. Age dating data showed the highest correlation coefficient with CBH ($r = 1$), and CAB ($r = 0.909$) followed by cover ($r = 0.694$) and height ($r = 0.651$).

10. Discussion

F. benghalensis is the world's largest tree as far as its spread [20]. The tree is native to India and Pakistan (it is named for Bengal). It is a popular shade-tree, cultivated in many tropical countries [21]. The plant begins growth on other trees and eventually envelopes them completely. Aerial roots hang down from the branches and these eventually become trunks. This circle of trunks deriving from one original tree can reach an enormous size—200 m in diameter and 30 m in height. Their shade has made them important gathering places. Known in Hindu mythology as “the wish-fulfilling tree,” banyans represent eternal life. The tree is sacred to Hindus and Buddhists in India and is frequently planted around temples. Being a majestic ornamental tree it is also planted in parks and along streets in the tropics. In temperate climates it is grown as an indoor plant. In general, the banyan is a source of dye and shellac—an important component in French polish—produced by lac insects which inhabit the tree as pests.

The present study showed that populations of *Ficus benghalensis* have limited distribution in Ismailia city (target study area). Four sites were only recognized in the study area. The limitation may return to the requirements of the pollinating wasp (*Eupristina masoni*). However, Ismailia is located near the midpoint of the Suez Canal, on the northwestern shore of Lake Tamsah. The lake, is a natural depression, was connected to the Gulf of Suez of the Red Sea in pharaonic times. The city was founded in 1863 by the French engineer Ferdinand de Lesseps, constructor of the Suez Canal, as a base camp. It was named for the ruling Egyptian khedive (viceroy) Ismail Pasha, whose elaborate palace built for the gala opening of the canal in 1869 has fallen into ruin. Laid out in the nineteenth century style, with broad avenues, tree-lined squares, parks, and gardens, it has a gridiron street plan. Ismailia was cultivated with huge number of *F. benghalensis* and now is subjected to huge human threats affecting the presence of these trees.

Nadel et al. [10] described the pollination process which is the main reason of not producing off spring of *F. benghalensis*. In general, the genus *Ficus* (*Moraceae*) is distributed in the tropics and subtropics worldwide. About one-half of the species are monoecious, the rest being gynodioecious but functionally dioecious Nadel et al. [10]. Most species grow as trees, while others are shrubs or climber. Frequently, germination in many species occurs on other trees, with the seedlings growing epiphytically while sending a set of connections of roots down to the soil, eventually “strangling” their nurse trees [10]. However, other species begin their lives on rocks or straight in soil. Pantropical in distribution, only a few fig species extend into warm temperate regions.

As expressed by Nadel et al. [10], with few exceptions, each fig species is pollinated by a different species of wasp in the family *Agaonidae* (*Hymenoptera: Chacidoidea*) [5, 22–24]. The pollination biology of monoecious species has been described by Galil and Eisikowitch [25, 26]. A pollen-laden female wasp enters the syconium or “fig,” an urn-shaped inflorescence which, when in the receptive stage, is lined internally with dozens or hundreds of receptive female flowers and a few immature male flowers. The wasp lays her eggs through the styles into some of the ovaries, pollinating most of the flowers in the process. In dioecious fig species, pollination is more complex. The “male” tree is monoecious, having both male and female flowers in each syconium, but it has only short-styled female flowers. Nearly all of these female flowers are used by the ovipositing wasps, with the result that the tree produces no seeds, only pollen and agaonids. The female tree, on the other hand, is truly female; the syconia contain only female flowers. These flowers are all long-styled, which effectively eliminates the ability of the agaonid to oviposit in them. The absences of this process of pollination cause failure in germination of *F. benghalensis*.

Age dating results of *Ficus benghalensis* reflect the history of Ismailia area, which return to the age of Suez Canal. Digging of Suez Canal started in 1862 another canal, Ismailia canal, was constructed in the same time to sustain thousands of workers with water, food and other requirements. El-Mawany area and Nemra Ceta area showing the oldest *Ficus* trees are located near the construction of those canals. Importance of cultivating *F. benghalensis* at that time not only returns to their huge shade but also to their medicinal importance that could help in treatments of different diseases.

Based on age dating results, the oldest *F. benghalensis* is 394 years old cultivated in site number one (El Mawany), whereas the youngest tree is 96 years old cultivated in site number four (Nemra Ceta). The highest mean of age dating was recorded for the trees cultivated in site number three (304 years) located at Mohamed Ali, followed by *Ficus* trees cultivated in site number one (242 years) located at El-Mawany area. The lowest mean of age dating was recorded for *Ficus* trees cultivate in site number four and two (229, 216 years respectively). Correlation analysis indicates the direct correlation between age dating, cover, height, CAB, and CBH. CBH was the most important parameter could be used to predict the age dating of *F. benghalensis*. The results showed very important notes about growth mode of *Ficus benghalensis*: (a) average number of annual rings per centimeter ranges from 13 and 14 annual rings and (b) *Ficus* tree with age of 96 years has height 3 m and diameter at breast height equals 14 cm and the oldest tree has height and diameter equal 11 m and 57 cm, respectively.

Age dating of *Ficus benghalensis* data may be interpreted with one of the following two hypotheses. First, these trees may be introduced with age ranges from 150 to 200 years (about 20–30 cm diameter, and 5–7 m height) and connected with the Suez Canal construction for shade and medicinal importance. The second hypothesis returns the cultivation of these trees to the age before the construction of Suez Canal, and the populations of *F. benghalensis* were selected to be near to the route of Suez Canal and Ismailia canal to get benefit from their shade and medicinal importance.

10.1 Chemical constituents

Ficus benghalensis plant is an ever green plant of family *Moraceae* having many chemicals compounds present in this plant. There are so many researchers work out on this plant species. According to Patil et al. [27] described that in leaves, stem, bark; root and aerial root have different chemicals so this plant is having medicinal importance.

In *Ficus benghalensis* leaves have quercetin-3-galactoside, rutin, friedelin, taraxoseterol, lupeol, B-amyrin along with psoralen, bergapten and B-sisterol.

The bark of *Ficus benghalensis* has 5,7 dimethyl ether of lucope-largonidin 3-0- ∞ -L rhamnoside and 5,3, dimethyl ether of leucocynidin 3-0- ∞ -D galactosyl cellobioside, glycoside, 20-tetra-triaconthene-2-one, 6-heptatriacontene-10-one, pentatriacontan-5-one, beta sitosterol-alpha-D-glucose and meso-inositol Earlieds, glucoside, 20 tetratria-conthene-2-one, 6-heptaria contene-10-one, pentatriacontan-5-one, beta sitosterol-alpha-D-glucose, and me-so inositol, leucodelphinidin derivative, bengalenoside: aglucoside, leucopelargonin derivative, leucocynidin derivative, glycoside of leucopelargonidin have been isolated from the bark of *Ficus benghalensis*.

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, and root bark aerial roots, vegetative buds, leaves, fruits and latex are used in dysentery, diarrhea, diabetes leucorrhoea, menorrhagia, nervous disorders, tonic and astringent.

11. Medicinal importance of *Ficus benghalensis*

11.1 Anthelmintic activity

The extracts from *Ficus benghalensis* not only to paralyze, but also to kill the earthworms. The aqueous and methanolic extracts were found to be more effective to execute the earthworm when compared to antihelminthic drugs [28].

11.2 Anti-inflammatory activity

The ethanolic (300 mg) and petroleum ether extracts (600 mg/kg/day) of *Ficus benghalensis*, considerably abridged ($P < 0.05$) carrageenan-induced paw edema in rats. The ethanolic and petroleum ether extracts showed a greater anti-inflammatory effect compared with the standard drug Indomethacin. The results indicated the ethanolic extract of *Ficus benghalensis* exhibited more significant activity than petroleum ether in the treatment of inflammation [27].

11.3 Anti-stress and anti-allergic

Various extracts of *Ficus benghalensis* bark was screened for its anti-allergic and anti-stress potential in asthma by milk-induced leukocytosis and milk-induced eosinophilia. Aqueous, ethanol, and ethyl acetate extracts showed significant decrease in leucocytes and eosinophils in the order given while petroleum ether and chloroform extracts were inactive. This shows the application of polar constituents of *F. benghalensis* bark as anti-stress and Anti-allergic agents in asthma [29].

11.4 Antioxidant activity

The extract was examined for its antioxidant activity by DPPH radical scavenging activity, hydroxyl radical scavenging activity, reducing capacity, hydrogen peroxide activity, total phenolic content using Folin-Ciocalteu's phenolic reagent. The extract showed extreme scavenging of DPPH radical (96.07%) at $250 \mu\text{g mL}^{-1}$ concentration and hydrogen peroxide (69.23%) at $1000 \mu\text{g mL}^{-1}$ concentration. The extract shows good results when compared with other compounds. This shows the scavenging activity of the extract [30].

11.5 Antitumor activity

The chloroform extract of the fruit of *Ficus benghalensis* has shown toxicity in the brine shrimp (*Artemia salina*) bioassay ($\text{LC}_{50} < 1000 \mu\text{g/ml}$). It also possessed antitumor activity in the potato disc bioassay (% tumor inhibition $>20\%$).

The other tested extracts showed no marked inhibition on the uptake of calcium in to rat pituitary cells $\text{GH}_4\text{C1}$. The results support the traditional use of these plants in Folk medicine for respiratory disorders and certain skin diseases [9, 10].

11.6 Antidiarrheal activity

The ethanol extract of the hanging roots of *Ficus benghalensis* has been evaluated for antidiarrheal activity against different investigational models of diarrhea in rats. The extract (400 mg/kg, orally) has shown significant inhibitory activity against castor oil induced diarrhea (extract fed rats had 2.21 ± 0.27 defecations per animal in 4 hours; control 4.00 ± 0.33 , $P < 0.001$) and PGE2 induced enteropooling (for extract fed rats the value reported is 1.25 ± 0.15 in terms of intestinal fluid; control 0.78 ± 0.11 , $P < 0.02$) in rats. The extract has also been significantly effective in reducing gastrointestinal mobility (extract fed rats: $50.2 \pm 2.7\%$; control $79.41 \pm 2.76\%$, $P < 0.001$) in charcoal meal test in rats [31].

11.7 Antimicrobial activity

The chloroform concentrates of the product of *Ficus benghalensis* has likewise indicated inhibitory activity (0.5 mg/disc) against the bacterium *Micrococcus luteus* (18–26 mm diameter inhibition zone), which was not inhibited by kanamycin (100 µg/disc), streptomycin (100 µg/disc) or penicillin (5 µg/disc). *Streptococcus faecalis* and *Streptococcus faecium* were also inhibited by the fruit extract (17–20 mm inhibition zone). Other bacteria such as *Bacillus cereus*, *B. megaterium*, *Staphylococcus aureus*, *Streptococcus epidermis*, *Streptococcus lactis*, *Escherichia coli*, *Klebsiella pneumonia*, *Proteus vulgaris* and *Pseudomonas aeruginosa* were inhibited to a lesser extent (16–19 mm inhibition zone) [9, 10].

11.8 Antifungal activity

Mitosporic fungi and several sterile forms were isolated as endophytes from the leaf tissues and aerial roots of *Ficus benghalensis*. Although similar number of endophyte species was present in lamina and petiole, the endophytic fungi more densely colonized the petiole. The species composition and the colonization frequency of the endophytes were more for the aerial roots entering the soil when compared with those growing in the air since the roots recruited some endophytes from the soil.

The endophyte assemblages of the leaf and aerial root and of the aerial root growing in the air and soil showed little overlap suggesting that the nature of the host tissue as well as the environment determine the endophyte composition of a host [31].

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References

- [1] Wagner WL, Herbst DR, Sohmer SH. Manual of the Flowering Plants of Hawai'i. USA, Honolulu: University of Hawaii Press; 1999. 1919 p
- [2] Neal MC. In: Bernice P, editor. Gardens of Hawaii. Bishop Museum; Special Publication 40; Honolulu, HI; 1965
- [3] Bailey LH, Bailey EZ. Hortus. 3rd ed. NY: Macmillan General Reference; 1976
- [4] Edlin H, Nimmo M. The Illustrated Encyclopedia of Trees. Salamander, London: Timbers and Forests of the World; 1978. pp. 220-221
- [5] Ramirez BW. Host specificity of fig wasps (*Agaonidae*). Evolution. 1970;24:680-691
- [6] Chopra RN. Indigenous Drugs of India: Their Medical and Economic Aspects. London, United Kingdom: Art Press; 1933
- [7] Jayaweera DMA. Lanka NSCOS, Medicinal Plants Indigenous and Exotic Used in Ceylon. National Science Council of Sri Lanka; 1981
- [8] Pullaiah T. Encyclopaedia of World Medicinal Plants. New York City, USA: Regency Publications; 2006
- [9] Mousa O, Vuorela P, Kiviranta J, Wahab SA, Hiltohen R, Vuorela H. Bioactivity of certain Egyptian *Ficus* species. Journal of Ethnopharmacology. 1994;41:71-76
- [10] Nadel H, Frank JH, Knight RJ. Escapees and accomplices: The naturalization of exotic *Ficus* and their associated faunas in Florida. Florida Entomologist. 1992;75(1):29-38
- [11] Barford CC, Wofsy SC, Goulden ML, Munger JW, Pyle EH, Urbanski SP, et al. Factors controlling long-and short-term sequestration of atmospheric CO₂ in a multistage forest. Science. 2001;294(5547):1688-1691
- [12] Jonard M, Andre F, Giot P, Weissen F, Van der Perre R, Ponette Q. Thirteen-year monitoring of liming and PK fertilization effects on tree vitality in Norway spruce and European beech stands. European Journal of Forest Research. 2010;129(6):1203-1211
- [13] Martinez DE, Guamet JJ. Distortion of the SPAD 205 chlorophyll meter. 2004
- [14] Richards LA. Diagnosis and Improvement of Saline and Alkaline Soils. Washington, DC: USDA Agric. Handbook No. 60 US Gover. Print. Office; 1954
- [15] Gee GW, Bauder JW. Particle-size analysis. In: Klute A, editor. Methods of Soil Analysis. Part 1. Physical and Mineralogical Methods. 2nd ed. Madison, Wisconsin USA: American Society of Agronomy; 1986
- [16] Thomas GW. Soil pH and soil acidity. In: Sparks PL, Page AL, Helmke PA, Loppert HR, Soltanpour PN, Tabatabai MA, editors. Method of Soil Analysis, Part 3: Chemical Method. Madison, WI, USA; 1996
- [17] Smith JL, Doran JW. Measurement and use of pH and electrical conductivity for soil quality analyses. In: Doran JW, Jones AJ, editors. Methods for Assessing of Soil Quality Analyses. Madison, Wisconsin: SSSA Special Publication no. 49. Soil Science Society of American; 1996
- [18] Nelson DW, Somers LE. Total carbon, organic carbon, and organic matter. In: Sperclis DL, Dage AL, Helmke PA, Loppert HR, Soltanpour PN, Tabatabai MA,

Johanston CT, Sumner ME, editors.
 Methods of Soil Analysis, Part
 3: Chemical Methods. Madison,
 Wisconsin, USA: American Society of
 Agronomy; 1996

[19] Zar JH. Biostatistical Analysis. 2nd
 ed. Englewood Cliffs: Prentice-Hall,
 Inc.; 1984. 718p

[20] Riffle RL. The Tropical Look.
 Portland, Oregon: Timber Press, Inc.;
 1998

[21] El-Hadidi MN, Boulos L,
 El-Gohary M, Makar S. The Street Trees
 of Egypt. Rev Sub ed. Cairo, Egypt: The
 American University in Cairo Press; 1988

[22] Hill DS. Figs (*Ficus* spp.) and
 fig-wasps (*Chalcidoidea*). Journal of
 Natural History. 1967;1:413-434

[23] Janzen DH. How to be a fig. The
 Annual Review of Ecology, Evolution,
 and Systematics. 1979;10:13-51

[24] Wiebes JT. Bornean fig wasps from
Ficus stupenda Miquel (Hymenoptera,
 Chalcidoidea). Tijdschrift voor
 Entomologie. 1966;109:163-192

[25] Galil J, Eisikowitch D. On the
 pollination ecology of *Ficus syconzorus* in
 East Africa. Ecology. 1968;49:259-269

[26] Galil J, Eisikowitch D. Further
 studies on the pollination ecology of
Ficus sycomorus L. (Hymenoptera,
 Chalcidoidea, Agaonidae).
 Tijdschrift voor Entomologie.
 1969;112:1-3

[27] Patil VVPRB, Patil VR. Pharma-
 cognostical studies and evaluation of
 anti-inflammatory activity of *Ficus*
bengalensis Linn. Journal of Young
 Pharmacists. 2009;1(1):24

[28] Aswar MAU, Watkar B, Vyas M,
 Wagh A, Gujar KN. Anthelmintic
 activity of *Ficus bengalensis*.

International Journal of Green
 Pharmacy. 2008;2(3):170-172

[29] Taur DJNS, Patil RY, Kharya MD.
 Anti-stress and ant allergic effects
 of *Ficus bengalensis* bark in
 asthma. Natural Product Research.
 2007;21(14):1266-1270

[30] Rimi Shukla SGJG, Prabhu KM,
 Murthy PS. Antioxidant effect of
 aqueous extract of the bark of *Ficus*
benghalensis in hypercholesterolaemic
 rabbits. Journal of Ethnopharmacology.
 2004;92:47-51

[31] Pulok K, Mukherjee KS,
 Murugesan T, Mandal SC, Pal M,
 Saha BP. Screening of anti diarrhoeal
 profile of some plant extracts of a
 specific region of West Bengal, India.
 Journal of Ethnopharmacology.
 1998;60:85-89