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Research Article
A Taxonomic Study on the Six Species of Genus *Magnolia*

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ABSTRACT

Magnolia, a genus comprising approximately 225 species of trees and shrubs in the family Magnoliaceae. Magnolia plants can be evergreen or deciduous and bear alternate smooth-margined leaves. In this paper six species of magnolia were studied based on morphological observations of taxonomically relevant traits. Among these, four species—*Magnolia alba*, *Magnolia champaca*, *Magnolia grandiflora*, and *Magnolia liliifera*—are previously documented, while two species, *Magnolia figo*, a 3–4 m tall shrub with a sweet banana scent, and *Magnolia coco*, are newly recorded additions to the flora of Bangladesh. This study focused on the leaf descriptions *viz.* average breadth and length, average size, fresh weight, and dry weight of leaves of the six species with their brief taxonomic description, morphology features, and identifiable pictures. In terms of relative average leaf size (RALS), *Magnolia alba* has the largest, while *Magnolia figo* has the smallest. *M. champaca* exhibits the highest water content, and *M. coco* has the highest dry matter percentage at approximately 47.03%. The conservation status of these species was evaluated, with four classified as Least Concern (LC) and two as Data Deficient (DD). The addition of *Magnolia coco* and *Magnolia figo* brings the total number of Magnolia species in Bangladesh to fourteen. Overall, this study on Magnolia will help future research projects, conservation efforts, and management activities by enhancing the understanding of the various uses of these species.

Introduction

Out of 17 genera of the Magnoliaceae family, *Magnolia* is the largest, having 225 species of woody perennial, evergreen, or deciduous flowering trees or shrubs that can be found in tropical and temperate parts of China, the Neotropics, East and Southeast Asia and the Indian subcontinent (Rivers *et al*., 2016; Yahaya *et al*., 2022). *Magnolia* is the largest genus of the Magnoliaceae family and *Michelia* was included as a subfamily of this genus (Kim *et al*., 2001). Before the research, Bangladesh had 12 species of magnolia, including *M. officinalis* (Ahmed *et al*., 2009; Ara and Khan, 2022). Large, beautiful, attractive, fragrant, bisexual, protogynous, nocturnal blooms with plenty of petals and sepals are one of the Magnoliaceae's most distinctive characteristics and the fruits are loculicidal capsule and apocarpous, though occasionally syncarpous (Nooteboom, 1993). Magnoliaceae blossoms are mostly beetle-pollinated (with few exceptions by bees) due to their strong scented compound emitted at night (Gerhard *et al*., 2012). *Magnolia. liliifera* and *M. figo* are known for their aromatic flowers, whereas, *Magnolia champaca* and *M. alba* have been utilized for many years, not just for beauty purposes but also for aromatic business, medicinal, and religious purposes (Lin *et al*., 2016; Maesarahand Özel, 2021). The *Magnolia* tree also produces valuable wood used for furniture, cabinetry, firewood and other things (Thinley and Suberi, 2021). *Magnolia's* barks, leaves and flowers are used as a traditional medicine to treat stomach discomfort, menstrual cramps, nausea, diarrhea, indigestion, muscle relaxants, abdominal bloating, dietary supplements and cosmetic products, anti-inflammatory, antibiotic and antispasmodic effects (Poivre and Duez, 2017). The essential oil extracted from flowers is utilized in aromatherapy as well as in the cosmetics and perfume industries (Ramyashree and Hemalatha, 2020). Nearly a third of all magnolia species remain unassessed, and 50% are already considered threatened due to their reproduction difficulties, overexploitation, anthropogenic disturbance and low adaptation to the fluctuating environment (Kéry *et al*., 2000; Rivers *et al*., 2016; Ralls *et al*., 2018). Due to rising demand and worth, the current study was done to

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describe the taxonomic diversity, economic and ethnobotanical applications with conservation status of this family available in Bangladesh Agricultural University Botanical Garden (BAUBG). Thus, the current study will help in the management, conservation, further scientific works and efficient use of ecologically, economically and scientifically important genera.

Materials and Methods

Site Description

This study was conducted at the Botanical Garden, Department of Crop Botany, Bangladesh Agricultural University, the second-largest Botanical Garden in the country. It contains over 1800 species belonging to 168 families and 287 genera, making it the largest in terms of species number and biodiversity (Jone et al., 2022). This number increasing steadily by collecting from the forest resources. The prevailing tropical monsoon climate at BAU and the surrounding area has relative humidity levels between 80% and 84% and an average annual rainfall of about 2000 mm. The garden's boundaries are E90°26'29.6" and N24°43'26.8" and Map is provided (Figure 1. Haque *et al*., 2012).

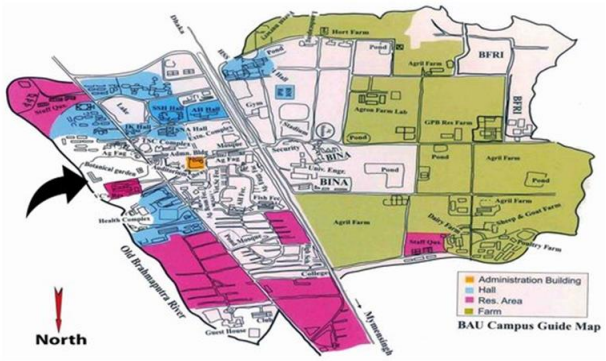

Figure 1. Map of Study Area

Data Collection and Processing

This taxonomic study on magnolia species diversity was conducted through regular visits to the BAUBG from December 2022 to April 2023. Initially, the scientific names and synonyms of six species were identified and confirmed using World Flora Online (https://www.worldfloraonline.org/)and Plants of the World Online (https://powo.science.kew.org/). The species in the garden were then examined for their morphological traits, with their taxonomic positions confirmed and botanical names validated by comparing the morphological descriptions from Ahmed *et al.* (2009) and online scientific records. On March 17, 2023, leaf samples were collected, as the leaf is the most therapeutically significant part of the plant.

The lab area had an average temperature of roughly 32°C and a relative humidity of 72%. For 72 hours, these leaf samples were kept in an electric oven set to 65°C. The final and constant dry weights were then calculated on March 20, 2023. At the time of the weight measurement, the lab's average temperature was about 33°C, and the relative humidity level was 65%. Morphological features such as leaf shape, size, floral, and other characteristics, along with the special emphasis on leaf description such as leaf size (length and breadth) and leaf fresh and dry weights, were studied. Fifteen fully grown mature leaves of each species were collected, and data about these parameters was recorded to show a graphical representation and comparison along with their conservation status. The DM % was measured with the following method.

DM %= Dry weight (DW) / Fresh weight (FW)

Microsoft Excel 2019 was used to tabulate, analyze and visualize the data. This study provides information on the habitat, conservation status, economic use, ethnobotanical use, and morphological characteristics of each species, along with photographs.

Results and Discussion

Six species of the genus *Magnolia* have been documented in the BAUBG. The species are arranged around the water garden and medicinal zone. *Magnolia* is an evergreen, more often deciduous tree or shrub. Leaves are simple and alternate, pinnately veined, entire, or lobed, with large stipules enclosing the terminal bud. Flowers are large, insect-friendly, terminal or axillary, solitary, perfect or unisexual, regular and hypogynous, with an extended receptacle. Perianth tepals range from 6 to 18 and are free. They are all petaloid, varying from spiral to cyclic and generally similar and less frequently distinguished cleanly into sepals and petals. Numerous, free and distinct stamens that are spirally arranged, starting in centripetal sequence, roughly ribbon-shaped and with four paired microsporangia pollen grains are smooth, boat-shaped, without staminodes and decorated in various ways. Numerous, usually free, anatropous bitegmic carpels with many ovules—usually two, but occasionally more—borne on a marginal placenta. Fruits that can be berry, samaroid, follicular or indehiscent. Large seeds with a lot of endosperms that are both oily and proteinaceous are the form. The following species are identified from the *Magnolia* genus from BAUBG.

In this study, the conservation status of six *Magnolia* species is presented in Table 1. Among these six species, the populations of *Magnolia champaca, M. figo*, *M. grandiflora and M. liliifera* are the least concerned (LC) species, while *Magnolia alba and M. coco are* data deficient (DD). Fifteen (15) leaf samples of each species were collected randomly for the

assessment of leaf characteristics such as average leaf size, fresh weight (FW), oven-dry weight (DW) and dry matter percentage (DM%). The RALS was calculated using the following formula; RALS = (Average length of the leaf including petiole (cm) × Average breadth at the middle portion). The highest RALS was found in *Magnolia liliifera* (165.238 cm^2), followed by *M. alba* (152.786 cm^2) and *M. champaca* (148.672 cm^2), while the lowest average leaf size was found in *M. figo* (49.612 cm^2), followed by *M. coco* (50.41 cm^2) (Figure 2 and 3).

The image of leaves in Figure 3 provides comprehensive details about the dimensions, morphological characteristics, and relative shape of the leaves, making it simple to identify the six species of genus *Magnolia*.

Table 1. List of *Magnolia* species along with their scientific name, habitat, and conservation status

SL.	Common Name	Scientific Name	Habitat	CS
1	White magnolia	*Magnolia alba* (DC.) Figlar	Evergreen Tree	DD
2	Sharna Chapa	*M. champaca L.* (Baill.) ex Pierre	Medium-sized to large trees (up to 50 meters)	LC
3	Coconut magnolia	*M. coco* (Lour.) DC.	Fast growing Medium to large trees (up to 20 meters)	DD
4	Banana magnolia	*M. figo* (Lour.) DC.	Medium-sized tree (up to 20 meters)	LC
5	Southern magnolia	*M. grandiflora* L.	Medium-sized tree (up to 20 meters)	LC
6	Egg magnolia	*M. liliifera* (L.) Baill.	Evergreen woody tree	LC

CS= Conservation Status, **DD**= Data Deficient, **LC**= Least Concerned

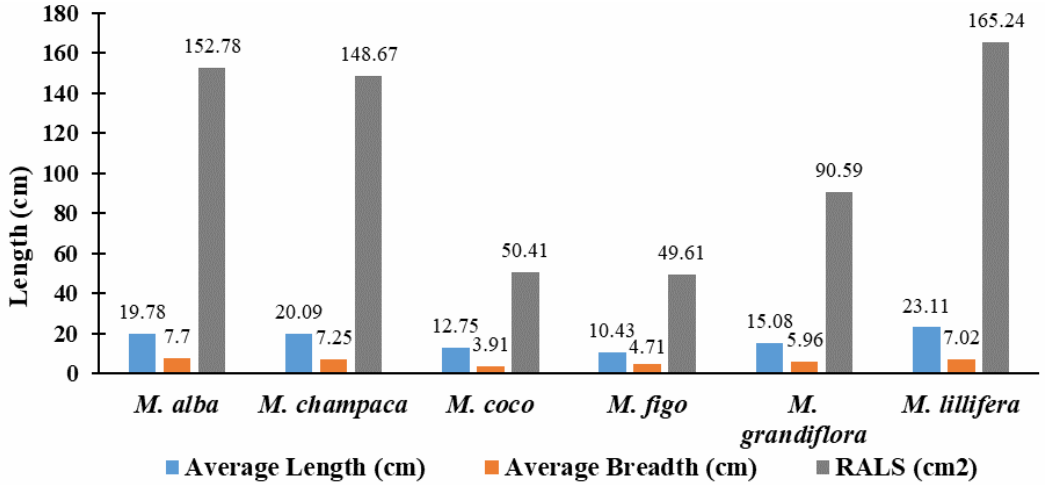

Figure 2. Average leaf size of *Magnolia* species

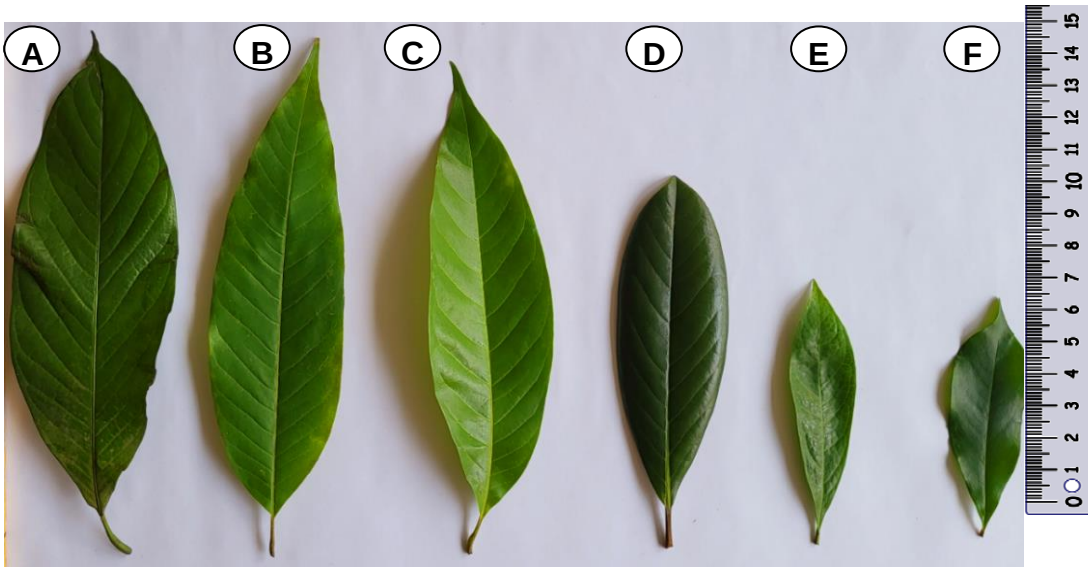

Figure 3. Picture of mature leaves under the study. (A: *Magnolia liliifera*, B: *M. alba*, C: *M. champaca*, D: *M. grandiflora*, E. *M. coco*, F: *M. figo*

There were significant differences in dry matter content in leaves (Figure 4). The DM % range of leaves from Figure 3 was within 18-47% and the highest value was found in *Magnolia coco* (47.03%), followed by *M. grandiflora* (43.35%) while the lowest was found in *M. alba* (18.66%).

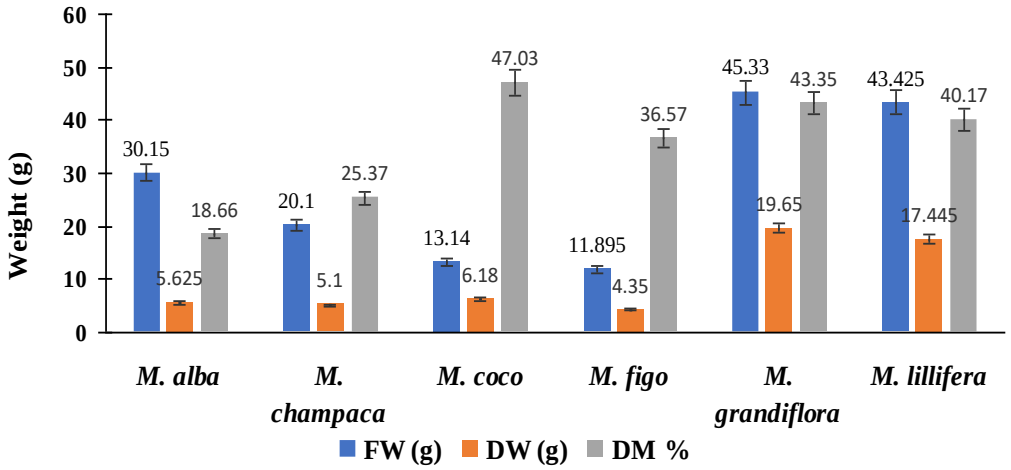

Figure 4. Fresh and oven-dry weight of leaves from *Magnolia* species

Enumeration of six Magnolia species available at BAUBG

Magnolia alba (DC.) Figlar

Synonym: *Michelia alba* DC.

Local name: Sheto Chapa, Cempaka Putih, Chempaka Puteh, Champi

English name: White Champaca

Origin and distribution: Native to Asia- tropical Inco-China-Thailand and Malaysia; and also introduced to tropical and sub-tropical countries.

Description: It is a medium sized, evergreen tree and is usually thought to be a hybrid between *Magnolia champaca* and *M. montana* due to the lack of wild or fruiting trees (Nooteboom, 2009). The medium-sized tree has a straight, cylindrical trunk and can reach heights of 15 to 20 meters. The bark is gently wrinkled and greyish-brown in color. The leaves are elliptical, simple, alternating, and measure 10–22 cm in length and 5–10 cm in width. The lower surface is light green with a faintly pubescent texture, while the upper surface is dark green. The petioles are short and thick. It has big, fragrant, bisexual blooms. They are single or in pairs, 10–18 cm wide and have 12–15 white or creamy-yellow petals. The carpels and stamens are enclosed in a thick, fleshy receptacle on the blooms (Figure 5: A). The fruit, which is 10–20 cm long and 2–5 cm wide, is a cylindrical, woody follicle. When the follicle reaches maturity, it splits open, releasing seeds with an aril that is 1-2 cm long and bright red and fleshy (Figure 5: B).

Flowering time: April to June

Economic and Ethnobotanical Uses: Fresh flowers are traded in traditional marketplaces, particularly for religious purposes. The essential oil from its extract has been used as a primary top note in Joy and J'adore, two of the world's most costly perfumes (Maheswary *et al.*, 2011). It is utilized for treating fever, gonorrhoea, syphilis, and malaria, as well as bronchitis, prostatitis, leucorrhoea, and cancer (Silalahi *et al.,* 2023). In China, the blooms are used to make yulan tea, and the essential oil has anti-depressive, anti-ulcer, anti-cancer, anti-inflammatory, anti-hypertriglyceridemia, and anti-hypertensive components (Cheng *et al.*, 2022).

Magnolia champaca L. (Baill.) ex Pierre

Synonym: *Michelia champaca* L.

Local name: Swarno chapa, Champa

English name: Champak

Origin and distribution: Assam, Bangladesh, India, Myanmar, China South-Central, Jawa, Laos, Malaya, Thailand, Tibet and Vietnam

Description: It is evergreen to semi-deciduous and can attain a height of up to 50 m with a straight, cylindrical trunk. The bark is grey, smooth, and hardly wrinkled. The leaves are elliptical, simple, alternating and measuring 10–22 cm in length and 5–10 cm in width with short and thick petioles. The lower surface is dull green with a faintly pubescent texture, whereas the upper surface is bright green. It produces 6-15 cm of broad, big, fragrant bisexual blooms with a yellowish-orange hue that grows alone or in pairs and has 6-15

yellow, orange or cream petals. The carpels and stamens are contained in a thick, fleshy receptacle on the flowers (Figure 5:C). Fruit is a cylindrical, woody follicle that is 10-20 cm in length and 2-5 cm in breadth. When the follicle matures, it cracks apart, producing seeds with 1-2 cm-long arils that are bright red (Figure 5:D).

Flowering and fruiting time: June-September and September-October

Economic and ethnobotanical uses: It has a high economic value in the decorative appeal, traditional and ayurvedic medicine, pharmacology, wood and fragrance industries. The oil extracted from the flowers and leaves contains anti-inflammatory, antipyretic, and anti-diabetic properties that are used to treat fever, nausea, vaginal infections, renal illnesses, leprosy, dyspepsia, gonorrhoea, gout, swellings and eye diseases. It is also used in perfumery to make attars and fragrant hair oils (Gupta *et al*., 2011; Karthikeyan *et al*., 2016; Dharmatilake *et al*., 2020).

Magnolia coco (Lour.) DC.

Synonym: Lirianthe coco (Lour.) N.H.Xia & C.Y.Wu,

Local name: Jahuri chapa

English name: Coconut magnolia, Dwarf magnolia

Origin and distribution: Native to China Southeast, China South-Central, Taiwan, and Vietnam

Description: The medium-sized evergreen coconut-like tree may grow to be 20 meters tall. It features simple, alternating, glossy, oblong to lanceolate green leaves ranging in length from 15 to 25 cm (Figure 5: E). It produces large, fragrant, cup-shaped flowers that can grow to 25 cm in diameter and contain 6 to 12 creamy-white to pinkish petals. They are often produced in clusters of two or three at the terminals of the stems (Figure 5: F). The fruits are 8 to 13 cm long and 4 to 5 cm wide and have a cone shape. When completely mature, it is reddish-brown and contains multiple seeds, each covered by a red fleshy aril.

Flowering time: It generally flowers year-round.

Economic and ethnobotanical Uses: The seed oil is a possible edible oil source that has substantial antibacterial and antioxidant qualities, the capacity to oxidize low-density lipoproteins, and is also utilized in the pharmaceutical and cosmetic sectors (Yahaya *et al*., 2022). The bark extracts and floral buds are used to treat headaches, stomach aches, periodontal disease, tooth cleaners, anti-anxiety, sleeplessness, leucorrhoea, allergy, asthma, cough, and photoaging (Kato *et al*., 2017).

Magnolia figo (Lour.) DC.

Synonym: *Liriodendron figo* (Lour.), *Magnolia fuscata*

Local name: Kala chapa

English name: Banana *Magnolia*, banana shrub, Port wine *Magnolia*

Origin and distribution: Native to China Southeast, Korea (Jeju-do), mainly grows in sub-tropical biome.

Description: Leaves are elliptic to oblong-shaped, shiny, evergreen, and 2 to 6 cm in width and 5 to 15 cm in length. The bark is smooth and greyish-brown with a rough surface. The fragrant blossoms are 5-10 cm in diameter and have a creamy white hue with purple or pink highlights (Figure 5: G). The fruit is a 3-5 cm-long, dry and woody follicle.4When it splits open red seeds with a diameter of around 1 cm are visible (Figure 5: H).

Flowering time: March-May

Economic and ethnobotanical uses: The fragrance has enormous potential in the cosmetics and perfume industries, and the leaf extract has significant sunscreen activity (Dharmatilake *et al*., 2020). In traditional medicine, the bark is used for the ailments of abdominal pain, dysentery, and diarrhea. The leaf extract shows significant anti-inflammatory and gram-negative antibacterial qualities (Abeykoon *et al*., 2020). The bark and roots are used as an antidote to fish poison, and the blossoms are used as a cardiac tonic (Kumar *et al*., 2012).

Magnolia grandiflora L.

Synonym: M. angustifolia Millais

English Name: Southern *Magnolia*, Bull Bay, Laurier tulipier

Common Name: Udoy poddo, Him Champa, Laurel *Magnolia*, Life tree, Bari Champa

Origin and distribution: Native to Florida, Georgia, Alabama, Louisiana, Mississippi, Texas, North Carolina, and South Carolina, and introduced to Assam, Cuba, East Himalaya, Dominican Republic, Mexico Central, Puerto Rico, Virginia, etc

Description: It has a straight and cylindrical trunk and can be 30 m tall. When young, the bark is smooth and dark brown, but as it matures, it becomes wrinkled and scaly. The simple and leathery evergreen leaves measure 12-20 cm long and 6-12 cm broad, having short and stocky petioles. The lower surface is brownish and hairy, whereas the upper surface is glossy and dark green. Its large, fragrant, bisexual flowers can remain singly or in pairs, and each of its 6-12 creamy-white, waxy petals measures 15-25 cm wide (Figure 5: I). The carpels and stamens are housed in a thick, fleshy receptacle on the flowers. The fruit is a woody follicle and cylindrical (Figure 5: J).

Flowering and fruiting time: May-July and October-December

Economic and Ethnobotanical Uses: It is a valuable ornamental tree for its attractive evergreen foliage and large and fragrant flowers, and the wood is also used in making quality plywood (Bahramov *et al*., 2020). It has therapeutic potential as an anti-inflammatory, anticancer, and anticonvulsant effect and is also used in traditional medicine for the treatment of fever, diarrhoea, high blood pressure, rheumatism, arthritis, pain, heart disturbances, muscle spasms, abdominal discomfort, epilepsy and infertility (Khan and Khan, 2017). The leaf and bark extract exhibit significant corrosion inhibitor, antitumor, and antiviral activity against the HSV-1 virus (Chen *et al*., 2020).

Magnolia liliifera (L.) Baill.
Synonym: Lirianthe liliifera (L.)
Local Name: Kushum Champa
English name: Egg magnolia

Origin and distribution: Indigenous in Andaman Islands, Assam, Borneo, Cambodia, East Himalaya, Hainan, Jawa, Laos, Lesser Sunda Islands, Maluku, Myanmar, New Guinea, Philippines, Sulawesi, Sumatera, Thailand and Vietnam.

Description: It is a medium-sized tree that ranges from 3.5 to 18.5 m in height, with a maximum of 27 m. The broad, simple, oval-shaped, massive velvet leaves can grow to be 25-30 cm long and 8-10 cm wide. It produces white to cream-coloured fragrant flowers with subglobose or ovoid buds on terminal stalks. Before opening, buds form an egg shape, thus the popular name (Figure 5: K). Fruiting receptacles are ovoid or ellipsoid, sharply beaked and dehiscent starting from the ventral side, containing 3-4 seeds in each carpel suspended by elastic silky cords (Figure 5: L).
Flowering time: is April-May and fruiting time is November-December

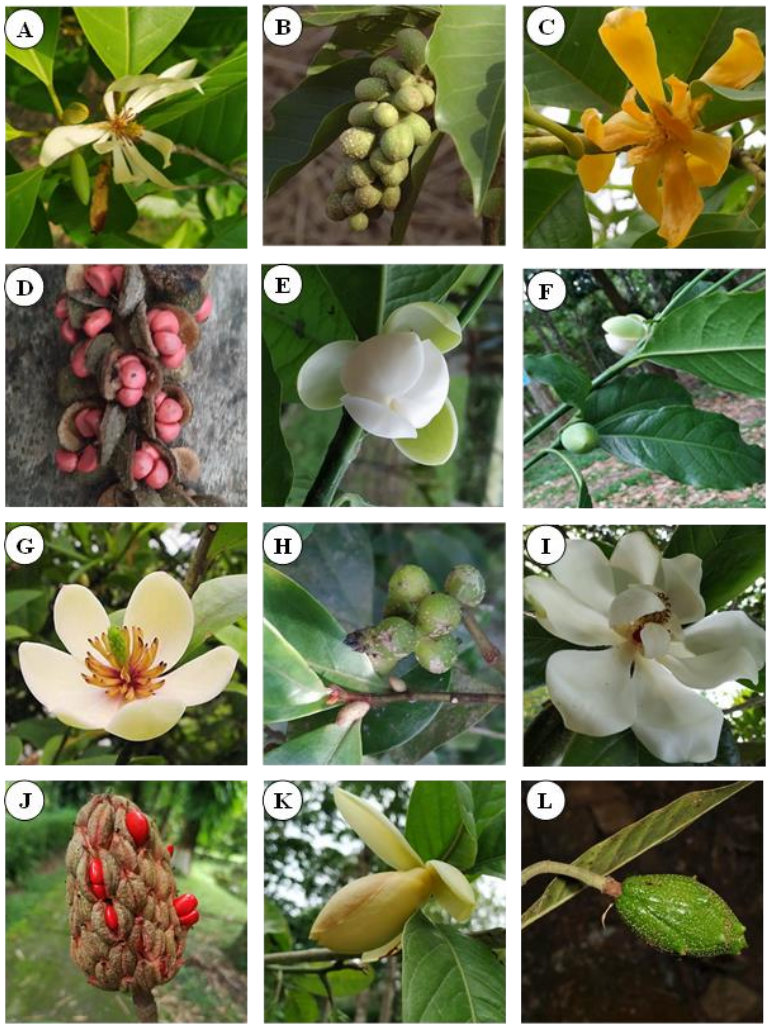

Figure 5. *M. alba* (**A**: Flower; **B**: Fruit), *M. champaca* (**C**: Flower; **D**: Fruit), *M. coco* (**E**: Flower; **F**: Bud), *M. figo* (**G**: Flower; **H**: Fruit), *M. grandiflora* (**I**: Flower; **J**: Fruit), *M. liliifera* (**K**: Flower; **L**: Fruit)

Economic and Ethnobotanical Uses: It is being used in traditional medicine as an anti-inflammatory, analgesic, and anti-tumour agent (Khumploy, 2020). It is one of Asia's most expensive fragrant ornamental trees with valuable volatile essential oils, and it is utilized in the decorative plant business (Maesarah and Özel, 2021). The saprobic fungus that thrives on its leaves may be a source of bioactive chemicals with potential applications in antimicrobial, antitumor, cytotoxicity, pharmaceutical, and other therapeutic uses (Monkai *et al.*, 2013).

Conclusion

The study effectively gives a complete synthesis of the taxonomy, morphology, distribution, ecology and economic value of the *Magnolia* genus available in BAUBG. All the six species are evergreen, containing amazing fragrant blooms that are well adapted in these regions. The distinct leaf structure, size, shape and DM% that are included here will help to identify them efficiently. In Bangladesh, the genus achieved fourteen species by introducing *Magnolia coco* and *M. figo* which require better preservation and propagation. Most of the species have enormous potential as medicinal plants and in the pharmaceutical industry. So, the genus needs to receive more attention for preservation through increased cultivation, not only to conserve genetic diversity but also to increase economic income as ornamentals and drug development.

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