



SELECTED MEDICINAL PLANTS OF CHITTAGONG HILL TRACTS



INTERNATIONAL UNION FOR CONSERVATION OF NATURE



SELECTED MEDICINAL PLANTS OF CHITTAGONG HILL TRACTS

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Cover Photo: Top left: Fruiting of *Mesua ferrea*; Below left: Flowering of *Ocimum tenuiflorum* and Below right: Flowering of *Saraca asoca* © Enamul Mazid Khan Siddique and Top right: Flowering of *Calotropis gigantea* © Istiak Sobahan.

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PREFACE

Medicinal plants are an important part of our natural wealth. They serve as important therapeutic agents as well as valuable raw materials for manufacturing numerous traditional and modern medicines. The history of medicinal plant use for treating diseases and ailments is probably dates back to the beginning of human civilization. Our forefathers were compelled to use any natural substance that they could find to ease their sufferings caused by acute and chronic illnesses, physical discomforts, wounds and injuries, and even terminal illnesses. Since ancient times, plants with therapeutic properties have secured an important place in the healing practices and treatment of diseases.

In many developing countries, traditional medicine is still the mainstay of health-care, and most of the drugs and cures come from natural sources, such as, plants. Even in developed countries, the raw materials for manufacturing essential drugs are extracted from medicinal plants, harnessing its natural properties of healing. Increasingly, more people are turning to herbal remedies, especially for treating minor ailments. Unfortunately, the inclination towards the revival and use of medicinal plants has resulted in a few undesirable outcomes. Medicinal plants abundant in supply are not infinite and with the widespread use and extraction, medicinal plants are on the verge of depletion. There are no visible and concerted efforts geared towards the conservation and wise-use of medicinal plants, the supply of which is dwindling given the threats of increasing demand, a rapidly increasing human population and rampant destruction of plant-rich habitats, such as, tropical forests. At the current rate of consumption and use, the status of medicinal plants is threatened, risking our own future benefits and knowledge.

Today, many medicinal plant species of Bangladesh have reached the fate of extinction or severe genetic loss. Unfortunately, detailed information and complete inventories on such plants often do not exist. For most of the endangered species, no conservation efforts have been implemented and a lion's share of the knowledge on their properties and use are held exclusively by traditional healer societies, whose very existence is now under threat.

The principal aim of this book is two-fold: (i) to provide detailed information on locally important medicinal plants of Bolipara, Bandarban and (ii) to preserve the traditional knowledge (TK) of herbal healers on medicinal plants use. This book describes 31 important species with medicinal properties, and including the scientific name; Bengali name; family name; vernacular name; general description; distribution; physiographic, edaphic and biotic requirements; silvicultural characteristics; phenological characteristics; regeneration; chemical constituents; medicinal uses; other uses; photographs and traditional use by the herbal healers of Bolipara. We believe that this book is one of the pioneering encyclopedic compilations in Bangladesh that can provide the reader with all the above silvicultural information of different medicinal plants at a glance. We sincerely hope that this book will be useful to the people interested in medicinal plants, especially in the developing world.



Professor Niaz Ahmed Khan, Ph.D.

Country Representative

IUCN Bangladesh Country Office



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IUCN Bangladesh, in association with BNKS, has been implementing a project in Bolipara Union of Bandarban Hill District titled, 'One Stop Service: facilitating conservation of medicinal plant and traditional health service to ethnic communities of Chittagong Hill Tracts (CHT), Bangladesh'. The conservation of medicinal plants is not only a tool for biodiversity conservation, but also has great prospects for livelihood enhancement. Thus, special efforts have been geared towards the conservation of medicinal plants and the knowledge and practices associated with their use, in the above mentioned project site.

We gratefully acknowledge the financial support received from Keidanren Nature Conservation Fund (KNCF) in implementing this project and in preparing this book. Special thanks are due to Mr. Manabu Takeda, Deputy Executive Director and Mr. Yasunori Tatsumi, Manager of KNCF for their active support, advice and guidance during the implementation of this project.

We would like to thank the field staff of BNKS, local people, herbal healers and Buddhist monks of Bolipara, who have provided information on medicinal plants and their uses during the field data collection. Thanks are also due to the officials of District Administration and Forest Department of Bandarban for their continuous support during the implementation of the project.

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Dhaka
April 2011

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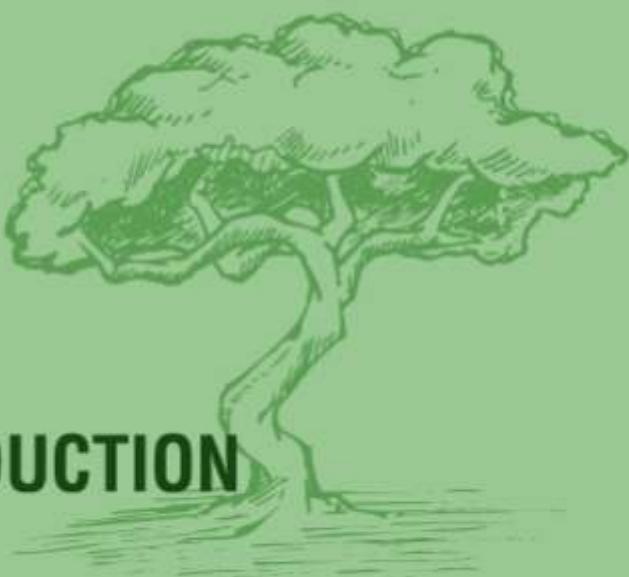
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ACRONYMS

*C	Degree Celcius
BFRI	Bangladesh Forest Research Institute
BNKS	Boliprар Nari Kalyan Somity
CHT	Chittagong Hill Tracts
cm	Centimeter
dbh	Diameter at Breast Height
ha	Hectare
IUCN	International Union for Conservation of Nature and Natural Resources
kg	Kilogram
KNCF	Keidanren Nature Conservation Fund
m	Meter
mm	Millimeter
OSSP	One Stop Service Project
TK	Traditional Knowledge
Union	The smallest local government unit in Bangladesh
WHO	World Health Organization

INTRODUCTION



INTRODUCTION

Plants that possess therapeutic properties or exert beneficial pharmacological effects on the human body are generally designated as medicinal plants. Medicinal plants naturally synthesize and accumulate some secondary metabolites, like alkaloids, sterols, terpenes, flavonoids, saponins, glycosides, cyanogenics, tannins, resins, lactones, quinines, volatile oils etc. The medicinal plants have been used for treatment of illnesses and diseases, since the dawn of time. Ancient Chinese scriptures and Egyptian papyrus hieroglyphics describe medicinal uses for plants. Indigenous cultures (e.g. African and Native American) used herbs in their healing rituals, while others developed traditional medical systems (e.g. Ayurvedic and Traditional Chinese Medicine) in which herbal therapies were used. Researchers have found that people in different parts of the world tend to use the same or similar plants for the treating the same illnesses.

Recently, the World Health Organization (WHO) estimated that 80% of people worldwide rely on herbal medicines partially for their primary health care. In Germany, about 600-700 plant-based medicines are available and are prescribed by some 70% of German physicians. In the last 20 years in the United States, public dissatisfaction with the cost of prescription medications, combined with an interest in returning to natural or organic remedies, has led to an increase in herbal medicine use. During the past three decades, the demand and utilization of medicinal plants has increased globally. There is now a consensus regarding the importance of medicinal plants and traditional health systems in solving the health care problems, efficacy and safety of medicinal plants in curing various diseases. Because of this growing awareness, the international trade in plants of medicinal importance is growing phenomenally, often to the detriment of natural habitats and mother populations in the countries of origin.

It has been recorded that about 450 to 500 plants growing or available in Bangladesh have therapeutic values (Yusuf *et al.*, 1994 and Ghani, 1998). In Bangladesh, people living in the remote hilly areas, such as, ethnic communities are rely mostly on herbal medicines. In addition, realizing the huge potential of herbal medicines, twenty pharmaceutical companies applied for manufacturing herbal medicine in Bangladesh. About six thousand metric tons of medicinal plants are required annually by the relevant industries in Bangladesh for producing traditional medicines. In the absence of organized cultivation of medicinal plants in the country, the local manufacturers are compelled to import medicinal plants and plant parts from neighbouring countries, such as, India.

Bangladesh, a country of fertile deltaic land has a rich diversity of flora of medicinal plants scattered throughout the forests, crop fields, roadsides, gardens and wastelands. However, population and overextraction of resources is a harsh reality for the country and like other resources, medicinal plants are also nearing extinction. Unfortunately, we do not have detailed information and complete inventories on such plants, which makes it more challenging to conserve them. The plant genetic resources are being lost at an alarming rate due to degradation of natural habitats, displacement of land races by modern cultivars, changes in land use systems by mono-cropping and commercialization. Growing population, over exploitation and recent phenomenon of climate change are also considered as threats, contributing towards the loss of genetic resources of medicinal plants in Bangladesh. Although some efforts have been made to protect forest resources by declaring them as Reserve Forests, Protected Areas, Sanctuaries, etc., there is no effective conservation effort for conserving the endangered species of medicinal plants and associated knowledge and practices.

The CHT comprises of three hill districts namely; Bandarban, Rangamati and Khagrachari covering about 10 percent of the total land area of Bangladesh. This land area harbors one-third of the flowering plants of the country and is endowed with floral biodiversity. There are about thirteen ethnic communities inhabiting in this hilly region of the country. The ethnic communities of the hill districts are in continuous search of indigenous plants for various uses, and in course of time they have accumulated important knowledge of the use of wild plants. This TK of plants is intertwined with their culture, geographical environment and heritage. It is the cultural heritage of the ethnic women to collect some wild plants from the surrounding forest everyday, to meet their daily needs and without destroying their natural habitats. The indigenous knowledge of plant use is transmitted orally from generation to generation without any written documentation or record.

The documentation of TK can ensure local people's rights in the light of intellectual property rights and help avoid adverse impacts on local people and the environment. The use of the TK in sustainable forest management can significantly contribute to the research and development of medicinal plants and reduce associated costs. TK on habitat, habit and use patterns of the wild plants by the ethnic communities are essential for a sustainable forest management plan, which is essential for restoration and conservation of wild biodiversity.

Interest in herbal medicines has increased dramatically in recent years

throughout the world, as globally people are seeking herbal remedies. In Bangladesh, the use of traditional medicine is widespread among most of the ethnic people and village dwellers. This endeavour documents information on 31 locally important medicinal plants. The selection of the species presented in this book is influenced the following considerations.

The primary focus was on suggestions by the practicing herbal healers of the locality as regards the species of their choice and utility. Nearly all the listed species are used by the local herbal healers to a varying degree and extent.

Although information on these species are available scatteredly and on a piecemeal basis, we felt an urgent need to compile these information in one volume for ease of reference and use by researchers, academia and practitioners.

Some of the listed species in this book, namely, *Asparagus racemosus*, *Terminalia arjuna* and *Terminalia bellirica* are becoming locally rare. Unfortunately species like, *Saraca asoca*, are currently facing the risk of acute depletion. It is, therefore, considered important to bring together the existing information on these species.

IUCN Bangladesh in association with BNKS has been implementing a project titled "One Stop Service Project (OSSP)" with financial support from KNCF (Japan) to fulfill the objective of creating enabling conditions for conservation of medicinal plants and related TK by providing health services to the local community in Bolipara, Bandarban Hill District. Plants have traditionally been used as a source of medicine by indigenous people of different ethnic groups inhabiting the hilly terrains, for treating various ailments affecting humans and domestic animals. From time immemorial, they have developed a close ethno-botanical relation with the surrounding flora. They also developed a local and community based TK of plant uses such as food, medicine, pesticide, dye, soap and for other purposes. TK is adapted to local situations, traditionally shared and handed down to generations by the elderly members of the community. These traditional practices are time-tested and have through experience, innovation and experimentation; they are sustainable and protect soil, water, natural vegetation and biological diversity of the forests. In order to bank on this rare and rich pool of knowledge developed through trial and error, documentation of important medicinal plants is crucial. For maintaining the records in a consolidated form, "Documentation" is required, to store and manage all the relevant information of the species. It is expected that the documentation initiative taken by IUCN Bangladesh through the OSSP will also be able to extend health care facilities to remote areas of the country.

The style followed in presenting species-annotation of this book is described as follows. All the entries are made on botanical names with proper author citation. The species enumerated were arranged alphabetically. For each species, the accepted correct botanical name has been given in roman bold face followed by family, synonyms, Bengali name and vernacular names occurring in pertinent literatures in parenthesis. The name of the locality or the community is also in parenthesis, in case of most of the vernacular names.

The taxonomic enumeration has been provided in the next section. I have adapted the botanical names and family enumerated in this book from Uddin, et al. (2008), which is the most recent and authentic source of information available in Bangladesh. The general description of each species includes its size, height range, bark, leaf, flowers, seed and fruit characters. After the general description, distribution; physiographic, edaphic and biotic requirements; silvicultural characters; phenological characters and regeneration process are given. These descriptions were based on information gathered from the field and several taxonomic treatises like Ahmed, et al. (2008); Alam (1999); Brandis (1906); Das and Alam (2001); Dey (2006); Hossain and Ahmed (2008); Hossen (2003); Motaleb and Hossain (2010); Selvam (2007); Troup (1921); Uddin (2006); Yusuf, et al. (2009) and Zabala (1990). Information was also collected from different websites.

The next section describes the chemical constituents of each species, followed by its medicinal use, other uses and traditional use by the herbal healers of Bolipara. The chemical constituents were mainly noted from the study of Ghani (1998). Medicinal use and other uses were listed from Das and Alam (2001); Uddin (2006); Ghani (1998); field observations and from websites. The traditional use was listed from the field observations and from key informant interviews of herbal healers.

For each species, photographs are provided. These have been captured during field visits in Bolipara, Jahangirnagar University and Chittagong University and identified by renowned taxonomists, who also provided the captions for the photographs. For every species, photographs of the entire plant, leaf, stem, seeds, flowers and fruits (where available) have been given. Some photographs were taken from the internet (* mark in the photo caption indicates photographs that were taken from internet). It is anticipated that this pioneering work on the medicinal plants and traditional uses will be used widely by professionals, students and herbal healers alike for the conservation, wise-use and revival of plants and indigenous knowledge. The following pages of this book describe 31 medicinal plants, including all the relevant scientific information, properties and uses and are well illustrated with color photographs.



DESCRIPTION OF SPECIES

***Abroma augusta* (L.) L. f.**

Family: Sterculiaceae

Synonym: *A. augulata* Lam.; *A. wheeleri* Retz.; *A. fastuosum* Gaertn. and *Theobroma augusta* L.

Bengali name: *Ulatkambal*.

Vernacular name: *Chi row afrow* (Marma); *Devil's Cotton* (English); *Gach shala* and *Gach chola* (Chakma) and *Daiya* (Garo).

General description: A large shrub, 2-4 m tall, branches downy. Leaves ovate-lanceolate, 10-20 x 5-15 cm, cordate, acuminate, entire or repand denticulate, sometimes lobed, glabrescent above, softly pubescent or tomentose beneath, 5-7 nerved at the base, petiole 1.5-2.5 cm long, stipules linear, as long as the petioles, deciduous. Flowers few in leaf-opposed, subterminal or axillary peduncled cymes, 5 cm in diameter. Sepal lanceolate, c 2.0 x 0.6 cm, connate at the base, persistent. Petal c 2.8 x 1.2 cm, choaclare coloured, imbricate, caducous. Fruit a capsule, 3.5-4.0 cm long, obpyraindal, 5-angled, truncate at the apex. Seeds many, 3 x 2 mm, obovate.

Distribution: *A. augusta* is distributed from India, throughout Southeast Asia to Southern China, the Solomon Islands and northern Australia. It is sometimes cultivated in India and New Guinea and experimental plantings have been set up in the Philippines and Africa (Uganda, Democratic Republic of Congo). In Bangladesh, the species occurs commonly in the eastern parts of the country, however, in other areas it is only found under cultivated condition.

Physiographic, edaphic and biotic requirements: The distribution area of this species is characterized by the mean daily temperature of 27°C-30°C in the hottest months, an average annual rainfall of at least 1,500 mm, and a high relative humidity. It is not suitable for areas with a marked dry season. It is not frost-hardy and so not found at altitudes above 1,100 m. It is a short day plant. The best soils for this species are fertile alluvial with a good structure and drainage, as it does not tolerate water-logging for a long period. However, it will also survive and grow when soil conditions are less favorable. When occurring naturally, it is found in thickets or tufts, secondary forests, waste places and village boarders and along railways and roads, seemingly preferring forest edges and the banks of clearings or watercourses.



Abrroma augusta



Leaf of *Abrroma augusta*



Flowering of *Abrroma augusta*



Fruiting of *Abrroma augusta*



Stem of *Abrroma augusta*

Silvicultural characteristics: It is a light-loving plant and does not occur in primary forest. It is a fast growing species and it needs full sun to partial shade with a rich well-drained soil mix. The species prefers hot and moist climate.

Phenological characters: It is an evergreen species. The flowering and fruiting is observed from June to December. The best seed collection time is from October to January.

Regeneration: *A. augusta* is propagated from seeds. Seed germinates in 21-30 days at 24°C temperature. In the greenhouse, it needs to use a soil mix consisting of 2 parts compost to 1 part loam to 2 parts sand. Plants are watered, and then allowed to dry slightly before watering again. They need to be fertilized during the growing season with a balanced fertilizer. They are very fast growing, so repotting should be done when they outgrow in containers. Wrapping newspaper around the trunk helps to prevent exposure to the hairs. During the winter months, water should be somewhat restricted, but not to a point where the plant loses its leaves. Propagated by seeds or cuttings, the former sown in March, the latter made in April from half-ripened wood. One kg seed contains about 1,45,000-1,48,000 seeds.

Chemical constituents: Leaves contain taraxerol, its acetate and β -sitosterol. Stem bark contains friedelin and β -sitosterol. Root and root bark contain gum, fixed oil, resin, alkaloids, abromine, choline and betaine, β -sitosterol, stigmasterol, digitonide and magnesium salts of hydroxy acids. Seeds contain 20.2% fixed oil with 71.5% linoleic acid. Heartwood contains β -sitosterol, glycol and octacosane-1, 28-diol.

Medicinal use: Leaves and stems are demulcent; root bark is emmenagogue. Aqueous extract of root is galactagogue in albino rats. Infusion of leaves and stems is very efficacious in gonorrhoea. Root bark is used in amenorrhoea, dysmenorrhoea and other menstrual disorders and act as uterine tonic. Leaf stalks are useful in dysentery, weakness and burning urination. Petioles are useful in dysentery, weakness and burning urination.

Other uses: The bark of the twigs yields a much-valued fiber, which deserves to be more generally known. It might be used with advantage as a substitute for silk.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from cold, cough, diarrhoea, fever and menstrual problems. Different ethnic groups, such as, Bawm, Chakma, Marma, Mru and Tripura use this species for their treatment. Seeds are used for neck pain by the Chakma community.

***Aloe vera* (L.) Burm. f.**

Family: Aloaceae

Synonym: *A. indica* L.; *Aloe barbadensis* Mill. and *A. vulgaris* Lam.

Bengali name: *Gheto kumara*, *Ghrita kumari*, *Mosabbar* and *Musabbar*.

Vernacular name: *Lang hi* (Marma); *Indian aloe* and *Common Indian aloe* (English); *Ghritakumari* (Hindi); *Katralai* or *Katrazhai* (Tamil) and *Kalabanda* (Talegu).

General description: A perennial, fleshy leaved herb, stem short, thick, somewhat divided. Leaves forming rosettes or 2-ranked, sessile, crowded, lanceolate, erect-spreading, rather concave, spine toothed at the margin. Flowers in terminal simple or branched racemes, racemes long, dense, bracts short-lanceolate, membranous, longer than the short pedicel. Flowers pendulous, imbricated, yellow, perianth-segments united into a cylindric or campanulate straight or slightly curved tube, tips sometimes free. Stamens as long as perianth or longer, filaments inserted into a pit in the connective, anthers somewhat exserted. Fruit a capsule, loculicidally dehiscent.

Distribution: The natural range of *A. vera* is unclear, as the species has been widely cultivated throughout the world. However, its origin is probably within Arabia peninsula and north Africa. It is cultivated throughout the tropics and subtropics of the world. In Bangladesh, the species occurs throughout the country under cultivation.

Physiographic, edaphic and biotic requirements: The plant can be grown in a variety of soils ranging from sandy coastal soils to loamy soils of plains. It can tolerate higher pH and high Na and K salts. Growth is faster under medium fertile, heavy soils such as black cotton soils. In well drained, loam to coarse sandy loam in a pH range up to 8.5, it grows well with higher foliage. *Aloe* has wide adaptability and can grow in various climatic conditions. It can be seen growing equally good in warm humid or dry climate. However, it is sensitive to water logged conditions and intolerant to extreme cool conditions. The plant flourishes well on dry sandy soils at localities with lower annual rainfall from 50 to 300 mm. It needs protection against frost and low winter temperature.



Aloe vera

Silvicultural characteristics: *Ghrito kumari* is an evergreen perennial succulent herb which coppices well. The species is hardy, although it is intolerant of very heavy snow or frost. In pots, the species requires well-drained sandy potting soil and bright sunny conditions; however, in very hot and humid tropical or subtropical climates, *Aloe* plants should be

protected from direct sun and rain, as they will burn easily under these conditions. The use of a good-quality commercial propagation mix or pre-packaged "cacti and succulent mix" is recommended, as they allow good drainage. Potted plants should be allowed to completely dry prior to re-watering. During winter, *A. vera* may become dormant, during which little moisture is required.

Phenological characters: The flowering is normally done from September to December and fruiting is scarcely observed.

Regeneration: It is generally propagated by root suckers or rhizome cuttings. For this purpose, medium sized root suckers are chosen and carefully dug out without damaging the parent plant at the base and directly planted in the main field. It can also be propagated through rhizome cuttings. In this case, after the harvest of the crop, the underground rhizome is also dug out and made in 5-6 cm length cuttings which should have a minimum of 2-3 nodes on them. It is rooted in specially prepared sand beds or containers and after starting sprouting, it is ready for transplanting. On an average, about 36,500 suckers are required for a nursery of 1 ha size (14,550 for 1 acre nursery). Before out planting, the land is ploughed and cross ploughed thoroughly. Farm yard manure is added @ 15 tonne/ha during the last ploughing. Ridges and furrows are formed at 45 or 60 cm apart. The plot may be irrigated if necessary. The suckers are planted at 40 or 30 cm apart, maintaining the spacing suggested. *Aloe* can be successfully cultivated both under irrigated and rained conditions. Provision of irrigation immediately after planting and during summer season will ensure good yields. However, the plants are sensitive to water logged conditions.

Chemical constituents: Principle constituents of leaves are anthraquinone glycosides, called aloins which include barbaloin, iso-barbaloin, β -barbaloin, emodin, chrysophanol, chrysophanic acid and aloe-emodin, and uronic acid and enzymes. Resins, sterols, triterpenes, cusmarins, saponins, carbohydrates, amino acids and vitamins are also present in this plant.

Medicinal use: The plant is used in the treatment of asthma, cirrhosis, constipation, dehydration, dullness of skin, duodenal ulcer, eczema, facial paralysis, flatulence, gout, gynecological disease, hook worm infestation, impotence, menopause, metralgia, paralysis, piles, rheumatism, spermatorrhoea, spleenomegaly and tuberculosis.

Other uses: *A. vera* has been widely grown for cosmetic use. The commonly used elements are leaf juice and leaf gel. The root is also used as a potent remedy. It is produced in different forms, such as, lotion or salve, natural gel, powder in tablets or capsules, liquid remedies, or freshly prepared. It is now widely used on face tissues, where it is promoted as a moisturizer and/or anti-irritant to reduce chafing of the nose of users suffering hay-fever or cold. It has also been suggested that bio-fuels could be obtained from *Aloe vera* seeds. It can also be used to retwist dreadlocked hair, a favorite agent for vegans and those preferring natural products.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from sexual diseases, jaundice, itching and menstrual problem. Different ethnic groups, such as, Bawm, Chakma, Khumi, Marma, Mru and Tripura use this species for their treatment.

Andrographis paniculata (Burm. f.) Wall. ex Nees

Family: Acanthaceae

Synonym: *Justicia paniculata* Burm. f. and *A. subspathulata* C.B. Clarke

Bengali name: Kalomegh, Kalmegh, Mohatita and Kalpanath.

Vernacular name: Kojomi and Chiota (Marma); Chiorta (Assam); Green chirayta, Creat, King of bitters, *Andrographis* and *India echinacea* (English); Nelavemaa (Telegu); Oli-kiryata (Marathi) and Nilavembu, Sirunangai and Siriyanangai (Tamil).

General description: It is an annual herb that can grow from 30-100 cm tall. The stem is distinctly 4-angular and smooth apart from a few hairs at the nodes. The leaves are opposite, simple and narrowly egg-shaped to lance-shaped that size 5-10 cm x 1.2-2.5 cm. The apex is acuminate while the margin is entire and hairless but often gland-dotted. The petiole is short, up to 6 mm long and it is connected to the opposite one by transverse ridges. Flowers are in lax, axillary and terminal racemes or panicles combined into a pyramidal inflorescence, with 2 small bracteoles at base of the 1-7 mm long edicel.

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Andrographis paniculata

© [n]



Flowering of *Andrographis paniculata*



Fruiting of *Andrographis paniculata*

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Seedling of *Andrographis paniculata*

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The flowers are bisexual and zygomorphic. The sepal has 5 segments, joined at the base, with glandular and aglandular hairs. The petal is bilabiate, white or rose with purple markings on the upper lip. The petal tube is between 5-6 mm long, slightly enlarged below the limb. The lower lip is 4-6 mm long, oblong and it is 2-toothed at the apex while the upper lip is deeply 3-lobed, also 4-6 mm in length. It has 2 stamens that are inserted at the petal tube apex and exerted. The filaments are hairy with the anthers are inserted at the equal level. At the base they are united and bearded, deep purple to black in colour. The ovary is superior. It is 2-locular with 3-7 ovules in each cell, the style is curved upwards and the stigma is entire. The fruit is erect, narrowly ellipsoidal and has glandular hairy capsule with the size of 14-20 mm x 3-3.5 mm. This is a species that is many-seeded. Seeds are held up on well-developed hooks (retinaculae), almost rectangular and with 2 deep furrows.

Distribution: *A. paniculata* is distributed in tropical Asian countries, often in isolated patches. It can be found in a variety of habitats, such as, plains, hillsides, coastlines, and disturbed and cultivated areas such as roadsides, farms, and wastelands. The species also occurs in Hong Kong, Thailand, Brunel, Singapore, and other parts of Asia where it may or may not be native. The plant is cultivated in many areas, as well. In Bangladesh, this species is less frequently occurs throughout the country under cultivated condition.

Physiographic, edaphic and biotic requirements: It can be cultivated on a wide range of soils from loam to lateritic soils with moderate fertility, as well as on shady wastelands. The climatic requirement for the plant is hot and humid conditions with ample sunshine. With the onset of monsoon, plant grows luxuriantly and starts flowering with the moderation of temperature after the end of the monsoon. It exhibits weedy characteristics and occurs from sea-level up to 1,600 m altitude in village groves, roadsides, waste places, open sandy locations and fields.

Silvicultural characteristics: The plant is gregarious and grows abundantly in moist, shady waste grounds and sometimes in dry forests. It needs 90 to 100 days of hot, humid weather to grow to its full maturity. It does best in a sunny location. Maximum herb biomass can be obtained in 90 to 100 days beyond which leaves start shedding. Crop remains dormant in winter.

Phenological characters: The plant is collected at maturity i.e. after complete flowering and fruiting. Depending upon area of cultivation; harvesting is done in October to November. The flowering and fruiting is done throughout the year especially from August to May. The best seed collection time is from October to November.

Regeneration: The propagation is through seeds in nature. Vegetative propagation is also possible in certain special cases through layering as each node is capable of producing enough roots. Seeds are small and remain dormant for 5-6 months. Liberal use of organic manure in nursery is advised for raising healthy seedlings. The seeds of about 250-300 gram are broadcast on each bed surface. The germination is 70-80%. Seeds should be covered with very thin layer of soil and compost mixture. Bed should be covered suitably with suitable mulch and irrigated regularly with water fountain till seedlings emerge (6-7 days). Immediately after germination mulch is removed to avoid elongation of the seedlings. If possible seedlings should be raised in shade to protect from heat. In well prepared and laid out beds, transplanting of seedlings is done when they are one month old and plant spacing of 45-60 cm and 30-45 cm respectively in a row. Beds are to be irrigated immediately after planting. It is advisable to irrigate beds one day earlier to planting to avoid any risk of exosmosis in seedlings which may result in gaps. One kg seed contains about 5,97,000-6,00,000 seeds.

Chemical constituents: The plant contains a resinous substance, kalmeghin, a bitter crystalline diterpene lactone, andrographolide, diterpene glucoside, neoandrographolide, deoxyandrographolides, epigenin ethers and other flavonoids and phenols. Leaves contain β -sitosterol glucoside, andrographolide and panicolide and polyphenols, caffeic and chlorogenic acids and a mixture of dicaffeolquinic acid. Roots contain flavones, andrographin and panicolin, α -sitosterol.

Medicinal use: The plant possesses febrifuge, tonic alterative, stomachic, anthelmintic and cholagogue properties, and also used in liver complaints, colic, constipation, cholera, dysentery, diarrhoea, diabetes, dyspepsia, general debility, hookworm infestation, hyper acidity, influenza, bronchitis, malaria, swellings and itches, piles, gonorrhoea, scabies, stomach disorder and stomachache. It is also used as a cure for torpid liver and jaundice. It is also used as curative or preventive in snake venom poisoning. It is chiefly used in viral hepatitis, diminished appetite and drug induced liver damage.

Other uses: This species is normally used for medicinal purposes and its other use is unknown.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from fever, intestinal worm, and infections. Different ethnic groups, such as, Bawm, Chakma, Chak, Khumi, Marma, Mru and Tripura use this species for their treatment.

Argemone maxicana L.

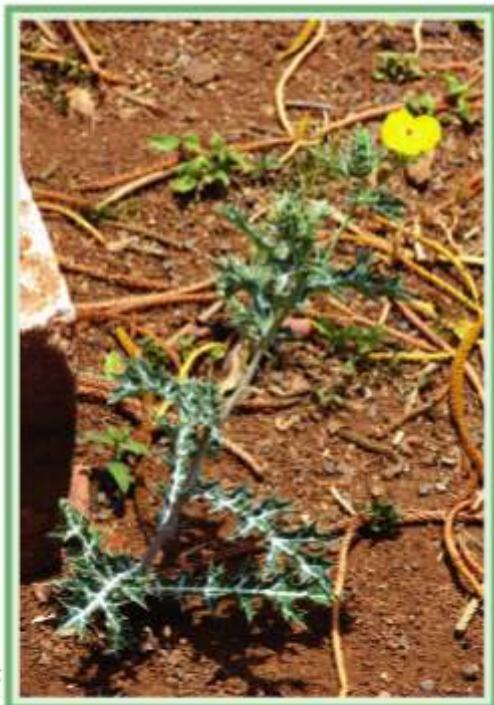
Family: Papaveraceae

Synonym: *A. leiocarpa* Greene.; *A. ucronata* Dum. Cours. ex Steud.; *A. versicolor* Salisb. and *A. ochroleuca* Sweet

Bengali name: *Shial kanta* and *Baro Shialkanta*.

Vernacular name: *Long* (Marma); *Prickly poppy* and *Mexican Poppy* (English); *Shialkanta* and *Satyanashi* (Hindi); *Kutiyotti* and *Ponnummuttai* (Tamil); *Daruri*, *Firangi-kote-pavola* and *dhotara* (Marathi) and *Brahmadandicettu* (Talegu).

General description: It is a prickly, glabrous, branching annual herb with yellow juice and showy yellow flowers. The height of this plant varies between 0.3-0.8 m. Stems are bluish-green, pithy, smooth or slightly pubescent (covered with short hairs). The leaves are stalkless, narrow lance shaped, curved and whitish-turquoise with white veins and are about 26 mm long by 1.3 mm wide at the first true leaf stage. The first true leaf is narrow with three triangular, pointed lobes at the tip and a tapering base. The second true leaf is also narrow but is deeply lobed. The leaves are bluish-green and alternate. The basal leaves are slightly stalked and crowded into a dense rosette (a cluster of leaves at the base of a plant often lying flat against the ground). The upper leaves are sessile (without a stalk) and clasping the stem, the shape being variable. The leaves are generally 6-20 cm long, 3-8 cm wide, deeply divided into 7 to 11 coarse irregular lobes, covered with a powdery bloom; the upper surface of the leaf has paler stripes along the veins. The margin (edge) of the leaf has wavy prickles at the tips of the lobes as well as scattered on the underside of the leaf. Flowers are creamy white to yellow, on a short stalk or sessile (without a stalk) at the ends of branches, and are 3-6 cm wide in diameter. There are 3 hood-like sepals that are sparsely prickled with a large spine just below the apex. The sepals are shed as the flower opens. There are 6 delicate deciduous petals that are 2.5-3 cm long and 1.4-4 cm wide. There are numerous stamens. The sepals are shed as the flower opens. The fruit is a prickly ellipsoid capsule that is 2.5-5 cm long and 2 cm in diameter, crowned with a persistent style and narrowed at both ends and widest below the middle. When the fruit is ripe it opens from the apex downwards, splitting away from the style with ribs attached to the stigma and so resembling the ribs of an umbrella. The seeds are numerous dark brown or black and globular and are about 1.5 mm in diameter.



Argemone mexicana



Flowering of *Argemone mexicana*



Fruiting of *Argemone mexicana*

Distribution: It is a native species of Northern America, Central America and Mexico but it is naturalized in most of the warm countries of the world as a weed. In Bangladesh, the species occurs in fallow lands all over the country.

Physiographic, edaphic and biotic requirements: The plant prefers light (sandy) soils, requires well-drained soil and can grow in nutritionally poor soil. Commonly found as a weed of roadsides, mining dumps, recently cultivated paddocks, waste places, and over grazed pastures, mostly at the sea-level, but sometimes up to 3,000 m altitude. It often occurs as dense stands in sandy stream beds and alluvial flats associated with intermittent inland streams. Seeds germinate best in moist soil with a temperature of up to 25°C. In some regions they germinate throughout the year if enough moisture is available.

Silvicultural characteristics: The scented flowers are hermaphrodite (have both male and female organs). The plant is self-fertile. It cannot grow in the shade. The plant is toxic to animals and cattle avoid grazing this plant. Harmful allelopathic effects of *A. mexicana* on germination and seedling vigor have been reported. The allelochemicals cinnamic and benzoic acid are identified as harmful chemicals responsible for inhibition of germination and seedling vigor.

Phenological characters: It is in flower from June to August, and the seeds ripen from July to September. The flowers open early in the morning, and last for 2–3 days.

Regeneration: *A. mexicana* is propagated by seed. Seed production can be 18,000–36,000 seeds per plant. Small stingless bees are the main pollinators, but it is predominantly self-pollinated. Most seeds fall around the base of the parent plant where they may form a carpet of seedlings. Seed may be dispersed by wind and water and is known to spread quickly in irrigation schemes. Dispersal also occurs by soil adhering to farm machinery and by man and livestock. Seeds can remain dormant for many years. It can easily grow in a light soil in a sunny position. One kg seed contains about 1,500-1,700 seeds.

Chemical constituents: Roots and stems contain alkaloids, protopine and berberine; resin and a toxic principle. Seeds contain alkaloid, allocryptonine, tannin, resin and oil. Seed oil contains bezophenanthridine alkaloid, sanguinerine. Aerial parts contain a number of alkaloids which include protopine, berberine, cryptopine, coptisine, sanguinerine, nor-sanguinerine,

chelerythrine, etc. Flowers contain glucosides. Latex contain alkaloids, berberine and protopine and free amino acids. Ceryl alcohol is also present in various parts of this plant.

Medicinal use: Root extract is alterative and has antifungal properties. Plant extract is anthelmintic, antileprotic, tonic, alterative, diuretic, hypnotic and anodyne. Latex and extract are used in skin diseases, dropsy and Jaundice. Latex is also used in warts, tumours, cancers and eye diseases. Flowers are useful in whooping cough. Seeds are demulcent, laxative, nauseant and expectorant. Oil is a powerful purgative.

Other uses: The plant is found suitable for the reclamation of alkaline soils. Dried and powdered plants are recommended as green manure as it contain sufficient amount of nitrogen, phosphorus and potassium. Oilcake is used as manure. Seed oil is used as an illuminant, lubricant, in soap making, and for protection from termites. Cattle do not graze the plant as it is spiny, but they can be poisoned if they consume it in hay or the chaff. Sheep and goats eat it when other vegetation is in short supply, while ostriches relish it. The value of wool decreases when it is contaminated by the prickly fruits. It is sometimes cultivated as an ornamental plant. Leaf extracts show antifeedant activity against insects. Dried plant extracts significantly reduced nematode damage on seedlings of tomato and eggplant.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from cough, dysentery, eye infection, itching and infection. Different ethnic groups, such as, Bawm, Chakma, Khumi, Marma and Mru use this species for their treatment.

Asparagus racemosus Willd.

Family: Liliaceae

Synonym: *A. penduliflorus* Zipp. and *A. javanica* Kunth.

Bengali name: Satamuli.

Vernacular name: *Boma raja* (Marma); *Wild asparagus* and *Sparrow Grass* (English); *Sattischara* (Chakma) and *Satavari* (Talegu).

General description: A medium sized, profusely branched, spreading or ascending climber, up to 2-3 m high or more, stems glabrous, smooth or grooved, roots with distant, elongate tubers. Scale-leaves with scarious portion up to 8 mm long and spine usually absent on final branches, cladodes present mainly on branches and towards the end of stems, triquetrous, linear-crenate, 1-3(-4) nate, 10-30 mm long, rarely over 1 mm broad Pedicels 1 or 2-nate, usually on branches 2-6 mm long, lacking cladodes, often on normal branches, articulated usually near the middle, 3-5 mm long. Flowers bisexual, scented. Perianth segments white with a green band, spreading, similar, oblong to ovoid-oblong, 2-3 mm long. Filaments shorter than or about the same length the same length as a perianth segments, anthers 0.2 -0.3 mm long. Ovary is obovoid, 1.5 mm long, style 0.5 mm, with 3 stigmatic ridges or 3 short branches, ovules 2 per locule. Berry red when ripe, 4-6 mm in diameter. Seeds are 1-3, globose or angled, 2-3 mm in diameter.

Distribution: It is distributed widely in Africa, through southern Asian into China, in south Malaysia. In Bangladesh the species rarely occurs in the northern, central and eastern parts of the country.

Physiographic, edaphic and biotic requirements: It usually grows in a variety of soils. However, sandy loam and soil rich in organic matter is suitable for proper root growth. The tropical humid climate is suitable for its cultivation. Soil pH 6-8.5 is suitable for its cultivation.

Phenological characters: Flowering of this species takes place in August to November. It has small white smelling flowers. The fruiting period is from December to January and collection period from September to October. It is an irrigated 24 months crop.



Asparagus racemosus

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Branch of *Asparagus racemosus*



Roots of *Asparagus racemosus*

© Golam

Regeneration: It can be multiplied through vegetative propagation. There is always problem of heterogeneity in obtaining uniform seed stock. The plants developed through seeds are poor in vigor. It has a slow rate of growth. The natural regeneration of this under shrub is through tuberous roots that have been scarce in nature because of indiscriminate collection of wild material. A mature old *A. recemosus* yields 10-12 kg of roots. Before sowing, the seeds have to be pretreated by dipping in water for 24 hours to get good germination. It takes 10-15 days to germinate and the germination percentage is about 70-80. When the age of germinated seedlings will be 2-3 months it has to be planted. The clean and dry seeds can be stored in good dry condition for at least 1 year.

Chemical constituents: Leaves contain diosgenin and other saponins such as shatavarins I to IV. Flowers and fruits contain glycosides (asparagosides), sarsasapogenin, spirostanolica and furostanolic saponins. Tubers and roots contain saccharine matters and mucilage. Ripe fruits contain quercertin, tutin and hyperoside. An antioxytocic compound, named racemosal (a 9, 10-dihydorphenanthrene derivative), has been isolated from this plant.

Medicinal use: Ethanolic extract of aerial parts is anticancer. Bark is antibacterial and antifungal. Tuberous roots are used as aphrodisiac, alterative, tonic, demulcent, diuretic, anti-diarrhoeaic and anti-dysenteric. Root promotes lactation in mothers and appetite and nourishment in children. It is also used in treating acidity and as hair tonic. The plant is also used in diabetes, jaundice and other urinary disorders. Aquous extract of roots is nematicidal.

Other uses: It is used as an ornamental plant in the homestead gardens.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this tree for several treatment purposes as, constipation, jaundice, stomach pain, and for increasing mother's milk. Different ethnic groups, such as, Bawm, Chak, Chakma, Marma, Mru and Tripura use this species for their treatment.

Azadirachta indica A. Juss.

Family: Meliaceae

Synonym: *Melia pinnata* Stokes; *Melia indica* Brandis and *Melia azadirachta* L.

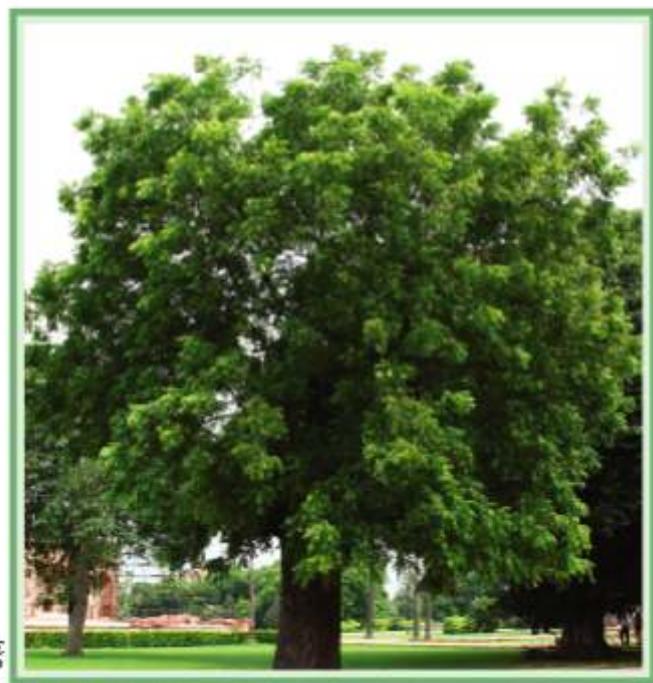
Bengali name: Neem.

Vernacular name: *Kala duru*, *Tama gach* and *Tamakha* (Marma); *Neem* and *Tamotak* (Chakma); *Neem* and *Indian lilac* (English) and *Yepa* (Telegu).

General description: A medium-sized to large glabrous evergreen to semi-deciduous tree that may grow up to 20 meter in height and 60 cm in diameter. Canopy is dense with thick foliage and is round in shape. Bark is brown in young age turns to grey and develops deep furrows and scaly plates; inner bark is pink in color. Leaves imparipinnate or paripinnate, 15-35 cm long, 4-7-jugate, red when young, petiole 3-7 cm long, sub-glabrous, base swollen, leaflets opposite to sub-opposite, falcate-lanceolate, 5-9 x 1.5-3.5 cm. Inflorescence axillary or in axils of fallen leaves thyrses, 25-30 cm long, sweetly scented, axis subglabrous, branches 15 cm long, squarrose, bracts and bracteoles lanceolate, 0.5-1 mm long, pedicels, 2 mm long, finely pubescent. Calyx 1 mm long, salveriform, the lobes rounded, pubescent, margins ciliate. Petals are linear spatulate, 4-6 mm long, white, pubescent. Staminal tube is glabrous to sparsely pubescent, 10-ribbed, margin basifixed, weakly exserted. Ovary is glabrous to finely pubescent. Fruit is a small drupe, oblong-ovoid in shape, green when young and yellow green when ripe with white latex. Each fruit contains a single ellipsoid seed.

Distribution: It is a native tree of Myanmar and said to be wild in the dry forests of South India. It does not grow wild in the forests of Bangladesh but often cultivated and naturalized throughout the country.

Physiographic, edaphic and biotic requirements: It is very useful roadside or avenue tree in dry and moderately dry climates, thriving as a rule where normal rainfall varies from 457.2 to 1,143 mm, and where the maximum shade temperature varies may be as much as 49°C, though it will not stand excessive cold. Grows everywhere, on dry, stony, sandy, clayey, slightly acidic or alkaline, shallow soils. It is lightly saline tolerant, can tolerate drought and high rainfall but cannot tolerate water logging.



Azadirachta indica

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Leaf of *Azadirachta indica*

© ACW/M.A. Wimal



Dry fruit and seed of *Azadirachta indica*

© Abur Mohamed



Flowering of *Azadirachta indica*

© ACW/Enamul Nabi Khan Siddique



Stem of *Azadirachta indica*

Silvicultural characteristics: The tree is a light-demanding, but has great capacity for pushing its way through thorny scrub in youth. It regenerates naturally and is propagated mainly through seed. It is very frost-tender, especially in the seedling and sapling stages. Its capacity for thriving on poor dry ground and its tolerance of an excess of moisture in the soil have already been alluded to. It coppices well and produces root-suckers, especially in dry localities. It is not readily browsed by cattle and goats; it is, however, recognized as fodder suitable for camels. In some localities porcupines damage and sometimes girdle and kill the trees by gnawing off the bark round the base.

Phenological characters: Only in dry localities does the tree become almost leafless for a short period; otherwise it is an evergreen species, the new leaves appearing in March to April replacing the old one. The panicles of small white flowers, smelling of honey, appear from March to May and the fruit ripens from June to August.

Natural regeneration: Under natural conditions the seed ordinarily reaches the ground in the rainy season, and germination takes place in one to two weeks. Although the tree is believed not to be indigenous, it often reproduces naturally with tolerable freedom, in this it is aided by its capacity for establishing itself under the protection of thorny bushes and its hardiness on dry poor soil, provided it is not subjected to frost.

Artificial regeneration: Although *Neem* can be easily raised in the nursery and transplanted, for forest purposes direct sowings have proved more successful than transplanting. Care is necessary in the collection of the seed: it should be collected off the trees about July when thoroughly ripe and should be sown as soon as possible after collection. It is advantageous to cover the seed lightly with earth, since seed germination on the surface of the ground is liable to have radicle eaten off by insects.

For raising seedlings, the seed sown in the nursery should be lightly covered with earth and sparingly watered, the soil being kept loose to prevent caking. The seedlings will be fit to transplant during the first rains, when they are 8 to 10 cm in height, the taproot then being about 15 cm long. If larger seedlings are required they may be kept another year in the nursery and transplanted early in the rains of the second season, the planting being protected in water by screens in frosty localities. Transplanting may be carried out successfully after pruning down to stem and roots. One kg seed contains about 3,300-4,500 seeds.

Chemical constituents: Various parts of the plant and Neem oil contain triterpenoid bitter principles, saponins, flavonoids, tannins and alkaloids. The bitter principles of *Neem* include nimbidin, nimbin, nimbinin, nimbidol and bakayanin. In addition to these, the fruits contain triterpenoids, salanin, and azadirachtin, oil, organic acids, and alkaloid, melianone. Leaves contain nimbinene, nimbolide, quercetin and its glycosides, β -sitosterol, n-hexacosanol, nonacosane, ascorbic acid, and amino acids. Barks contain tannin, margosin and azadarin. *Neem* oil contains margosic acid. Flowers contain essential oil, kaempferol, glucoside, nimbosterin and N-nonacosane. Kernel contains triterpenoids, salanin, azadirachtin, oil and fatty acids. Seeds contain 6-tetranortriterpenes and four new limonoids.

Medicinal use: Various parts of the plant are used in inflammation of gums, gingivitis, sores, fever (including malaria), spleen complaints, tumors, head scald, smallpox, diarrhoea and cholera. In addition, the leaves possess antiseptic properties and are used in boils, ulcers, eczema, ringworm and scabies. The leaves, bark, gum and seeds are used as remedies for scorpion-sting, snake-bite, as antiviral, antineoplastic and antifungal agents. The gum is a demulcent tonic and is useful in catarrhal affections. Flowers are used in atomic dyspepsia and general debility. The oil is used in the treatment of ulcers, chronic skin diseases and rheumatism. Seed cake used as insecticide and nematicide, possesses vermicidal properties.

Other uses: This is considered as a multipurpose tree and the entire tree (including bark, wood, leaves, fruits etc.) has various uses. The timber is used for making furniture.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as intestinal worm, itching and teeth pain. Different ethnic groups, such as, Chakma, Tripura, Marma, Mru and Bawm use this species for their treatment.

Boerhaavia diffusa L.

Family: Nyctaginaceae

Synonym: *B. repens* L. and *B. paniculata* Rich.

Bengali name: *Punarnava*, *Gondhapurna* and *Swetapurna*.

Vernacular name: *Chi saidal* and *Parengnawa* (Marma); *Hog weed*, *Spreading hog weed* and *Pig weed* (English); *Vishkhapara*, *Santha* and *Tambadivasu* (Marathi); *Gahadpurna* (Hindi); *Mukaratee-Kirei* (Tamil); *Punernava* (Talegu) and *Punarnava* (Sanskrit).

General description: Perennial creeping or climbing herb, prostrate or straggling, with stems up to 60 cm long, with a slender taproot; stem few to much, branched, fleshy, green, often flushed with red, finely hairy or glabrescent, nodes swollen. Leaves opposite, simple, unequal; stipules absent; petiole 0.5-1.5 cm long; blade broadly ovate to elliptical, 1-2.5 cm × 0.5-1.5 cm, base cuneate, rounded or truncate, apex rounded to acute, margins sinuate, pale green to whitish beneath, finely hairy, glandular hairy or glabrescent. Inflorescence an axillary, congested, irregular umbel or cyme, (3-) 5-7(-13)-flowered; peduncle (2-) 4-7 cm long; bracts and bracteoles small, fimbriate, caducous. Flowers bisexual, regular; pedicel (0-)1-1.5 mm long; perianth tubular-campanulate, distinctly constricted halfway, lower part ellipsoid, surrounding the ovary, 5-ribbed, green, upper part 5-lobed, up to 3.5 mm × 3 mm, lobes emarginate, white, pink or mauve, soon falling; stamens (1-)2(-3), slightly exerted; ovary superior, seemingly inferior, 1-celled, style slightly exerted, stigma head-shaped. Fruit an achene, enclosed by the thickened lower part of perianth (collectively called anthocarp); anthocarp obovoid to ellipsoid, 3-3.5 mm × 1.5-2 mm, apex rounded, 5-ribbed, with rounded ribs, with glandular hairs all over, 1-seeded. Seed is ovoid and pale brown.

Distribution: *B. diffusa* is found in the tropical, subtropical and temperate regions of the world. It is distributed in China, India, Australia, Pakistan, Egypt, Sudan, Sri Lanka, U.S.A. and South Africa. It is also found in a number of countries of the Middle East. This plant is indigenous to India. In Bangladesh, the species frequently occurs in fallow lands, and often on ruined walls all over the country.

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© IUCN/M.A. Mortuza

Boerhaavia diffusaFlowering of *Boerhaavia diffusa*

Physiographic, edaphic and biotic requirements: It is found in inundated and disturbed sandy and rocky localities, such as, ditches along the road sides, road dividers, near railway tracts, ruined walls, rubles, near old earthen ponds, dry riverbeds, flood plains and irrigated fields.

Silvicultural characteristics: It prefers sunny sites and a seasonal climate with a pronounced dry season. The mucous coat of the anthocarp shows a distinct sticky swelling when ripe, with which it clings to mammals and birds.

Phenological characters: It is an evergreen species. It can be found flowering and fruiting throughout the year when sufficient water is available. But normally flowering is observed in the month of May. The mature seeds are formed in October to November.

Regeneration: Usually the plant is propagated through seeds and creeping stem nodes. But the seed viability is poor and has very low germination percentage. The plant grows profusely in the rainy season. It remains dry and dormant during summer and regenerates from the same old root stock in the

rainy season. Some workers have studied the regeneration of this plant through tissue culture.

Chemical constituents: Various parts of the plant contain two quinolizidine alkaloids, Punarnovine I and Punarnovine II, squalene, phytol, sitosterol, myricyl alcohol, myristic and oxalic acids, tannins and potassium nitrate. Roots contain a glycoside, hypoxantine-9-L-arabinofuranoside, hentriacontane, ursolic acid, β -sitosterol, stigmasterol, amino acids, and oxanthrone, boerhavine, and some rotenoids, boerhavinones A, B, C, D, E and F, repenone and repenol.

Medicinal use: Plant is bitter stomachic, laxative, expectorant, emetic; roots and leaves are effectively used as a diuretic in dropsy and anasarca. Leaves and roots are also useful in jaundice, anemia, ascites, ophthalmia, gonorrhoea, and as blood purifier and anti inflammatory agents. Plant powder is used against abdominal tumor and cancer. It is also useful in epilepsy, dysentery and inflammatory renal diseases.

Other uses: Indigenous tribes of many countries have been reported to use different parts of the plant for food. The entire plant, including the roots, is eaten as vegetable, in curries and soups. In Nigeria, the root is added to cake and the Hausa people eat the plant as a cure for faintness due to hunger. The roots and seeds are added to cereals, pancakes, and other food stuffs. They are also served as bird feed or poultry feed. The plants are grazed by sheep, goats, and cows, and in West Bengal, it is believed that the plant enhances lactation period and also the amount of milk in cattle. Recent studies have found that the plant has anti-microbial including anti-viral properties. However, the commercial use of the plant has not so far been encouraged except some companies selling its dried powder.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from cough, headache, jaundice, sleepless, rheumatic pain and vomiting. Different ethnic groups, such as, Chakma, Marma, Mru and Tripura use this species for their treatment. Several Bengali people living in the area also use this species for their treatments.

***Bombax ceiba* L.**

Family: Bombacaceae

Synonym: *B. malabaricum* DC.; *B. heterophyllum* L. and *Salmania malabarica* (DC) Schott et Endl.

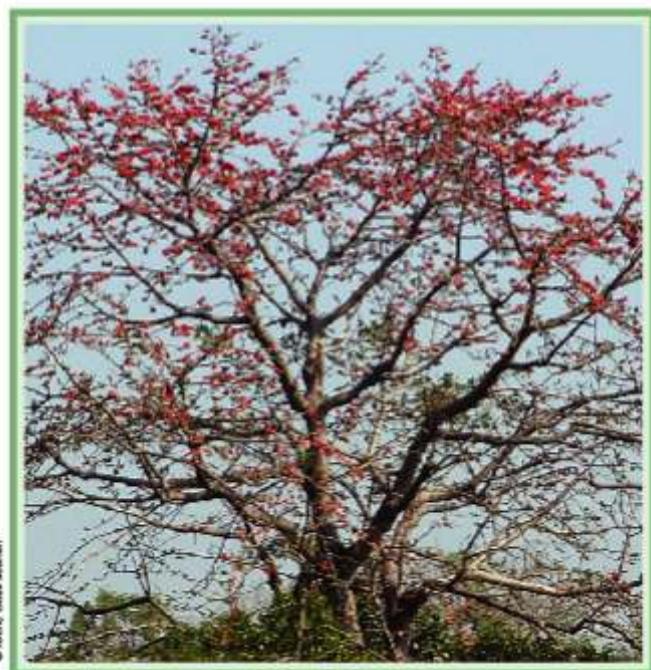
Bengali name: *Shimul, Semul, Shimul tula* and *Lalshimul*.

Vernacular name: *Agaroi* (Marma); *Red silk cotton tree* and *Indian Kapok tree* (English); *Bolchu* (Garo); *Sittan* and *Sanmalli* (Tamil); *Kondaburuga* (Telegu) and *Lapping* (Magh).

General description: A large deciduous tree with tall trunk and spreading crown reaches up to 45 m in height with a dbh of 150 cm; base of trunk often buttressed and fluted; trunk and branches, particularly of young trees covered with large woody conical black prickles with corky bases. Bark rather thick, smooth, grayish white when young, but vertically fissured in old trees; bluish pinkish, soft and fleshy with coarse stands of bast fibers. Leaves digitately compound; common petiole 12-30 cm long, as long or longer than the leaflets; leaflets 5 or 7, lanceolate or obovate, 15-18 x 8-10 cm, acuminate, entire, coriaceous, glabrous; petiolules about 2.5 cm long. Flowers large, showy of various shades of orange and red on short fleshy pedicels, 10-12 cm across, fleshy, at the end of branches and appearing when the tree is completely leafless. Fruit a capsule, greenish velvety outside, 12-18 cm long, woody, oblong-ovoid, 5-angled, blackish when dry. Seeds glabrous, smooth embedded in silky wool which float in the air after bursting out fruit.

Distribution: It is distributed throughout India, Myanmar, South China, Thailand, Malaysia and Indonesia. It is a common associate species in moist deciduous sal forest of Nepal, India and Bangladesh. In Bangladesh, it occurs widely in the forests of Chittagong, CHT, Dhaka, Sylhet and Mymensingh, more often, found by the side of roads, railway tracks and by river banks throughout the country.

Physiographic, edaphic and biotic requirements: It prefers a deep sandy loam soil derived from granite. It also prefers valleys and flat or undulating ground with deep soil. It can grow on well drained hill slopes. It is almost gregarious on flat alluvial ground in grasslands near river banks. It occurs in regions showing a wide range of temperature and rainfall but thrives best in a comparatively moist tropical climate. In the natural habitat, excluding the places where it is found up to 1,200 m elevation in the hills, the absolute



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Bombax ceiba



© IUCN/M.A. Misra

Leaf of *Bombax ceiba*



© Forest & Kim Star

Flowering of *Bombax ceiba*



© IUCN

Dispersal of fruit of *Bombax ceiba*



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Dry seed of *Bombax ceiba*



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Stem of *Bombax ceiba*

maximum temperature varies from 37.5°C to 50°C and the absolute minimum from minus 2.5°C to 17.5°C. It grows in regions with an annual rainfall ranging from 750-4,570 mm or more, showing best development in place with a high rainfall well distributed throughout the year.

Silvicultural characteristics: The tree is a strong light demander. It resists slight frost, but is affected by severe frosts in hills. It coppices in its early years but cannot later. It also produces root suckers, but these survive only if the parent trees are small. Many of them tend to die after 2-3 years. It suffers from grazing and in its young stages, it gets benefit due to the presence of thorns that protect them from grazing animals.

Phenological characters: In some cases particularly in dry situations, the leaves turn yellow and commence to fall at the beginning of December, the tree being leafless by the end of that month, whereas, in other cases, especially in moist situations, trees may remain in full foliage till March or never be entirely leafless. The new leaves appear on March to April. The large, round, dark brown buds become visible in the month of December. The showy scarlet flowers appear in February to March. The fruits develop very rapidly, sometimes reaching a length of 7.5 cm while there are still flowers on the tree; they ripe from March to May. The fruits open usually while still on the tree, but sometimes after falling. The best seed collection time is from April to May.

Regeneration: Natural reproduction of this species through seeds is abundant in some regions, however, propagation through seeds leads to the formation of highly heterozygous plants. For this reason, it is also propagated through branch cuttings, but the survival rate is poor. Artificial regeneration of the tree species is done by direct sowing or by transplanting one year old nursery raised seedlings or by stump planting. The tree starts fruiting at the age of 8 years. The seeds are collected locally from mid March to mid May. The capsules or seed pods are collected from the tree when they are just about to open and placed in the sun under wire netting and they soon burst. Seeds are separated from floss by putting them in a gunny bag and thrashing with a stick until the seeds get separated. The weight of 100 dry capsules is about 2 kg of which the floss constitutes about 0.57 kg and the seeds 0.45 kg and the remaining portion is the capsule shell. The seed weight varies from 21,430 to 38,500 per kg. Germinative capacity has been found to vary from 14-75%. The seed is viable for two years. It can be stored in sealed jars for 1 to 2 years with only slight decrease in germination capacity. Viability of seeds, stored in gunny

bags, decrease considerably at the end of first year. *Shimul* seed does not require pre treatment before sowing. Experiments show that the untreated seeds germinate (63%) better than cold water treated seeds (60%).

Chemical constituents: Stem bark yields a gum (polysaccharide) containing catechutannic acid, lupeol, β -sitosterol and tannic acids. Root bark, in addition, contains a naphthoquinone compound, phenolic substances, triacontanole, a glycoside and a lactone. Roots of young plant contain proteins, tannins, sugars, pectin and starch. Flower petals contain essential oil, hertriacontanol, quercetin, kaempferol, β -sitosterol and glucosides of pelargonidin and cyaniding, etc. Seeds contain fat, hexacosanol, tocopherol, terpenes etc. Seed fat contains stearin.

Medicinal use: Various parts of the plant are used in fever, smallpox, rheumatism and leprosy. Bark is demulcent and tonic and is used in menorrhagia, leucorrhoea, diarrhoea, dysentery, boils, acne, pimples and coughs. Roots have stimulant, tonic and aphrodisiac properties and are given in impotency. Roots and barks are emetics. Young fruits are stimulant, expectorant and diuretic and beneficial in calculous affections, chronic inflammation and ulceration of bladder and kidneys. Seed extract is used as oxytocic and gonorrhea.

Other uses: It is easy to work but not durable anywhere other than under water. So, it is not popular for construction work, but is very good and prized for the manufacture of plywood, match boxes and sticks, scabbards, patterns, moulds, etc. Also for making canoes and light duty boats and or other structures required under water. *Bombax* species are used as food plants by the larvae of some *Lepidoptera* species including the leaf-miner *Bucculatrix crateracma* which feeds exclusively on *B. ceiba*. The oil obtained from the seeds is edible. It can also be used for soap making. The seed cake of *Indian kapok* is excellent cattle feed, as it contains very little or no gossypol.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this tree for several treatment purposes as burned infections, dysentery and urinary problems. Different ethnic groups, such as, Bowm, Chak, Chakma, Khumi, Marma and Tripura use this species for their treatment.

Bryophyllum pinnatum (Lamk.) Oken

Family: Crassulaceae

Synonym: *Kalanchoe pinnata* (Lam.) Pers.; *B. calycinum*, Salisb. and *Cotyledon pinnata* Lam.

Bengali name: *Patharkuchi*, *Kophpata* and *Gatrapuri*.

Vernacular name: *Aney chailote*, *Jeejak laua*, *Rokeya panko*, *Rokkapang bang* and *Wakheponey* (Marma); *American Life Plant*, *Life plant* and *Floppers* (English); *Jeus*, *Joes*, *Patharkuchi* and *Roah kapanghey* (Chakma) and *Jeos* (Tripura).

General description: A tall, erect, perennial herb. Leaves simple, opposite-decussate, sometimes bi or trifoliate, upper ones sometimes up to 7 foliate, fleshy, petiolate, ovate, elliptic to elliptic oblong, crenate, apex rounded to acute. Inflorescence is a very long, paniculate cyme. Flowers pendulous, pedicellate, bisexual, actinomorphic. Sepals 4, united at the basal part into a calyx tube, up to 3 cm long, lobes 4, short. Petals 4, united into a long corolla tube; much exceeding the calyx tube, lobes 4, short, up to 1.7 cm long, acute. Sometimes 8, in two series, from the base of the corolla tube, filaments up to 3.7 cm long, anther basifix, oblong, 2-celled. Carpels 4, apocarpous, each carpel with a shorter style and stigma. Fruit a follicle.

Distribution: *B. pinnatum* has become naturalized in temperate regions of Asia, Australia, New Zealand, West Indies, Macaronesia, Mascarenes, Galapagos, Melanesia, Polynesia, and Hawaii. It is also widely distributed in the Philippines. In Bangladesh, the species most commonly occurs throughout the country.

Physiographic, edaphic and biotic requirements: It normally grows in hot and moist areas and can tolerate high wind. It tolerates a variety of soil such as ordinary soil (pH 6.6 to 7.5), enriched soil, and mildly acidic (pH 6.1 to 6.5) to mildly alkaline (pH 7.6 to 7.8) soil.

Silvicultural characteristics: *B. pinnatum* is a drought tolerant species. It needs full sun to partial shade for its better growth.

Phenological characters: This is an evergreen species. Flowering and fruiting is normally occurred in December to April.

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Leaf of *Bryophyllum pinnatum**Bryophyllum pinnatum*

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Flowering of
Bryophyllum pinnatum

© (r)

Regeneration of
Bryophyllum pinnatum

Regeneration: They are popular because of their ease of propagation, low water requirements, and wide variety of flower colors typically borne in clusters well above the vegetative growth. The plant's ability to propagate itself from each and every dropped leaf is quite amazing. In these plants, new individuals develop vegetatively as plantlets, also known as bulbils or gemmae, at indentations along the leaves. These young plants eventually drop off and take root. No male plants have been found in any species of this genus which does flower and produce seeds, and it is commonly called, the Mother of Thousands. Artificial propagation can be done from seeds and leaves. The propagation materials are obtained from leaf cuttings, herbaceous stem cuttings, softwood cuttings and by simple layering.

Chemical constituents: Leaves contain glycosides of quercetin and kaempferol; fumaric acid, lipids, phenolic substances and a cytotoxic bufadienolide orthoacetate. Cellular sap contains flavonoids. The plant extract also contains n-alkane, n-alkanol, α - and β -amyrins and stosterol.

Medicinal use: Leaves are eaten to control diabetes. They are diuretic and applied to wounds, boils and bites of insects. The plant is also used in the treatment of asthma, dysurea, epilepsy, gout, hooping cough, jaundice, nephrolithiasis, osteo-arthritis, pneumonia, respiratory troubles, tuberculosis, uterolithiasis and vertigo.

Other uses: These plants are cultivated as ornamental houseplants and rock or "succulent" garden plants. These plants are the food plant of the caterpillars of Red Pierrot butterfly. The butterfly lays its eggs on the leaf and after hatching the caterpillar goes inside the leaf and eats the leaf from inside.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, cough, diabetes, indigestion, insect bites and wounds. Different ethnic groups, such as, Bawm, Chakma, Marma, Mru and Tripura use this species for their treatment.

Calotropis gigantea (L.) R. Br.

Family: Asclepiadaceae

Synonym: *Asclepias gigantea* L. and *C. procera* (Aiton) W.T. Aiton

Bengali name: *Akand, Akkan gach and Madar.*

Vernacular name: *Chi kang mui* and *Monouarowi* (Marma); *Gigantic Swallow wort, Mudar and Bowstring hemp* (English); *Angar gach, Angara, Angarpata, Gach angar and Maro nah* (Chakma) and *Khachkufu* (Tripura).

General description: A large shrub or small tree, up to 3 m tall. Stem much branched and slightly woody at the base. Leaves sessile or subsessile, lamina 9.5-18.0 x 6-9 cm, broadly ovate or ovate-oblong, fleshy, base cordate,



Calotropis gigantea



Leaf of *Calotropis gigantea*



Flowering of *Calotropis gigantea*



Fruiting of *Calotropis gigantea*



Seed dispersal of *Calotropis gigantea*

lateral nerves 6-7 pairs. Inflorescence of cymes, umbellate or subcorymbose, lateral, mostly solitary at the nodes, peduncles about 10 cm long, shortly branched, secondary branches up to 2 cm long, pedicels shorter than the peduncles, about 4 cm long, densely cottony pubescent. Calyx lobes ovate, acute, 4-6 x 2-3 mm, cottony pubescent. Corolla white, lilac or purple, glabrous, tube short, lobes ovate-lanceolate, spreading. Corona adnate to and shorter than the staminal column, coronal scales five, fleshy, apex rounded with two auricles, basal spur incurved with obtuse tips. Pollinia oblong-lanceolate, caudicular, pendulous, solitary in each anther sac. Gynostegium about 1 cm long. Follicles in pairs, ovoid, boat shaped, 6.5-8.0 x 3-5 cm.

Distribution: *C. gigantea* is native to the Old World tropics but has been widely naturalized throughout the New World tropics including the Caribbean and on the continent from Mexico to Brazil. Also found in Bangladesh, China, India, Indonesia, Malaysia, Myanmar, Nepal and Thailand. In Bangladesh, the species very commonly occurs throughout the country, especially in open wasteland, roadsides and sides of railway lines and in village surroundings.

Physiographic, edaphic and biotic requirements: It grows on a wide variety of soils, sometimes growing where few plants will grow or where nothing else grows and in different climates. Its salt and drought tolerance is high. It can survive and flourish on low nutrient soil out competing other species. It cannot tolerate long time waterlogged condition.

Silvicultural characteristics: *C. gigantea* is a light-loving plant. They are very fast growing species and it needs full sun to partial shade. The species prefers hot and moist climate. It is common and scattered in dry coastal areas. Being unpalatable to sheep and cattle, it tends to spread and become common on heavily grazed pastures.

Phenological characters: It is an evergreen species. The flowering and fruiting is observed throughout the year but the peak time of flowering is April to May and fruiting time is from July to August. The best seed collection time is from July to August.

Regeneration: The fruit is a follicle and when dry, seed dispersal is by wind. *Calotropis* is an example of entomophily pollination (pollination by insects) and pollination is achieved with the help of bees. In *Calotropis*, gynostegium is present (formed by the fusion of Stigma and androecium). The pollens are arranged in a structure named pollinia which are attached to a glandular, adhesive disc at the stigmatic angle (Translator Mechanism). These sticky

discs get attached to the legs of visiting bees so that pollinia are pulled out when the bee moves away. The propagation may be done by seeds and rooted cuttings. It is occasionally found in nurseries, but deserves wider use. It does not do well in wet soils as this promotes root rot. Once established it requires only minimal care. Shrubs can be pinched back to encourage a thicker canopy. If a small tree is the objective, lightly prune the tree after it has attained 91 to 122 cm of clear trunk. Frequent pruning is required thereafter to develop a full, bushy crown. In summer the plant might become semi deciduous. It is a frequent bloomer unaffected by drought. One kg seeds contains about 1,35,000-1,40,000 seeds.

Chemical constituents: Principle content of the leaves and stems is a milky latex containing protease enzymes, calotropain I, calotropain II, calotropain D_I and D_{II} and uscharine, glutathione, ascorbic acid, calotoxin, calactin and caoutchouc. Leaves and stems also contain β-amyrin and stigmasterol.

Medicinal use: Extracts of roots and leaves are used against abdominal tumors, cancers, boils, syphilis, tuberculosis, leprosy, skin diseases, piles, wonds and insect-bites. Root bark is used in dysentery and as purgative, alterative, diaphoretic and emetic; paste of the roots is applied to elephantiasis. Flowers are stomachic, digestive and tonic. Latex is a violent purgative and abortifacient. Warmed leaves are used as poultice in rheumatism, dropsy and chest pain due to cold.

Other uses: The flowers last long, and in Thailand, they are used in various floral arrangements. In Java, the central part of the flower used to make sweetmeat. Fiber from inner bark once used in the manufacture of cloth for the nobility. Seeds said to have been used in making thread in Borneo. Wood used in making charcoal and gun-powder. Stems yield a durable fiber for products for underwater use: nets, halters, carpets, lines, ropes, fishing nets and sewing thread. Floss of seeds used for stuffing mattresses. Salted acrid milky juice used to remove hair from hides. Root makes a good tooth cleanser. As poison, the juice, forced down the throat of infants, was a reported method of infanticide employed by castes, with the purpose of putting the girl babies to death. It is also used in the production of bio-fuel.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from boils, diarrhoea, skin diseases and rheumatic pain. Different ethnic groups, such as, Bawm, Chakma, Chak, Khumi, Marma and Mru use this species for their treatment.

***Centella asiatica* (L.) Urban**

Family: Apiaceae

Synonym: *Trisanthus cochinchinensis* Lour. and *Hydrocotyle asiatica* L.

Bengali name: *Thankuni, Brahmabuti, Brahmokuti* and *Thulkuri*.

Vernacular name: *Ki ching shi, Mrang khua* and *Gaokolibos* (Marma); *Indian pennywort* (English); *Ada minmini, Menmeni, Melguni, Minmini shak, Mrangkhoa, Mrangkhoai bang* and *Thankuni* (Chakma); *Gotu Kola* (Tamil) and *Shakkumu bakla* (Tripura).

General description: A perennial herb, stem creeping, rooting at the nodes with long stolons, minutely pubescent at the young stage. Leaves simple, in clusters of 1-4, reniform, 1.0-2.5 x 1.5-6.5 cm, margin repand-crenate, glabrous, sometimes minutely puberulous, petiole up to 30 cm long, rather slender. Inflorescence simple umbel, peduncles 1-4 cm long. laxly pubescent or glabrous, involucral bracts 2, ovate, 1.0-2.0 x 1.0-1.5 mm. Flowers usually 3, lateral ones pedicillate, pedicel up to 1 mm long, middle one sessile to sub sessile. Sepal obsolete or absent. Petals 5, white to rose-tinged, minute, obtuse, 1.0 x 0.7 mm, apex inflexed, more or less imbricate at the young stage. Stamen usually 5, alternate to the petals, 1 mm long, filament slender, base little swollen, anther oblong, basifixied, bi-lobbed. Carpels 2, syncarpous, style 2, free, short, filiform. Fruit sub-cylindric, ovate to orbicular, 2.0 x 1.5 mm, minutely pubescent when young, 7-9 ribbed, pericarp thick.

Distribution: It is native to India, Sri Lanka, Northern America, Northern Australia, Indonesia, Iran, Malaysia, Melanesia, Papua New Guinea and other parts of Asia. In Bangladesh, the species occurs naturally in almost all over the country.

Physiographic, edaphic and biotic requirements: *Centella* grows along ditches and in low wet areas. The plant prefers light (sandy), medium (loamy) and heavy (clay) soils. It requires moist or wet soil. It tolerates temperatures down to between -5°C and -10°C. It grows and spreads very well outdoors during the summer and is very easy to increase by division. It can, therefore, be grown as a summer crop with divisions being taken during the growing season and overwintered in a greenhouse in case the outdoor plants are killed by winter cold.



Centella asiatica

Silvicultural characteristics: It can grow in semi-shade (light woodland) or no shade. This species is not hardy. The plant is self-fertile. It prefers a moist to wet soil in sun or partial shade. Plants also grow on walls in the wild and so should tolerate drier conditions. The plant likes sunshine. It grows on flooded sites, floating its leaves on the surface like a water lily, but it is happiest where the soil is wet, but its leaves are dry. It may disappear during drought, but it will come back when the rains come. Since this species is common in pine flat woods, which are fire-maintained habitats, it can be assumed that it would recover or reestablish itself readily after a fire.

Phenological characters: *C. asiatica* is an evergreen species. The crop matures in three months and the whole plant, including the roots, is harvested manually. It is in leaf all year, in flower from July to August, and the seeds ripen from August to September. The flowers are hermaphrodite (has both male and female organs) and are pollinated by insects. It blooms repeatedly.

Regeneration: It can easily regenerate in the damp places like wetland edges, roadside ditches, and soggy lawns. It seems to prefer somewhat disturbed areas where the sandy soils have been heavily enriched with organic matter. It can be propagated by stem cutting. Seeds need to sow in spring in a greenhouse. The seedlings should be pricked out into individual pots when

they are large enough to handle and needs to grow them in a greenhouse for their first winter. Then planting might be done in late spring or early summer of the following year. Division is simple at any time in the growing season, though the spring is probably best. It spreads by producing new plants on above-ground runners. The new plants can be separated from the parent plant once they have taken root. It should also be easy to start this plant from seed set in damp soil.

Chemical constituents: The plant contains about 60 indole alkaloids including vinblastine, vincristine, vinleurosine and vinrosidine having leukopenic activity. Leaves contain small percentage of leurosine, isoleurosine, perivine, mitraphylline, lochnerine, perosine, sitsirikine, perividine, canvincine, etc. Roots contain more than 24 alkaloids including vincamicine, Catharine, vinosidine, lochnerivine, leurosivine, cavincine, alstonine and serpentine. The plant also contains two secoiridoid glucosides, monnoterpene glycosides, ursolic, laganic and oleanolic acids.

Medicinal use: Plants alkaloids possess effective anti-cancer properties and are used successfully in the treatment of leukaemia in children and Hodgkin's disease. They also possess hypotensive, sedative and tranquilising properties, cause relaxation of pain muscles. The plant is used in treating diabetes. Leaf juice is used in wasp-stings and infusion is given in menorrhagia. Roots possess stomachic properties. Also used in the treatment of amoebic dysentery, blistering, blood dysentery, boils, bronchitis, chicken pox, epistaxis, flatulence, indigestion, mental disorder, nervous disorder, nervous debility, respiratory troubles, sore in mouth and throat and stomach disorder.

Other uses: Leaves are edible in raw and in cooked form. Used in salads and in curries and also cooked as a vegetable. Extracts of the plant are added to cosmetic masks and creams to increase collagen and firm the skin. Its leaves are also used in the sweet "pennywort drink". In Vietnam and Thailand, this leaf is used for preparing a drink.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from dysentery, boils, itching, menstrual problem and rheumatic pain. Different ethnic groups, such as, Bawm, Chakma, Marma, Mru and Tripura use this species for their treatment.

Cinnamomum tamala Nees & Eberm.

Family: Lauraceae

Synonym: *Laurus tamala* Buch. Hum. and *C. albiflorum* Nees

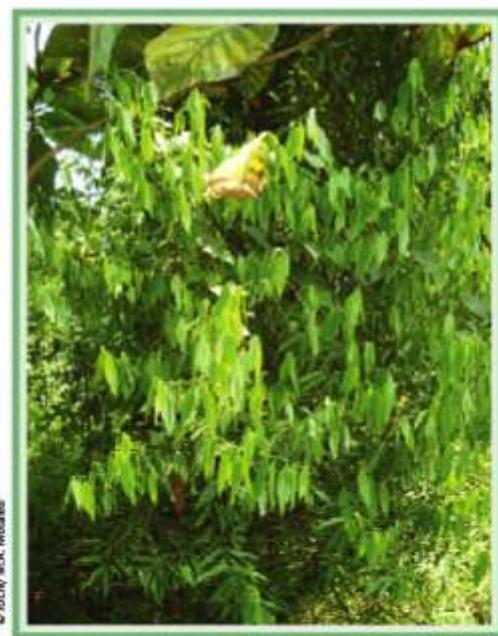
Bengali name: *Tejpata, Amla* and *Ambolati*.

Vernacular name: *Jal purua* (Marma); *Bay leaf* (English); *Tamal patra* (Marathi); *Tejpata* (Chakma); *Tej-patta* and *Tejpat* (Hindi); *Talishapattiri* and *Pattai* (Tamil) and *Patta akulu* and *Talisha* (Talegu).

General description: An evergreen tree, bark slightly rough, dark brown or grayish brown, lenticels prominent. Leaves opposite to sub-opposite, simple; ex-stipulate; petiolate; laminae ovate to broadly ovate-lanceolate, the bases obtuse to oblique, the margins entire, the margins entire, the tip acute to slightly acuminate, 3-costate, reticulate, the surfaces glabrous, the lower glaucous, coriaceous. Inflorescences in terminal paniculate cymes, axillary ones few; peduncles quadrangular, the main peduncles longer than the leaves, flowers lax; bracts deciduous. Flowers bracteolate, deciduous, pedicellate, bisexual, zygomorphic, trimerous, hypogynous. Perianth synphyllous, campanulate, 6-lobed, 2-seriate, the lobes elliptic, sericeous, cream colored, the tubes short, accrescent and persisting as a cupule at the base of fruit. Androecium polyandrous, stamens in 4 whorls of 3 each, adnate to the perianth tube, the first and the second whorls opposite the petals, inserted, introrse, the third whorl alternate the petals, extrorse, the filament bases of the third whorl bear 2 orange colored sessile glands, the fourth whorl of 3 staminodes, the filament bases villous, the anthers 4-celled, basifix, dehisce by flap-like valves opening upwards. Pistil 1, ovary oblong, sessile, 1-carpelled, 1-loculed, the placentation parietal, the ovule solitary, apical pendulous, the style thick and stout, the stigma discoid. Fruit a drupe, ellipsoid, apiculate, the basal prominent; seed 1, ellipsoid, hard, glabrous, non-endospermic.

Distribution: This species is globally distributed across India, Nepal, Bhutan and Myanmar. In Bangladesh, the species occurs throughout the country under cultivation, especially in the hilly areas. In Sylhet and Haripur of Bangladesh, large scale plantation is done.

Physiographic, edaphic and biotic requirements: It grows in the hilly areas. It cannot tolerate the water logged condition and that's why it needs to cultivate comparatively in upland areas. The altitude range may be from 450-2,100 m.

Young plant of *Cinnamomum tamala*Dry leaf of *Cinnamomum tamala*Green foliage of
Cinnamomum tamala

Silvicultural characteristics: Seedling survival on the forest floor is governed by the availability of light, water and nutrients. Increase in light and nutrients in mesic gaps stimulate the growth of the competing shrubs and fast growing herbaceous plants. Best regeneration of *C. tamala* was in the undisturbed forest with high canopy cover provided the seeds are de-pulped. Such forests had highest seedling emergence, highest degree of seedling survival, shorter germination time and greater extension growth of the seedlings as compared to rest of the microhabitats.

Phenological characters: It flowers during March to May and usually pollinated by small insects, such as, honey bees. The fruits are ellipsoidal drupe and require approximately one year to attain maturity. Hence, the flowers and fruits can be seen on the same time during April to May. Ripe fruits are dark purple in color and contain single seed. The best seed collection time is from June to July.

Natural regeneration: In nature, the seeds of *C. tamala* mature in early May. The seeds do not possess any dispersal appendages and, so are dispersed primarily by two means. Firstly, by the frugivorous birds who feed on the fruit pulp and drop the seed on the ground in de-pulped state. Secondly, by strong winds or arboreal mammals may facilitate mechanical dispersal of fruits leaving the seeds on the ground in pulpy state. The germination success of this species would, therefore, largely depend on the state of seed dispersal. However, post dispersal events such as decomposition of the fruit pulp through microbial action, abrasion or feeding by smaller mammals can also facilitate removal of the fruit pulp. Fruit pulp has been reported as inhibitor of seed germination in a large number of species. The compounds present in the fruit pulp may inhibit seed germination by blocking biochemical pathways of seed germination or by altering the seed micro-environment. Seedling survival on the forest floor is considerably low (5-23%) and varied with micro-environment conditions. Similar to seedling emergence, the seedling survival is also more in case of de-pulped seeds than in pulpy seeds. Seedling survival is comparatively higher in disturbed forest areas than the undisturbed virgin areas.

Artificial regeneration: The plants are raised from seeds sown in the nursery beds in March to April. Seedlings appear 30-45 days after sowing, and are transplanted in the field when the seedlings are 1-2 years old. Seedlings should be transplanted in the field with a recommended spacing of 3-4 m. Sufficient shade should be provided in the early stages of growth, and shade trees should be cleared after 8-9 years. The fields are not usually manured or otherwise cared for but undergrowth need to be occasionally removed. The ease with which essential oils can be obtained from this plant material makes it ideal for cash crop farming. Leaves are ready for harvesting when trees are 10 years old. Tree longevity is up to 100 years, and they continue producing large volume of leaves even in old age. Leaves are collected every year from vigorous plants and in alternate years from old and weak ones. Collections are made in dry weather from October to March. Continuous rain can diminishes the aroma of the leaves. Small branches with leaves are dried in the sun for 3 to 4 days and tied up into bundles for marketing. The average annual yield per tree is 40-100 kg.

Chemical constituents: The plant contains phellandrin, eugenol and cinnamic aldehyde.

Medicinal use: The plant is used in the treatment of abdominal pain, anorexia, body pain, cardiac weakness, chicken pox, hook worm infestation, flatulence, gastric, tumor, gynecological disease, rabies, sexual weakness, stomachache and tuberculosis.

Other uses: The leaves are used extensively as a spice. In Kashmir, they are used as a substitute for *paan* (betel leaves). Leaves yield an essential oil with a specific gravity of 1.025, it is soluble in 1.2 volume of 70% alcohol. The oil resembles *cinnamon* leaf oil and contains phellandrene and 78% eugenol. The essential oil from the bark is pale yellow, and contains 70-85% cinnamic aldehyde. The oil is used in perfuming soap and in medicine. Four essential oils of *C. tamala* screened for fungicidal activity against *Fusarium moniliforme*, a post harvest fungal pathogen of cereal crops. Activity of the four oils increased with concentration. Hydrodistilled essential oils of *C. tamala* also shown anti-fungal activity against *Trichophyton mentagrophytes* and *Microsporum* spp. which cause ring worm diseases in animals and humans. The fungicidal or fungistatic toxicity of the essential oils of *C. tamala* were more effective than the synthetic antifungal agents, such as, clotrimazole, griseofulvin or nystatin. The leaf extracts are used as clarifiers in dyeing procedures with myrobalans or kamala. Protects surrounding soil from erosion. With an evergreen canopy *C. tamala* is an important shade provider in its native range.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, intesital worm, sexual diseases, diarrhoea and general weakness. Different ethnic groups, such as, Bawm, Chakma, Marma, Mru and Tripura use this species for their treatment.

Datura metel L.

Family: Solanaceae

Synonym: *D. fastuosa* L. and *D. alba* Nees

Bengali name: *Dhutra* and *Dutura*.

Vernacular name: *Gaing sang roi mro* and *Dutra gach* (Marma); *Dhutra phul gach*, *Duduraphul*, *Hala duduru* and *Kala dhutura* (Chakma) and *Thorn apple* (English).

General description: A robust herb or under shrub up to 2 m tall, glabrous or minutely pubescent, branches green or purplish, spreading, often in a zigzag manner. Leaves 8-17 x 4-12 cm, ovate, entire, sinuate or deeply toothed, acute to acuminate, membranous, base oblique. Petiole is 5-10 cm long. Flowers are axillary, solitary. Pedicels are 1-2 cm long. Calyx 3-8 cm long, glabrous or minutely hairy, lobes 0.5-1 cm long, free, ovate-triangular, acute to acuminate. Corolla 1-7 cm long, funnel-shaped, limb 5-8 cm across, white or purple, glabrous or minutely hairy, lobes usually 5, rarely 6 or more, ovate-acuminate or cuspidate, occasionally with double form (corolla within corolla) or very rarely triple. Filaments much longer than anthers, upper half glabrous, lower half hairy, anthers oblong. Ovary is glabrous; style is filiform, as long as filaments, glabrous; stigma swollen, 2-lobbed. Capsule globose, nodding, spiny or tuberculate; spines 0.3-0.5 cm or more long, calyx base persisting as 0.5 cm or more broad collar. Seeds 0.4-0.5 cm long, many, compressed, roughly triangular, brown, and rugose.

Distribution: It is native in China, tropical Asia and is also distributed throughout the greater part of India and the Philippines. In Bangladesh, it is available in roadsides and other fallow lands. It is occasionally cultivated in some areas.

Physiographic, edaphic and biotic requirements: *D. metel* grows on waste land and river sand, especially in sunny portions. The plant prefers light (sandy) and medium (loamy) soils and requires well-drained soil. The plant prefers neutral and basic (alkaline) soils and can grow in very alkaline soils. It requires dry or moist soil. It does not prefer heavy rainfall.

Silvicultural characteristics: This is a light-demanding species. It cannot grow in the shade. It coppices well.

*Datura metel*Leaf of *Datura metel*Flower of *Datura metel*Fruit of *Datura metel*

Phenological characters: Flowering occurs in rainy season and fruiting occurs thereafter. The suitable time for seed collection is in July. After ripening of the fruit, it bursts and the solid mass of yellow or light brown and flat seeds comes out.

Regeneration: It is generally propagated by seeds. Vegetative propagation by stem cutting is also successful but rare. Seeds are collected from mother plant when fruits turn yellow. They are washed immediately to remove fruit pulp and dried in the shade. Dried seeds are sown in sand beds during March-April. Frequent water and proper shade is necessary for successful germination. Dormancy of 30-40 days has been noticed in the seeds. Pre soaking of the

seeds for 24 hours reduces the dormancy period to 20 days. The seedlings can be transferred to the field directly during the monsoon. The percentage of success is reported to be 70%. For planting, suitable field (with proper drainage that ensures 'no water logging' during the rains) should be selected and ploughed. All weeds are to be removed. The plant starts yielding from the sixth month. Scale insects are noticed on the lower surface of the leaves and young branches drying during dry season. They suck the sap leading to the drying up of plants. One kg seeds contain about 74,000-77,000 seeds.

Chemical constituents: Principle constituents of the plant are a large number of tropane alkaloids including, hyoscine, hyoscyamine, litorine, acetoxytropine, valtropine, fastusine, fastusinine and various tigloyl esters of tropine and pseudotropine. Fruit pericarp also contains β -sitosterol, triterpene, daturanolone and daturadiol. Seeds also contain daturanolone and fastusic acid in addition to the tropane alkaloids.

Medicinal use: Leaves are narcotic, anodyne and antispasmodic. They are smoked to relieve spasmodic asthma and used in rheumatic swellings, lumbago, sciatica, neuralgia, painful tumours, glandular inflammations, mumps and also in erache. Various parts of the plant are also used for piles, fever with catarrh and cerebral complications, insanity, diarrhoea and skin diseases. Extracts of leaves, fruits and seeds are anticholinergic.

Other uses: It is used as a herb for its hallucinogenic effects. It is also demanded for performing different ritualistic events.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this tree for several treatment purposes as chicken pox, cough, itching, and intestinal worm. Different ethnic groups, such as, Bawm, Chakma, Khumi, Marma, Mru and Tripura use this species for their treatment. The Marma use to insert thumb into the fruit and keep for a time to treat finger felon. Seeds are used for asthma and to made men mad in Khagrachari hill districts.

Gmelina arborea Roxb.

Family: Verbenaceae

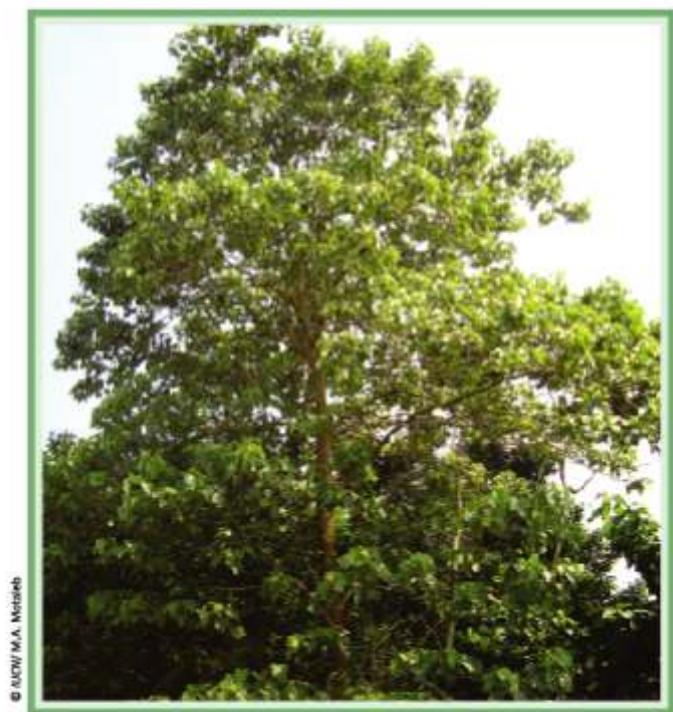
Synonym: *Premna arborea* Roth. and *Gmelina tomentosa* Wall.

Bengali name: Gamari and Gambar.

Vernacular name: Pangle ka thotting, Reminiba and Remnibang (Marma); Gamarigulo (Chakma); Gamar (English); Gamari gach (Tripura); Jogini-chakkar (Mymensingh); Gambhar, Boi-gippok and bol-kobak (Garo); Ramain (Magh); Gomari (Assam); Shuvan (Marathi) and Gumadi (Tamil).

General description: A medium-sized to large tree, up to 20 meter tall and 80 cm in diameter, bark smooth, pale ashy-grey, branchlets and young parts yellowish-tomentose. Leaves deciduous, decussate-opposite, broadly ovate, 10-25 x 7-18 cm, apex acuminate or caudate, margins entire or toothed, base cordate or truncate, densely tomentose above when young, becoming glabrous above when mature, permanently densely fulvous-tomentellous with stellate hairs beneath, nerves 5-10 pairs, petioles cylindric, 5-15 cm long, puberulent or glabrous. Inflorescences terminal and axillary, 1-3 flowered paniculate cymes, fulvous-tomentose, 7-25 cm long, bracts, linear or linear-lanceolate, about 1 cm long, flowers appearing before or with the young leaves. Calyx broadly campanulate, about 5 mm long, densely fulvous-tomentose externally, the rim with 5 triangular, acute teeth. Corolla is large, showy, yellow or brilliant orange to reddish-yellow or brownish-yellow, 2.5-4 cm long, tubular below obliquely funnelform at the throat, densely pubescent externally, the limb 2-lipped, the upper lip often orange-pink, deeply divided into 2 oblong, the lower lip often lemon-yellow, about as long or twice as long as the upper and 3-lobed. Stamens 4, didynarous, exserted from the mouth of the corolla-tube, sometimes one pair sterile, anthers oblong. Pistil exserted from the mouth of the corolla-tube, style slender, stigma shortly bifid, and ovary 4-celled, 1-ovule per cell. Fruit is drupaceous, ovate or obovoid-pyriform, 2-2.5 cm long, orange-yellow, usually 2-celled.

Distribution: It is native of Pakistan, Bhutan, India, Myanmar, Thailand to Indo-China, Malaya and Indonesia, north to southern China; introduced in many parts of tropical Africa, South America and elsewhere. In Bangladesh, it occurs naturally in the forests of Chittagong, Cox's Bazar, CHT, Dhaka, Mymensingh and also raised in plantations.



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Gmelina arborea



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Leaf of *Gmelina arborea*



Flowering of *Gmelina arborea*

© Dinesh Verma



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Green fruit of
Gmelina arborea



Dry seed of *Gmelina arborea*

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Stem of *Gmelina arborea*

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Physiographic, edaphic and biotic requirements: Large size trees are found in the mixed moist forest regions of Myanmar. It prefers moist fertile valleys, but could hardly thrive in badly drained areas. It is adaptable to wide range of soil types: acid soil, calcareous loams and lateritic soils. Growth is stunted on very thin soils, impermeable soil layers, highly leached acid soils, or dry sand. It produces best in moist, base-rich, well-drained alluvium soils. It grows at an elevation up to 1,200 meters above sea level. It can withstand up to 52°C. It grows on sites that receive 750 mm to 4,500 mm of precipitation annually.

Silvicultural characteristics: The tree is a light-demanding, though it stands rather more shade than Teak. It is moderately frost-hardy, and has good power of recovery when injured by frost. It does not stand excessive drought. It coppices very well, the coppice-shoots growing vigorously. It has not been observed to produce any root suckers to any extent. In best sites, it may yield about 30 m³/ha/year. Some trees can reach 3 m after a year from planting and 20 m after 4-5 years. In Bangladesh, the rotation is 5-8 years is common for fuel wood, 8-10 years for pulpwood but about 15-18 years for sawn timber.

Phenological characters: The leaves fall as a rule about January to February, the new leaves appear in March to April. The panicles of flowers appear from February to April, when the tree is more or less leafless or with the young leaves, and the irregular tubular corollas. Fruiting starts from April to May and the fruits ripen in July. Seed dissemination is occurred by cattle and deer, rodents and bats.

Natural regeneration: Considerable amount of alternating heat and moist is necessary to stimulate germination of seeds which fall on the ground. Germination, however, is increased when the fruits are ingested by cattle and deer and the stones are ejected during rumination, in some cases washed by rain water and stones are scattered, exposed to sunlight, then germination takes place immediately.

Artificial regeneration: The tree can be raised easily by transplanting from the nursery or by direct sowing. It is also said that large cutting planted during the rainy season strike well. For transplanting purposes, the fruit stones should be sown in the nursery as soon as the fruit ripens. No shading is necessary, but the beds should be regularly watered and weeded. The seedlings ordinarily begin to appear in about two to three weeks. Transplanting may be carried out either in the first or in the second rainy season. In the former case, small plants about 8 to 10 cm high should be used,

the seedlings begin separated and planted out during damp weather with roots and stems intact. If the plants are to be kept for a year in the nursery they should be separated and pricked out to about 25 cm apart in the first rains while still small. Next rainy season they should be planted out with the stem pruned down to about 5 cm from the ground level, and the root trimmed to a length of about 30 cm. Subsequently, it may be necessary to prune off surplus shoots springing from the stumped plants. For plantation purposes, a spacing of 1.8 x 1.8 m to 2.0 x 2.0 m is ordinarily suitable. One kg seeds contain about 1,800 seeds.

Chemical constituents: Leaves contain alkaloids and luteolin, apigenin, quercetin, hentriacontanol, β -sitosterol, quercetogenin and other flavonoids. Roots contain a viscid oil, resin, alkaloids and also gmelinol, hentriacontanol, ceryl alcohol, octacosanol, β -sitosterol and sesquiterpenes. Heartwood contains ceryl alcohol, β -sitosterol, n-octacosanol, gmelinol, and a number of other lignanans. Fruits are reported to contain butyric and tartaric acids.

Medicinal use: Ethanolic extract of bark and wood is hypoglycemic and antiviral. Bark is also used as bitter tonic and galactagogue. Juice of young leaves is used as demulcent, in gonorrhoea and coughs. Flowers are used in leprosy and blood diseases. Fruit is diuretic, tonic, aphrodisiac, alterative and is used in anemia, leprosy and ulcer. Root and root bark are stomachic, laxative, anthelmintic and used in fever, piles and abdominal pains.

Other uses: The wood is used as a source of paper-pulp, lumber, shade and ornament. Its wood resembles that of Teak and is widely employed in carriage-building and ornamental cabinet work, in the manufacture of palanquins, shafts, axels, yokes, agricultural instruments, toys etc. The fruit is edible.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, diarrhoea, intestinal worm and sore. Different ethnic groups, such as, Tripura, Marma, Mru and Bawm use this species for their treatment.

altitudes, up to 1300 m. The shrub requires tropical and subtropical climate; it is killed to the ground by brief periods of frosts but recovers quickly. The plant tolerates a wide range of precipitation.

Silvicultural characteristics: *Basak* is an evergreen perennial shrub. It is a fast growing species and it coppices well. It grows well in low moisture areas and dry soils. This species thrives where other vegetation fails, because it does not browse by goats or other grazing animals. It can be cultivated in gardens or as a hedge plant.

Phenological characters: The flowering and fruiting period occurred from January to March.

Regeneration: It can be grown from seeds or by cuttings. No pre-treatment is required before sowing seeds and it has the ability to compete with weeds. The plants have strong herbicidal action. It requires very little watering and needs to be singled out for propagation and planting on a large scale.

Chemical constituents: Leaves contain quinazoline alkaloids, vasicine (peganine), vasicinol, vasicoline, vasicolinine, anisotine and adhatodine. They also contain adhatodic acid, betaine, essential oil, fats, resins and vitamin C. Roots contain vasicine, vasicinol and an essential oil. Flowers contain vasicine, vasicinine, kaempferol, quercitin and β -sitosterol. Seeds contain fatty oil consisting of arachidic, behenic, lignoceric, cerotic, oleic and linoleic acids, and stosterol. Inflorescence contains alkaloids vasicinone.

Medicinal use: The plant is used in the treatment of jaundice, diabetic, arthritis, asthma, bronchitis, blood dysentery, cicatrix, cold, cough, diseases of eyes dyspnea, gingivitis, hemorrhage, hemorrhoids, inflammation, osteoarthritis, respiratory troubles, tuberculosis and vomiting. It is also used as disinfectant.

Other uses: The leaves are a source of vitamin C. The entire plant has been put to some use, either in parts or in its entirety. The plant is administered orally, locally, or inhaled in various bitter-tasting forms such as oils, alcohols, cigarettes (dried leaf is smoked as a cigarette), paste, or juice. They have a smell similar to strong tea. The wood of the stem is soft, and makes a great charcoal for gunpowder. The flower has large, attractive, white petals, streaked with purple on the lower lip. Some people use it as an herbicide. The leaves used for destroying termites, flies, mosquitoes and other noxious insects. The leaves are used in packing or storing immature fruits to speed



Mesua ferrea



Leaf of *Mesua ferrea*



Flowering of *Mesua ferrea*



Fruiting of *Mesua ferrea*



Dry seed of *Mesua ferrea*



Stem of *Mesua ferrea*

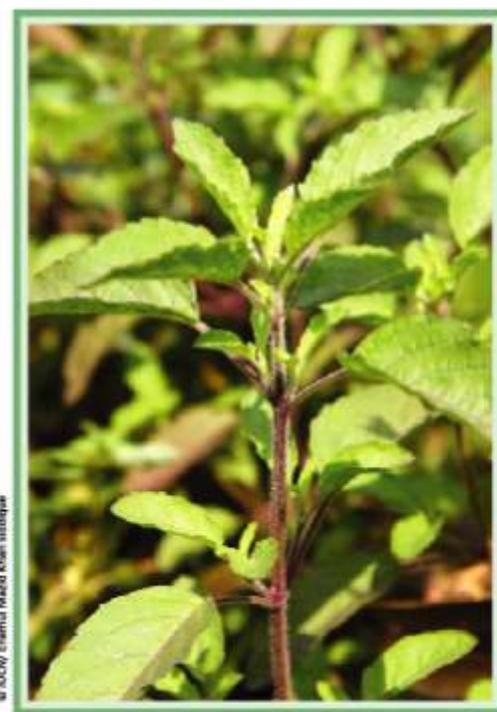
densely obcordate, 2.0-4.5 cm long, cuneate, margins curled and erose. Stamens numerous, forming a globose, yellow mass, 4-5 mm long, filaments very slender, filiform, anthers linear, 2.5-3.0 mm long, golden yellow. Ovary ovoid, 5-7 mm long, bilocular, ovules 2 in each locule, styles 5-6 mm long, often curved, stigmas small, peltate. Fruits are 2.5-3.5 x 3-4 cm, ovoid to globose with a conical point, 1-loculed, 1-4-seeded, pericarp tough, somewhat woody. Seeds are variously faceted, 2.5 mm long, pyriform, smooth, with a shiny, dark brown testa.

Distribution: It is native of Bangladesh, India, Nepal, Myanmar, Thailand, Vietnam, Cambodia, Indonesia and Malaysia. In Bangladesh, it occurs naturally in Chittagong, CHT (Kaptai), and Sylhet, rather rare in occurrence in natural forests. Also planted as ornamental trees in gardens, parks, Buddhist's temples and along roadsides.

Physiographic, edaphic and biotic requirements: The tree occurs on flat, generally undulating, or hilly ground, but not on low-lying badly drained land. It requires good drainage as well as a deep moist fertile soil: stiff clay is unsuitable. It is characteristically found in moist evergreen or semi-evergreen forest, either scattered or in more or less pure patches or belts of greater or less extent. It is associated with a large number of different species, many evergreen and some deciduous species. In its natural habitat the climate is moist, warm and equitable, the rainfall varying from 2,032 to 5,080 mm or more, the absolute maximum shade temperature from 35°C to 39°C, and the absolute minimum from 4°C to 15°C.

Silvicultural characteristics: The tree is a strong shade-bearer, particularly in youth. Frost is particularly unknown in the natural habitat of the tree, and in the sheltered position in which the young plants grow they are never exposed to the risk of frost. If planted outside its natural habitat in places subject to the risk of frost, it has been found to be very tender, and the same applies as regards to the drought. Fire does not ordinarily occur in the forest type it is found. In certain localities the trees are subject to the attacks of what is believed to be root fungus, which kills them off in groups. The coppicing ability of the tree appears to vary.

Phenological characters: The old leaves fall during the cold season, and the new flush of red or pink leaves appear towards the end of that season, usually from about the end of February. The large scented white flowers appear from the end of February to April or up to May or even June. The time of fruit ripening is also varies. It may happen from May to June or October to March or even August to October. The tree generally commences to produce fertile seed

*Ocimum tenuiflorum*

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reflexed and apiculate; the two lateral teeth broadly ovate and shortly awned, the two central teeth with long slender awns projecting beyond the upper lip and much curved upwards. Corolla 5, 0.5 cm long, white, often purplish, upper lip pubescent on the back. Stamens 4, exserted, filaments slender, the upper pair with a small bearded appendage at the base. Ovary 4-partite, style

slender, bifid. Nutlet 0.1 x 0.1 cm, subglobose, slightly compressed, nearly smooth, pale brown or reddish with small markings, maturing at different times, turns mucilaginous when wet.

Distribution: *O. tenuiflorum* is native throughout the old world tropics extending from Arabia to Malay Peninsula, China, India and Japan up to Pacific Islands and Australia. In Bangladesh, the species very commonly occurs all over the country under cultivated condition.

Physiographic, edaphic and biotic requirements: The natural habitat of *Tulsi* varies from sea level to an altitude of 2,000 m. It is found growing naturally in moist soil nearly all over the tropic. It grows well in the open spaces, such as, backyard, road sides etc. It prefers well drained soil and frost free area.

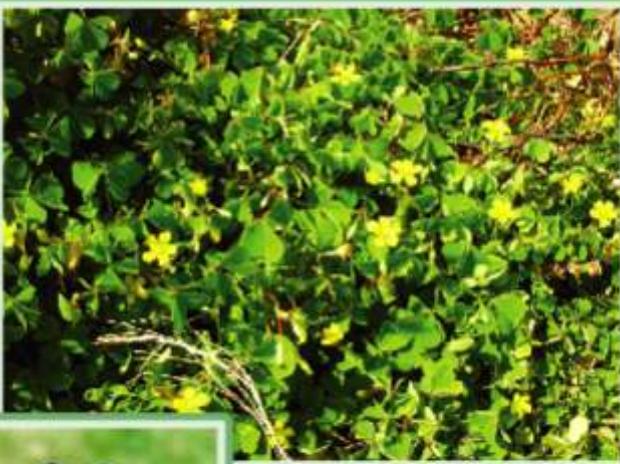
Silvicultural characteristics: It can grow as a perennial in warm climates, but it is considered an annual in climates with cold winter months. It prefers full sun, but will tolerate partial shade.

Phenological characters: The flowering and fruiting is done throughout the year and the best time for seed collection is July to August or November to December.

Regeneration: *O. tenuiflorum* is easy to grow from seeds. Under natural condition the seed itself fall from the plant and germinate naturally. The seed is easy to germinate and grow in the nursery. Sow the small seeds in early spring indoors or in the greenhouse for an early start, or sow seed directly in the spring or summer garden. Sow the seeds just under the surface of the soil and press in firmly. Keep the seed watered and warm until germination, which occurs within 2 to 3 weeks. It prefers full sun, rich soil, and plenty of water. Thin or transplant to 30-60 cm apart. *Tulsi* does well in pots or window boxes, and is traditionally grown for good luck near the front door of the house. The germination percentage is about 50-60. It contains 3 million seeds in one kg.

Chemical constituents: Leaves yield a bright yellow essential oil containing phenols, aldehyde, eugenol, carvacrol, methyl eugenol, cineol, linalool and caryophyllene. This plant also contains alkaloids, glycosides, flavonoids, triterpene saponins and citric, tartaric and malic acids. Seeds contain a fixed oil composed of palmitic, stearic, linolenic, linoleic and oleic acids.

Medicinal use: Leaves are expectorant, and used as domestic remedy for catarrh, coughs, bronchitis and diarrhoea. Juice of leaves is diaphoretic,



Oxalis corniculata

© Forest & Kim Sam

© Klaasen kentrik



Leaf of Oxalis corniculata



Flowering of Oxalis corniculata

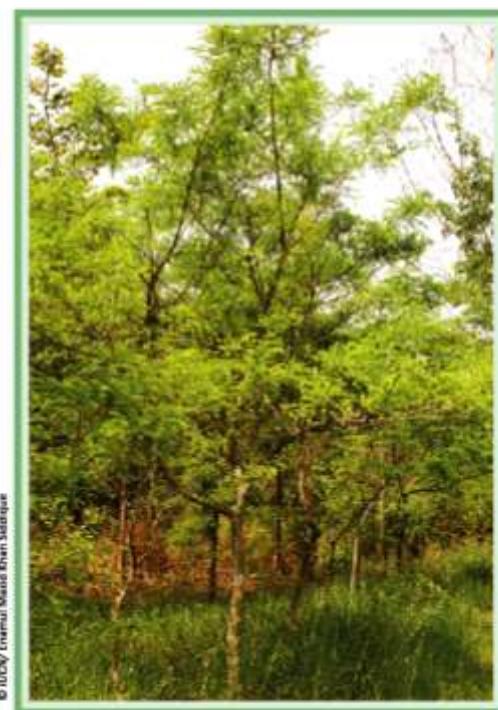
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Fruiting of Oxalis corniculata

© Knip

several, sub-opposite to whorled, ovate-lanceolate, puberulous. Sepals 5, 0.2-0.4 cm long, obtuse to acute, adpressed hairy without. Petals 5, 0.4-0.5 cm long, spatulate to oblanceolate, apex rounded to emarginate, yellow with lighter base. Stamens 10, in 2 whorls of 5 each, more or less glabrous, the longer outer 0.4 cm long, provided with teeth, the shorter, 0.3 cm long, anthers dorsifixed. Carpels 5, united, ovary 5-lobed, 5-celled; styles 5, 0.4 cm long, minutely ciliate, stigmas small, flattened, minutely papillose. Fruit a capsule, 1.5-2.0 x 0.2-0.4 cm, linear-oblong, 5-angled, shortly beaked, tomentose. Seeds 1.2-1.6 x 0.4-1.0 mm, numerous, brown, broadly ovoid, acute, transversely ribbed, aril ejaculatory, often remaining attached to the seed.



Phyllanthus emblica

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Fruiting of *Phyllanthus emblica*

© [?]



Dry fruit and seed of
Phyllanthus emblica

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Green foliage of *Phyllanthus emblica*

© IUCN/Enamul Masud Khan Siddique



Stem of *Phyllanthus emblica*

© IUCN/Enamul Masud Khan Siddique

Artificial regeneration: Seedlings have been raised successfully by sowing seeds in the nursery about March, watering regularly but sparingly and protecting the seedlings for the first few months from the sun and from heavy rain. If the beds are regularly weeded, the seedlings should be large enough to plant out in the first rainy season, but care is necessary not to expose the roots, as the seedlings are somewhat sensitive to transplanting. Best result will be obtained if the sowing is done at the commencement of the rainy season and subsequently weeding is done regularly. Tolerably well stocked lines can be ensured by thinning out congested seedlings during the first rainy season and using the surplus plants for filling up gaps. One kg seeds contain about 4,000-4,500 seeds.

For the production of tan-bark, which is probably the chief use to which the tree will be put in future, coppice is the system indicated, though the best rotation remains to be ascertained. The concentration of supplies of bark over a limited area can be secured only by artificial reproduction. The growth of young plants is fairly rapid, but subsequent growth appears to be somewhat slow.

Chemical constituents: Fruit is a rich natural source of vitamin C. It also contains tannins and colloidal substances, phyllemblic acid, lipids, gallic acid, ellagic acid, corilagin and emblicol. Phyllebin and mucic acid have been isolated from the fruit pulp. Seeds contain fixed oil, phosphatides tannins and essential oil. Bark, fruits and leaves are rich in tannin. Bark also contains leucodelphinidin.

Medicinal use: The plant is used in the treatment of anemia, anorexia, beriberi, biliary cirrhosis, burning urination, dehydration, diabetes, diarrhoea, dysentery, dyspepsia, excessive menstruation, fever, flatulence, gastric, gall pain, general weakness, hair fall, hemorrhoids, hyper acidity, hyper tension, impotence, insomnia, jaundice, leucorrhoea, nausea, nervous debility, oedema (dropsy), ophthalmia, paralysis, promotes children's resistance to cold and cough, pyaemia, respiratory troubles, scurvy, skin problems, tape worm infestation, tympanitis, ulcer and vomiting.

Other uses: Fruit is used as a source of vitamin C, which is eaten raw and used in making pickle. Wood red, hard, apt to split, durable under water, used for agricultural implements, well-construction, and inferior building and furniture. The barks, leaves and fruits are used for tanning, and the tree promises to become important as a yielder of tannin.

Polyalthia longifolia (Sonn.) Thw.

Family: Annonaceae

Synonym: *Unona longifolia* (Sonn.) Dunal. and *Uvaria longifolia* Sonn.

Bengali name: *Debdaru* and *Saralgachh*.

Vernacular name: *Dhamruchi* and *Dra pang* (Marma); *Indian fir* and *Mast tree* (English); *Debdaru* (Chakma) and *Nettilinkam* (Tamil).

General description: *P. longifolia* is a tall, handsome, evergreen to semi-deciduous tree with a pyramidal or conical crown. Young branches pilose, becoming glabrous. Leaves lanceolate, 21.5-30.0 x 3.7-5.6 cm, tapering to a fine point, margins undulate, glossy above, glabrous on both sides (juvenile leaves tomentose). Petiole 4-8 mm long, glabrous. Peduncle 3-11 mm long, axillary, pubescent, 6-many flowered, usually pendant. Pedicel 23-30 mm, pubescent. Bract minute, caducous, bracteole semi-amplexicaule, densely hairy. Sepals broadly deltoid, 2 x 2-3 mm, obtuse to subacute, pubescent on both sides. Petals narrow lanceolate, 10-19 x 2.5-3.5 mm, outer slightly smaller than the inner, tapering into a fine point, slightly undulate, pubescent on both sides, pale green to yellowish green. Receptacle convex. Stamens 1 mm long, anther subsessile, locules unequal, connective-tip subtruncate. Carpels free, 1.5 mm long, ovary glabrous except few hairs in the upper part, stigma subsessile, papillate. Fruit of 10-15 baccate monocarps on up to 37 mm long woody stalk. Mature mono-carp 20 mm long, ovoid, rounded at both ends, purplish black, 1-seeded, stipe 12 mm long, stout, glabrous.

Distribution: Native to India and Sri Lanka. It is introduced in gardens in many tropical countries around the world. In Bangladesh, it is planted as roadside tree, in parks and gardens throughout the country. They also found growing naturally in homestead gardens in some parts of the country.

Physiographic, edaphic and biotic requirements: The species grown in an altitude range of 0-1,200 m with a mean annual rainfall of 1,800 – 5,000 mm. Preferable soil texture is from medium to heavy, soil drainage is free but tolerates seasonally waterlogged conditions. Best thrives in neutral soil. It likes humid climate where it gives luxuriant growth, but tolerates drought to a fair extent.

Silvicultural characteristics: Seed storage is orthodox to intermediate, a light demanding species. It is a fast growing species and requires good exposure to sunlight and moderate watering.

Phenological characters: It is an evergreen species. Numerous yellowish-green flowers on long slender pedicels appear in February to May. Fruits appear in bunches and ripen from June to August and fall on the ground.

Regeneration: The seeds of *Polyalthia* do not keep their vitality for long, so that it is usually necessary to plant them as soon as they are ripe. On the other hand, the tree does not withstand transplanting well, so that to obtain the best results it is good to plant the seeds directly in the site where the tree is intended to grow, or with a little care they may be planted in baskets, and later on transplanted without injury to the delicate roots of the seedlings. Fruits are collected by lopping the branches or swept from the floor, heaped to rot and washed in water to take out the pulp. The seeds are dried in the shade. It contains around 595 seeds per kg and the germination percentage is about 60. It takes 7-10 days to germinate seeds under favorable condition and is completed in 2-3 weeks. In nursery, seeds are put in poly bags soon after collection. Beds are watered regularly. One year old seedlings are planted out.

Chemical constituents: Leaves contain an azafluorene alkaloid, polylongine, and three aporphine N-oxide alkaloids, (+)-O-methyl-bulbocapnine- β -N-oxide, (+)-O-methyl-bulbocapnine- β -N-oxide and (+)-N- methylnandigernine- β -N-oxide. Bark also contains alkaloids, tannins and resins.

Medicinal use: The plant is useful in the treatment of hysteria, influenza, oedema, respiratory troubles, inflammation, fever, skin disease, diabetes, hypertension and worm infestation. Bark is used as febrifuge.

Other uses: The leaves are good for ornamental decoration and used in festivals. The tree is a main attraction in gardens. The tree can be cut into various shapes and maintained in required sizes. In past, the flexible, straight and light-weight trunks were used in the making of masts for sailing ships. That is why, the tree is also known as the "Mast Tree". Wood is suitable for plywood, matches, packing cases, pencil boxes etc. Both the trunk and the bark are used in manufacturing of fiber.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from fever, itching, and intestinal worm. Different ethnic groups, such as, Chakma, Marma, Mru and Tripura use this species for their treatment.

Silvicultural characteristics: It is a light demander but can tolerate shade and susceptible to severe frost. It is a drought hardy species to certain extent. It can also tolerate high moisture for a short period. It has an excellent coppice producing ability. It can also produce root suckers readily and can withstand pollarding.

Phenological characters: The tree exhibits considerable variation in its phenological habits. It is evergreen in favorable conditions and completely leafless between March and May under adverse condition. Fresh leaves and flowers appear immediately after first rain. Flower appears from April to July. Pods appear from January to March. The tree starts flowering and setting pods from 4 to 7 years. The pods ripen from March to May of the following year. The seeds retain their viability for at least one year if carefully stored. The best collection time of seed is from March to May.

Natural regeneration: It regenerates profusely from seeds in nature under forest condition. The tree naturally coppicing well and sends out root suckers in natural conditions.

Artificial regeneration: The tree is easily raised from seeds or from cuttings. The seed may be sown in the nursery when it ripens in April or May, and the seedlings will be ready to transplant early in the rains of the next year. In dry places, the plants require to be watered regularly for a few years. For forest purposes direct sowing in suitable localities would probably prove more successful than transplanting. Seedlings of six months to one year old are outplanted in the main field. Seeds require no treatment before sowing. One kg seeds contain about 1,500-1,700 seeds.

Chemical constituents: Bark contains a hydroxychalcone, pongapinone. Root bark contains a large number of flavonoids, ponganones, four furoflabones, keranjin, pongapin, pinnatin and gamatin. Seeds contain a bitter fatty oil, crystalline substances, karanjin, pongamol, glabrin and pongapine and also traces of essential oil.

Medicinal use: Decoction of leaves is used as a bath in rheumatic pains. Bark is used in bleeding piles. Juice of roots is used in fistulous sores, cleaning foul ulcers and internally for gonorrhea. Seeds exert have hypotensive effects and produce uterine contractions. Powdered seed is used in bronchitis, whooping cough and as a febrifuge and tonic. Paste of seeds is applied to leprosy sores, skin diseases and painful rheumatic joints. Oil is successfully applied in rheumatism, scabies, herpes, leucoderma and other cutaneous diseases.

Other uses: An orange colored thick oil (*karanj oil*) obtained from seeds is used for soap-making, varnishing, cooking, in lamps and also as a bio-diesel. Leaves are good manure and flowers are eaten as vegetables. Wood is yellowish with very fine ripple marks. Wood is not considered as a quality timber. It is used for cabinet making, cart wheels, agricultural implements, and tool handles. Dried leaves are used as an insect repellent in stored grains. The oil cake is used in poultry feed.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this tree for several treatment purposes as, itching and indigestion. Different ethnic groups, such as, Chakma, Khumi, Marma, Mru and Tripura use this species for their treatment.

Santalum album L.

Family: Santalaceae

Synonym: *Santalum verum* L.

Bengali name: *Sheto chandon, Swet chandan and Sada chandan.*

Vernacular name: *Nahosha and Chandan* (Marma); *Shetchandan* (Chakma); *Sandal wood* (English); *Chandanam* (Telagu) and *Santhanam* and *Srigandam* (Tamil).

General description: A small evergreen glabrous tree to 15-18 m in height with slender drooping branchlets. Leaves opposite, sometimes alternate, occasionally ternate, ovate or ovate-lanceolate, 3-4 x 2-3 cm, apex acute or subacute, base acute, pale brown when dry, thin, and narrowed into a slender petiole 8-12 mm long, glaucous beneath, nerves faint. Bark reddish-brown to dark brown, smooth in young trees, rough and fissured in older trees. Inflorescence is terminal and lateral, paniculate racemes, much shorter than the leaves, pedicels opposite, about equaling the perianth-tube. Flowers are 4 mm in diameter, at first straw-colored, then blood-red, inodorous even when bruised. Perianth-tube is adnate to the base of the ovary, campanulate dark brown, smooth in young trees, rough and fissured in older trees. Inflorescence is terminal and lateral, paniculate racemes, much shorter than the leaves, pedicels opposite, about equaling the perianth-tube. Flowers are

grubbed up, observations as to their coppicing ability are not very extensive. Frost is unknown in the natural habitat of the sandal. It is sometimes killed by long-continued drought. It often suffers from bark scorching caused by isolation and possibly to some extent by wind. The tree is extremely sensitive to fire, and may be killed outright or badly injured and rendered unsound; when the stems are killed new shoots are frequently sent up from the base.

Phenological characters: The tree is a true evergreen species. A flush of new leaves appears during the early showers in May and after the monsoon in October. The flowering and fruiting seasons appear to vary. Flowering season lasts from February till April, and the fruits ripen in May and June. Most trees usually flower and fruit twice a year, however, some have been observed to flower once and others throughout the year. The fruit stones retain viability for some time if kept dry, but is apt to rot with damp. The seeds are very subject to the attacks of rats and squirrels, which destroy them in quantities. Birds readily eat the fruits and are important agents in disseminating the seeds, which they do not destroy. Flowering and fruiting often commence at an early age. Tree three or four years old have been noticed to flower, but it is not certain if they produce fertile seeds. Good seed years occur every year, with occasional exceptions. The seed collection time is from June to September and November to February.

Natural regeneration: Natural sandal seedlings are to be found mainly under bushes, hedgerows, and scrub, and not as a rule in the open. This is due not only to the fact that birds settle in such growth and drop the seeds, but also to the fact that the seedlings require protection, on the one hand from excessive drought and the heat of the sun, and on the other from browsing animals; this protection they receive under cover of bushes and hedgerows, particularly of thorny species. Seedlings perish in large numbers if exposed to excessive drought or to a hot sun. While on the other hand soil moisture, if not excessive, is an important factor, as may be seen from the manner in which sandal often reproduces itself along the banks of streams. In dry localities, seedlings which have not perished altogether have been observed to die back to ground-level for a year or two and eventually to establish themselves. Damping off of seedlings owing to an extensive amount of dense wet herbaceous undergrowth is in some situations a hindrance to reproduction. Natural seedlings suffer much in their earlier stages from the attacks of rats, while hares also seek them out readily; as the plants grow larger, deer, goats and cattle browse them eagerly if they are not protected by bushes. Outside its natural habitat the tree often shows a marked tendency to spread naturally by the agency of birds. In natural stands, under favourable

marasmus, navel-string infection, ophthalmia and respiratory troubles.

Other uses: *Sandal wood* oil is extensively used in the perfumery and cosmetics industries. Sapwood is white and scentless; heartwood is hard, very close-grained, oily, yellowish brown, strongly scented, used for carving and other fancy works, and largely distilled for fragrant oil. For distillation purposes the heartwood of the stem, branches and roots is used, every part of the tree which contains heartwood down to about 1 inches in diameter being used. Stem powder is used in skin care. Leaves are used for fodder and green manure. Fruits and kernels are also edible. Sandal wood is sacred to Hindu and Buddhist community and is used in most of their religious rituals.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, fever, itching (prickly heat), navel infection and vomiting. Different ethnic groups, such as, Chakma, Marma, Mru and Tripura use this species for their treatment.

***Saraca asoca* (Roxb.) de Wild.**

Family: Caesalpiniaceae

Synonym: *S. indica* Auct. non L. and *Jonesia asoca* Roxb.

Bengali name: Ashok, Asok, and Anganapriya.

Vernacular name: *Koin khrow* (Marma); *Ashoka* (English); *Pingal, Moma gach, Palleng moma, Rangg mogma* and *Faleng mogma* (Chakma); *Paichang* (Tripura); *Asogam* (Tamil) and *Asokamu* (Talegu).

General description: A small to medium-sized tree up to 15 m tall with spreading branches. Leaves 4-6 jugate, subsessile to shortly petioled, rachis 7-15 cm long, leaflets elliptic-oblong or elliptic-lanceolate, or glabrous, apex acuminate, base cuneate, obtuse or rounded, symmetric, rarely the lowest pair obscurely sub-cordate, midrib slightly elevated above, prominent beneath, nerves 5-9 pairs, subsessile to petiolate. Inflorescences umbellate cymes, 5-15 cm wide, glabrous, main branches up to 6 cm long, bracts broadly ovate, 1-6 x 1-4 mm, caducous or persistent, minutely ciliate on the margin, bracteoles persistent, erect, pedicels 8-18 mm long. Flowers

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Saraca asoca

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Leaf of *Saraca asoca*

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Flowering of *Saraca asoca*

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Fruiting with flower of
Saraca asoca

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Stem of *Saraca asoca*

(either single or mixture) from *Neem* (kernel, seeds & leaves), *Datura*, Cow's urine etc. Irrigation is needed in some cases. Normally grown as rainfed crop but for better yield supplementary irrigation may be applied as per requirement.

Chemical constituents: Bark contains haematoxylin, tannins, catechol, epicatechin, a crystalline galactoside, a ketosterol, a sponin, an organic calcium salt and a large number of minerals. It also contains a powerful oxytocic principle.

Medicinal use: Bark is strongly astringent and uterine sedative, and used especially in menorrhagia, in bleeding haemorrhoids and haemorrhagic dysentery. Bark also cures biliousness, dyspepsia, dysentery, colic, piles, ulcers and pimples. Leaves possess blood purifying property, and their juice, mixed with cumin, is used in stomachache. Flowers are useful in biliousness, syphilis and haemorrhagic dysentery and constitute an excellent uterine tonic. It also contains a powerful oxytocic principle.

Other uses: It is cultivated in many gardens because of its decorative orange red flowers and evergreen beautiful foliage. Wood is light reddish-brown, soft; heart wood is hard and dark-colored which is in some cases used for house building purposes in the northern part of Sri Lanka. The tree is sacred to both Hindus and Buddhists and is frequently grown as an ornamental, often near to Hindu temples.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from menstrual problem, diarrhoea and dysentery. Different ethnic groups, such as, Chakma, Bawm, Khumi, Marma, Mru and Tripura use this species for their treatment. Several Bengali people living in the area also use this species for their treatment.

also contain essential oil composed of sesquiterpene and phenolic compounds, xanthone, cassiolin (pinselin) and kaempferol. Roots contain quinine pigments.

Medicinal use: Leaves are used as purgative and antiparasitic. Paste of leaves is specific for ringworm; decoction of leaves is useful as a cure for herpes in venereal diseases, as an expectorant in bronchitis, astringent, wash for eczema and a mouth-wash in stomatitis. The paste is very effective and cures ringworm within 2-3 days. Extract of the aerial parts is also used as diuretic, anti-inflammatory and anti-tumour agent and as a general tonic.

Other uses: It is the food plant of some butterflies. The plant recruits ant bodyguards against the caterpillars. It has "extrafloral nectaries" near the base of the leaves that produce sweet nectar to attract ants. As a short-lived plant that grows commonly in wastelands which are damp and on flood plains, it helps to colonise these areas and pave the way for regeneration of growth. Often forms thickets and grown as ornamental.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from fever, intestinal worm and itching. Different ethnic groups, such as, Bowm, Chakma, Khumi, Marma and Mru use this species for their treatment.

Spondias pinnata (L. f.) Kurz

Family: Anacardiaceae

Synonym: *Spondias mangifera* Willd.; *S. acuminata* Roxb. and *Mangifera pinnata* L. f.

Bengali name: *Amrah*, *Deshi amrah*, *Piayala* and *Pial*.

Vernacular name: *Oahshoi*, *Osonshibang* (Marma) and *Amragach* (Chakma); *Hog plum* (English); *Totoi gera* (Tripura); *Ambi-thong* (Garo); *Pial*, *Piala*, *Thoura* (Magh); *Ambada* (Marathi) and *Ambalam* (Tamil).

General description: A medium-sized (may be tall and large in forests), glabrous, deciduous tree with a pleasant smell (from leaves and twigs). Bark grayish, smooth but often with horizontal wrinkles and vertical fissures; blaze

reddish-brown. Leaves imparipinnate, crowded at the ends of branchlets, 30-45 cm long; leaflets 9-13 pairs, elliptic oblong, 5-25 x 2.5-10 cm long, acuminate, entire, membranous, shining, more or less oblique, intra margin veins prominent, turning yellow before shedding. Flowers are polygamous, small, yellowish green, scented, in spreading terminal panicles. Fruit is a drupe, ovoid, greenish yellow when ripe, 4-5 cm long.

Distribution: It is distributed throughout the greater parts of India and Myanmar in deciduous and often in dry forests. In Bangladesh, this species grows wild in the forests of Chittagong, CHT, Cox's Bazar, Sylhet, Dhaka, Mymensingh and Dinajpur. Also found in village shrubberies and mango groves through out the country.

Physiographic, edaphic and biotic requirements: The *Spondias* species are best adapted to the hot, lowland tropics. They will grow in warm subtropical areas where no frost occurs, or which experience only occasional light frosts. The trees grow best in fertile, well-drained soils but can be grown satisfactorily in a variety of poorer soils if they are provided adequate nutrition. In its natural habitat the absolute maximum shade temperature from 38°C to 48°C, and the absolute minimum from -1°C to 16°C, and the normal rainfall varying from 762 to 3,810 mm or more.

Silvicultural characteristics: The tree is a decided light-demanding. It is sensitive to frost, and suffered much in the abnormal frost. It coppices, but is not known to produce root-suckers.

Phenological characters: The tree remains leafless for a long period in winter and spring season. The leaves fall in November to December, sometimes even earlier, and the tree remains leafless until April to May or even later. The inflorescences of whitish flowers cover the leafless trees about March to April, and at that time the trees are a conspicuous sight. The fruits form during the rains and commence to ripen in December, continuing to ripen and fall until February or March. The fruits are greedily eaten by deer, pigs, monkeys, squirrels and other animals, and the large bare stones with flesh removed may be found scattered around the forest from the time the fruit ripens onwards. The best seed collection time is from February to April.

Natural regeneration: The fruit-stones, from which the fleshy covering has usually been stripped by animals, lie on the ground from the time the fruits fall in the cold season until the rains, when germination takes place. If the

stones are lying on the surface of the ground at the time of germination the radicle is very apt to dry up or to become eaten by birds or insects before reaches the soil. Many stones, however, become covered with earth and debris during the months in which they lie on the ground, and particularly during the early showers preceding the monsoon rains: this promotes successful germination, which is still further ensured by the fact that many fruits do not germinate until the second rains, and thus have every opportunity of becoming covered with earth during the long period in which they lie on the ground. For the establishment of natural regeneration, abundance light is necessary.

Artificial regeneration: The tree can be propagated from cuttings or from seed. In the later case direct sowings give better results than transplanting, provided the fruit-stones are covered with earth. Nursery-raised seedlings should be transplanted when about 8 cm high during the first rains, but considerable care is necessary to retain earth round the roots and to avoid exposing them. More success is attained by transplanting seedlings raised in baskets. One kg seed contains about 100-130 seeds.

Chemical constituents: Aerial parts contain 24-methylene cycloartenone, stigmasterone, β -sitosterol, its glycoside and lignoceric acid. Fruits contain water soluble polysaccharides, triterpenes, β -amyrin and oleanolic acid, amino acids, glycine, cystine, serine, alanine and leucine.

Medicinal use: Fruit is antiscorbutic and astringent, and used in bilious dyspepsia. Leaves are aromatic, acidic and astringent; juice is used in earache. Bark is astringent and useful in dysentery, diarrhoea and vomiting. Paste of bark is used in rheumatism. Decoction of bark and wood is used in gonorrhoea and leucorrhoea. Gum is demulcent. It is also used in the treatment of anemia, asthma, hyper acidity and scurvy.

Other uses: Fruit is acidic and edible. Wood is whitish, very soft and light and used for making packing cases. Barking deer is fond of its fruits.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this tree for several treatment purposes as, diarrhoea, dysentery, rheumatic pain and vomiting. Different ethnic groups, such as, Chakma, Khumi, Marma, Mru and Bawm use this species for their treatment.

Physiographic, edaphic and biotic requirements: The *Java apple* is extra-tropical, growing only at the lower altitudes up to 1,220 m. The soil must be fertile, or the crops will be small and the fruit quality poor. The trees prefer heavy soils and easy access to water instead of having to search for water in light deep soils. It needs adequate rainfall, some humidity and fertile soil for best growth. Can be container grown to a certain extent.

Silvicultural characteristics: The species is too cold sensitive. In drier areas trees should be protected from dry winds and needs regular irrigation. Growth and development of the trees need to be observed more closely to gain a better insight into the growth rhythm, including the timing and intensity of bloom, and quantitative aspects of yield. In so doing the basis is also laid for selection of superior types.

Phenological characters: *S. samarangense* is an evergreen species. The tree blooms in March and April and the fruit ripens in May and June. The *Java apple* is a heavy bearer on good soil. When it is 5 years old it may yield a crop of 700 fruits.

Regeneration: The trees grow spontaneously from seed. Preferred types are reproduced by layering, budding onto their own rootstocks. Shoot growth proceeds in flushes which are more or less synchronous, depending on the climate. The juvenile period lasts for 3-7 years. Bearing of clonal trees starts after 3-5 years. If planted in orchards, the trees are spaced 8-10 m apart and are given a minimum of attention. Propagation from seed is common. Seeds are sometimes abortive, and some wax jambus tend to be seedless. Seeds lose their viability quickly and should be sown fresh from the fruit. Clonal propagation through air layers, cuttings or budding is not difficult. Air layering is commonly employed in South-East Asia. The trees receive little attention after the first year or two when manuring, weeding, mulching and watering ensure rapid increase of tree volume. Trees which bear well benefit from compound fertilizers applied after harvest and supplemented with a top dressing as soon as the inflorescences are being formed. There appears to be no experience with pruning or thinning.

Chemical constituents: The principal constituent is tannin. They also contain desmethoxymatteucinol, 5-O-methyl-4-desmethoxymatteucinol, oleanic acid and β -sitosterol.

Medicinal use: Various parts of the tree are used in traditional medicine, and some have in fact been shown to possess antibiotic activity. The flowers are astringent and used to treat fever and to halt diarrhoea. They show weak antibiotic action against *staphylococcus aureus*, *mycobacterium smegmatis*, and *candida albicans*.

Other uses: The greenish fruits are eaten raw with salt or may be cooked as a sauce. They are also stewed with true apples. The pink fruits are juicier and more flavorful and suitable for eating out-of-hand or cooking without accompaniments, except sugar. The wood is red, coarse, and hard; used for constructing huts in the Andaman and Nicobar Islands.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, fever, diarrhoea, dysentery and headache. Different ethnic groups, such as, Chakma, khumi, Marma, Mru and Tripura use this species for their treatment.

Tamarindus indica L.

Family: Caesalpiniaceae

Bengali name: *Tentul*.

Vernacular name: *Kiamong*, *Jee pru bang*, *Jifru bang*, *Manggebang*, *Manga sifang*, *Mohoi sipang* and *Molyee pang* (Marma); *Tentul gach* (Chakma); *Arang katra* (Tripura); *Tamarind* (English); *Chinch* (Marathi); *Puli* (Tamil) and *Chinta* (Telugu).

General description: A large usually evergreen tree attaining a height of 15-22 m and a girth of 80 cm or more, with a spreading rounded crown. Young branchlets are pubescent, glabrescent. Leaves pinnately compound, spiral, 10-20 jugate, petiole and rachis 5-14 cm long, slightly pubescent, glabrescent, leaflets sessile or sub-sessile, opposite or sub-opposite, narrowly oblong, 8-30 x 3-10 mm, unequal, rounded slightly mucronate at the apex, rounded at the base, glabrous or slightly puberulous, stipules minute, free caduceus. Inflorescences terminal and lateral racemes, up to 20 cm long, the rachis puberulous, loosely flowered, bracts and bracteoles ovate-oblong, 5 x 3 mm,

caduceus, pedicles up to 14 mm long, puberulous. Hypanthium is narrowly turbinate, 4-5 mm long. Sepals 4, reddish outside, yellow inside, zygomorphic, imbricate, oblong-elliptic, 8-12 x 5 mm, slightly puberulous at the base. Petals 5, yellow or cream with red veins, very zygomorphic, upper 3 well-developed, lower 2 reduced, elliptic or obovate-elliptic, 10-13 x 2-6 mm. Stamens less than 10, up to 15 mm long, filaments connate for about half their length into a pubescent tube, anthers oblong, longitudinally dehiscent, stamiondes 4 or 5, tooth-like, alternating with the fertile ones. Ovary stipitate, linear, 7 mm long, pubescent, 8-14 ovuled, style elongate, 7 mm long, pubescent, stigma subcapitate. Pods are indehiscent, oblong, slightly curved or straight, 5-15 x 2-3 cm, scurfy, with acid pulpy part, up to 10-seeded. Seeds are obovate-obicular, 11-17 x 10-12 mm, compressed, glossy, dark brown, non arillate, and exaluminous.

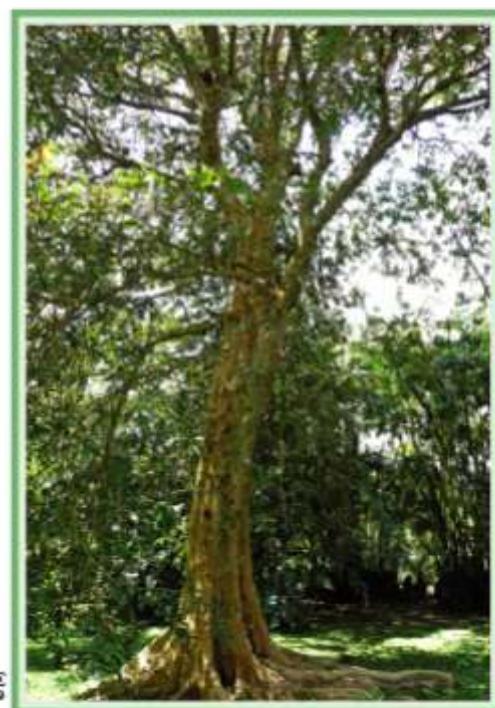
Distribution: This is said to be native of Tropical Africa. It is also found in Bangladesh, India, Sri Lanka, Pakistan, Myanmar, Kampuchea, Thailand and Malaysia. In Bangladesh, it is found throughout the country, particularly in villages and roadsides for shades.

Physiographic, edaphic and biotic requirements: It is adapted to a wide range of climatic and soil conditions but prefers well drained alluvial soil for better performance. It is drought and wind tolerant. It is also tolerant to aerosol salt spray. It requires long, well marked dry weather for fruiting. It is generally considered not very compatible with other plants because of its dense shade and allelopathic effects.

Silvicultural characteristics: The tree is not exacting as regards to soil, though it thrives best on deep alluvium. It is sensitive to frost. The tree produces root suckers. Owing to the fact that under its shade the ground is usually bare it is one of the most suitable trees for planting along fire-lines. Germination is epigeous. The radicle emerges from one end of the seed and descends rapidly. Its growth is somewhat slow.

Phenological characters: The tree is never leafless except in very dry localities, where it sometimes leafless for a short time in hot season. The new leaves appear in March to April. The small yellow and red variegated flowers appear from April to June (also in October) and the pods ripen from February to April.

Regeneration: The tree is not difficult to propagate, whether by direct sowing along ploughed or hoed lines or by transplanting. In either case regular



© (c) *Terminalia arjuna*



© (c) *Fruiting of Terminalia arjuna*



© IUCN/M.A. Muntasir *Dry fruit of Terminalia arjuna*



© IUCN/M.A. Muntasir *Seedling of Terminalia arjuna*



© IUCN/Emanul Maazul Khan Siddique *Stem of Terminalia arjuna*

Silvicultural characteristics: The tree is capable of standing in the shade. It has a more or less superficial root-system, and relies for its moisture chiefly on the stream flow. It is some-what tender to frost as well as to drought but cannot tolerate the abnormal drought. The tree produces root-suckers and pollards well. It coppices well up to a girth of about 75 cm, after which the coppicing power is indifferent. The seedlings are somewhat sensitive to frost, and are decidedly sensitive to drought, both in the germination stages and the subsequently stages. They grow well in full sunlight provided the ground contains adequate soil moisture; they also stand moderate shade, but not dense overhead shade.

Phenological characters: The tree is evergreen or nearly so, the new foliage appear in the spring. The panicle spikes of small white flowers appear from April to July and the fruits ripen the following February to May. The tree flowers and fruits at an early age, e.g. six years old trees flowered and fruited abundantly.

Natural regeneration: Under natural conditions germination take place early in the rainy season, may actually commence with the early showers before the monsoon. The seed does not germinate readily if exposed to the sun, and even if the germination begins the radicle is very susceptible to dry up. If the fruits become partially buried by rain or any other means, the germination is much more successful, while the success is greater on bare soil with a considerable amount of moisture; these conditions ordinarily obtain on alluvial ground along streams. A certain degree of shade, particularly from the side, assists the establishment of the seedling, but heavy shade is inimical. In the forest, seedlings are often to be found in large quantities where the fruits have been accumulated by the action of streams in loose alluvial soil and conditions for germination have been favorable.

Artificial regeneration: The plants bear can be transplanted well during the first rainy season before the taproot becomes too long. The fruits should be sown in the nursery about April to May, covered lightly, and watered regularly. Irrigated weeded line sowings have been found successful. Seedling growth is stimulated by regular watering and loosening of the soil. The ripe seeds can be collected from the mother tree from March to April. One kg seed contains about 300-500 seeds. The germination percentage is about 60-70% and it takes 10-15 days to germinate. In normal temperature, it can be stored with good viability for at least 4-5 months after drying in the sun. Seedlings of 8-9 months age are ready for transplanting. The spacing must be 2 x 2 meters.

Chemical constituents: Bark contains tannins, calcium salts of tannins, alkaloidal and glycosidal substances, arjunine, arjunglycoside, arjunin, sapogenin, arjungenin, flavone, arjunolone, methylated flavone, arjunone, terpene acids, arjunic, arjunolic and terminoic acids, phenolic substances, ellagic acid, sitosterol and oxalic acid. It also contains a lactone, arjunetin, essential oil, reducing sugars and (+)-leucodelphinidin.

Medicinal use: The species has been widely used in Ayurvedic medicine for the treatment of cancer, dermatological and gynaecological complaints, heart diseases and urinary disorders. The powdered bark relives hypertension, has a diuretic and general tonic effect in case of liver cirrhosis. Barks also acts as a cardiac tonic, astringent and febrifuge, and is used in the treatment of red and swollen mouth, tongue and gums. It stops bleeding and pus formation in the gums, and is useful in asthma, diabetes, dysentery, menstrual problems, pains, leucorrhoea, wounds and skin eruptions.

Other uses: The bark is much valued for tanning and dying. The tannin is used in leather industries. Heart wood is dark brown, very hard and heavy and used for construction of buildings, carts, boats and as beam supports in mines. It is also used in making agricultural implements.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, dysentery, fever, headache, indigestion, sexual problems, skin diseases, stomach pain and vomiting. Different ethnic groups, such as, Chakma, Chak, Tripura, Marma, Mru and Bawm use this species for their treatment.

***Terminalia bellirica* (Gaertn.) Roxb.**

Family: Combretaceae

Synonym: *Myrobalanus bellirica* Gaertn.

Bengali name: *Bohera, Bahera and Bayra.*

Vernacular name: *Ang gara ani, Bohera, Chadcingti and Kasingsi* (Marma); *Bara sara, Bohera and Bora gulo* (Chakma); *Belleric myrobalan* and *Bastard myrobalan* (English); *Dedaowang* (Tripura); *Goting bherda* (Marathi); *Tani* (Tamil) and *Tandi* (Telugu).

General description: A large, deciduous tree with tall trunk, 10-20 m high, buttressed at the base and long horizontal branches; young shoots and inflorescence rusty pubescent. Bark is thick, ashy-grey, brownish or blackish with vertical cracks or fine fissures; inner bark light yellow, turning brown. Leaves are papyraceous to coriaceous, spirally arrange along the branchlets or crowded at the ends of the branchlets, sometimes whorled, broadly obovate-elliptic to obovate-oblong, sometimes narrowly oblanceolate, 6-16 (-23) x 5-10.5 (-14.5) cm, apex rounded or obtuse, or sometimes shortly acuminate, base rounded, obtuse or cuneate, often unequal at the base, margin entire, veins usually 6-8 pairs, rather widely spaced; rufous-sericeous when very young, soon becoming glabrous or almost glabrous; petiole 3-9 cm long, at first pubescent, soon glabrescent, generally long in relation to the lamina, glands inconspicuous, usually present mid-way down the petiole. Flowers are greenish-yellow, bud subglobose, sessile. Calyx is 4-5 x 4-5 mm, shortly rusty pubescent outside, densely rusty villous at the base inside, lobes recurved, deltoid. Stamens are 3.0-3.5 mm, glabrous, anther 0.8 mm long. Ovary is ellipsoid, 1.5-5.0 mm long. Fruit a drupe, 2-3 x 1.5-2.5 cm, subglobose to broadly ellipsoid, very hard when dry, slightly longitudinally ridged, densely velvety pubescent. Seed is 1.2 x 0.5 cm, ellipsoid rough.

Distribution: It is native of Bangladesh, India, Pakistan and Myanmar. Also found in Bhutan, Sri Lanka, Thailand, Indo-china, Indonesia, Malaysia and Australia. In Bangladesh, it occurs in the hill forests of Chittagong, Cox's Bazar, CHT and Sylhet, usually growing in dry areas and in the Sal forests of Dhaka, Mymensingh, Dinajpur and Comilla. It often cultivated in village groves.

Physiographic, edaphic and biotic requirements: This is a common associate of Sal, Teak and other important trees occurring more or less



Terminalia bellirica

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Flowering of *Terminalia bellirica*

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Dry fruit of *Terminalia bellirica*

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Young foliage of *Terminalia bellirica*

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Stem of *Terminalia bellirica*

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scattered and not gregariously. It has been raised successfully in comparatively dry soil and in the valleys. In its natural habitat the absolute maximum shade temperature varies from 36°C to 46°C, the absolute minimum from -1°C to 15°C, and the normal rainfall from 1016 to 3048 mm or more.

Silvicultural characteristics: The tree is a light-demanding, though it can stand slight shade during youth. It is decidedly sensitive to frost; the leaves are usually found to be touched by frost more readily than those of almost any of its associates. As regards to drought it is somewhat more hardy, though it does not occur in very dry localities. It coppices fairly well. The germinative power of the seed is better than that of most species of this genus. Germination is hypogeous, and the cotyledons and the remnants of the putamen remain in or on the ground. The growth of seedling during the first season is moderate, a height of about 13 to 20 cm being ordinarily attained.

Phenological characters: The tree is deciduous; the leaves commence falling in December and by February the trees are usually leafless. The new leaves start appearing from March to April; Flowering takes place from March to May and fruiting from November to following January. The fruit ripens from January to February. The favorable seed collection time is from January to February.

Natural regeneration: The consumption of the fleshy portion of the fruit and the dissemination of the hard nuts by animals has already been alluded to. Where the flesh is not so consumed it rots off or is eaten off by white ants, the nuts often being wholly or partially buried in the process. Germination takes place at different times during rainy season. Successful germination is greatly assisted if the nuts are buried by rain, by white ants, or otherwise, since the redicle of the germinating seedling is liable to be eaten by birds and insects or to dry up if exposed to the sun. A considerable degree of moisture is necessary to stimulate germination. The high germinative power of sound seed and the comparative ease with which the seedling establishes itself would indicate that the tree should be more gregarious than it is. There can be little doubt that, its sporadic character is due to the fact that the seed is so much subject to the attacks of animals and insects that a comparatively small proportion reaches the germinating stage.

Artificial regeneration: The seeds have to be sown during the month of March and April. Before sowing, the seeds have to be pretreated by dipping in water for 48 hours then dried in the sun and then again dipped in water.

The germination percentage is about 80-90 and it takes 10-12 days to germinate. Before starting the monsoon (or during June-July) the seedling or stump or seed has to be sown directly. It gives good result if the transplanting seedlings age is about one year. Transplanting may be carried out either after pruning the stem and roots or with stem and roots intact; the later gives better results, the former checking the growth considerably. One kg seeds contain about 200-250 seeds.

Chemical constituents: Fruits contain tannins composed of gallotannic and ellagitannic acids phyllemblin, β -sitosterol, mannitol, sugars, hydrocarbons, tetratriacontane, ditriacontanol, tritriacontanone, a hexahydroxy diphenic acid ester, resins and a greenish yellow oil containing palmitic, stearic, oleic and linoleic acids. Heartwood, bark and fruits contain ellagic acid; bark also contains substantial amount of oxalic acid. Seed coat contains gallic acid.

Medicinal use: The plant is used in the treatment of anal fissure, anorexia, cardiac weakness, constipation, cough, dehydration, diarrhoea, dysmenorrhoea, dyspepsia, fever (high), foot mud sore, general weakness, heat stroke, hepatomegaly, hyper acidity (gastritis), hyper tension, impotence, jaundice (haemolytic), lipoma (tumour) malaria, nervous debility, oedema (dropsy), rheumatism, sight weakness, spermatorrhoea, stomachache and vomiting.

Other uses: The fruit is the source of tannin, dye and ink. The kernel of seed is edible but has narcotic effect. It produces oil. Leaf is used as insecticide during the storing and packing of different fruits. The wood is used for making packing boxes, dugouts, boats and agricultural implements.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, cough, dysentery, food poisoning, rheumatic pain and teeth pain. Different ethnic groups, such as, Chakma, Chak, Tripura, Marma, Mru, Murang and Bawm use this species for their treatment. Several Bengali community of the Bolipara also uses this plant as medicine.

***Terminalia chebula* Retz.**

Family: Combretaceae

Synonym: *Terminalia tokentella* Kurz

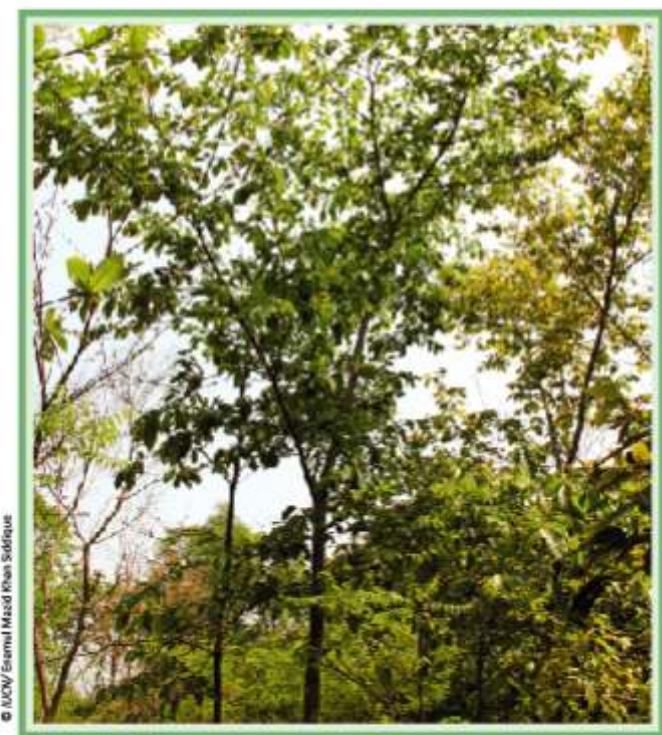
Bengali name: Horitoki, Gol haritokil and Halaghach.

Vernacular name: *Tara thaba* and *Horitoki* (Marma); *Hattel*, *Hottel* and *Horttal* (Chakma); *Kaho* (Magh); *Artak* (Garo); *Chebulic myrabalan*, *Black myrabalan*, *Ink nut* and *Gall nut* (English); *Kadakai* (Tamil) and *Karakka* (Telugu).

General description: A medium-sized to large tree up to 30 m in height, with a dbh of 130 cm, deciduous tree. Bark dark brown, longitudinally cracked, exfoliating in woody scale; inner bark is reddish brown with a thin yellow layer near cambium. Leaves coriaceous opposite or sub-opposite, broadly oblong or oblong-elliptic, 6-15 x 3.3-10.0 cm, apex shortly acuminate or acute, base rounded or cuneate or slightly cordate, usually unequal, margin entire, lateral nerves 6-12 pairs; silky when young, becoming glabrescent; petiole 1-3 cm long, glabrous or sparsely pubescent with a pair of nodular glands near the base. Inflorescence of axillary or terminal panicles, usually with 3-6 undivided spikes; spikes 3-6 cm long, rachis pubescent or downy, scent offensive, bracts solitary, subulate, linear, acute, pubescent, 5-6 mm long, caduceus. Flowers are dull-white to yellowish, small 2 mm long, all hermaphrodites, subtended by subulate downy bracts. Calyx tube bowl-shaped, 3.0- 3.5 mm long, glabrous outside, hairy or villous within, calyx-lobes 5, short, hairy, broadly triangular. Stamens 10, alternately 3-4 mm long, anthers small, oval. Ovary inferior, oval or ovoid, glabrous; style rather shorter than stamens, 2.5-5 mm long, glabrous, stigma acute; disc lobed, densely villous. Fruit a drupe, ovoid from a cuneate base, 2.5-5.0 cm long, more or less 5 angled, yellowish green when ripe. Seed (stone) obscurely angled, rough, bony.

Distribution: It is a native tree of Bangladesh, India, Nepal, China, Vietnam, Pakistan and Myanmar. In Bangladesh, the species occurs sporadically in the forests of Chittagong, CHT, Sylhet, Dhaka, Mymensingh and also planted as avenue tree.

Physiographic, edaphic and biotic requirements: It has been raised successfully in the forests of comparatively dry types, in higher areas and in



Terminalia chebula

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Leaf of *Terminalia chebula*



Dry fruit of *Terminalia chebula*



Stem of *Terminalia chebula*

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areas where the rainfall is light. In Myanmar, it occurs in deciduous forests both of the upper and of the lower mixed types, along with *Teak*, *Terminalia tomentosa* and their associates. It is found on a variety of geological formations, on clayey as well as on sandy soil. In its natural habitat the absolute maximum shade temperature varies from 37°C to 48°C, the absolute minimum from -1°C to 15°C, and the normal rainfall from 762 to 3,302 mm.

Silvicultural characteristics: The tree is a light-demanding, though in youth it stands slight shade and even benefits by side protection from the sun. It is fairly hardy against frost as well as drought. It withstands fire well, and has good power of recovery from burning. It coppices fairly well. Germination is epigeous with poor germinative power of the seed.

Phenological characters: The tree is deciduous; and in some localities the leaves commence falling in November, and by February or March the trees are usually leafless. The new leaves appear from March to May; they are light green or sometimes copper colored. The spikes of greenish white flowers appear with the new leaves. The usual flowering takes place in April to May. The fruits ripen from November to March and fall soon after ripening. The best favorable seed collection time is from January to February.

Natural regeneration: The fallen fruits often become partially buried by rain, the soil round them being blackened with the tannin they contain. The fleshy portion becomes partly eaten by white ants or disintegrates, leaving the hard nut exposed. Germination takes place in the rainy season, sometimes not until the end of that season, or in some cases not until the following year. The seed germinates better if it has become covered with earth or debris than if it is lying in the open.

Artificial regeneration: The most successful method of raising seedlings in the nursery is to dry the fruits thoroughly, removing the hardened fleshy covering, and sowing the fruit-stones in boxes before rainy season, covering them with earth and watering them regularly. For artificial regeneration the fruits must be collected from the ground as soon as they fall, and not off the tree. After drying the seeds can be stored for one year. The seeds may be sown in the nursery bed or polybag in the month of March to April. Before sowing, the seeds have to be pretreated by dipping in to water for 24 hours then dried in the sun and then again dipped in water. The germination percentage is about 60 and it takes 10-20 days to germinate. Before starting the monsoon the seedlings can be transplanted. It gives good result if the transplanting seedlings age is about one year. One kg seed contains about 150-160 seeds.

Chemical constituents: Tannins, steroid triterpenoids, flavonoids, glycosides, resins, proteins, amino acids, reducing sugars and minerals are present in the plant. Fruits, the principal drug, contain tannins, chebulinic acid, chebulin, chebulic acid, luteolic acid and other organic acids and sugars. Bark and leaves contain β -sitosterol, tannins, d-catechol, gallic and ellagic acids. Nuts also contain tannins and chebulagic, chebulinic and gallic acids and gorilagin. An anthraquinone-like purgative principle also occurs in the fruits.

Medicinal use: Fruits are given internally in the treatment of indigestion, constipation, dysentery, jaundice, piles and painful menstruation, and as a general tonic. Externally they are used to treat eye discharges. Unripe fruit is purgative and ripe ones astringent and used also in fevers, coughs, asthma, flatulence, hiccup, colic, enlarged spleen and liver, rheumatism and urinary diseases. Powdered fruit is useful in carious teeth, bleeding and ulceration of gums. Bark acts as a cardio tonic and diuretic.

Other uses: The fruit is the source of tannin, dye and ink. Fruits taste bitter, astringent when first chewed, afterwards if water is taken, it tastes very sweet. Wood is greenish yellow, hard and heavy and takes a good polish. The wood is used for making houses, furniture, tool handles, agricultural implements etc. Wood extracts contain tannin that are used to produce ink.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this for several treatment purposes as, cough, dysentery, fever, food poisoning, jaundice, menstrual problems, rheumatic pain and sore. Different ethnic groups, such as, Chakma, Tripura, Marma, Mru and Bawm use this species for their treatment. Several Bengali community of the Bolipara also uses this plant as medicine.

Vitex negundo L.

Family: Verbenaceae

Synonym: *V. paniculata* Lam. and *V. spicata* Lour.

Bengali name: *Nishinda*, *Samalu*, *Nishinde* and *Nirgundi*.

Vernacular name: *Tong joi sobai*, *Chonbagpata*, *Chang ma in*, *Choaitang pain*, *Choyonmain* and *Thoai bai gach* (Marma); *Chaste tree* (English); *Nirbandha gach* and *Nirganda* (Chakma) and *Nirgandha* (Tonchonga).

General description: A large shrub or small evergreen to semi-evergreen tree, up to 8 m tall, young branches densely, white tomentose. Leaves strongly aromatic, decussate-opposite, leaflets 3-5 (rarely 1), subequal, membranous or chartaceous, narrowly oblong or elliptic to lanceolate or ovate-lanceolate, apex acute or subacute, base acute or short-acuminate, margins entire to sinuate or irregular dentate, minutely pubescent or glabrous above, densely whitish tomentose beneath, petioles slender, 2.5-6 cm long, densely puberulent. Inflorescence terminal, pedunculate, paniculate cymes or thyrses, 15-20 x 3-7 cm, peduncles 5-7 cm long, acutely tetragonal or flattened, densely short-pubescent or puberulent, flowers fragrant. Calyx obconical cyathiform, 1.5-2.0 x 1.5-2.0 cm, densely puberulent, 5-nerved, rims very shortly 5-dentate, occasionally cuspidate, the upper ones ovate, the lower ones lanceolate. Corolla hypocrateriform, blue or pale-blue to lavender, pink, or sometimes white the tube infundibular, 3-4 mm long puberulent outside, the upper lip 2-lobed, the lower 3-lobed with the middle lobe larger, obovate. Fruit globose, black when ripe, with a 3 or 4 celled central stone.

Distribution: *V. negundo* is found in Pakistan, India, Sri Lanka, Nepal, Myanmar, Thailand, China, Indonesia and Malaysia. In Bangladesh, it occurs in the forests of Chittagong (Bhariadhal) and other forest areas, usually growing in moist places, usually by the side of streams. Also found in coastal areas in sandy sea beaches; planted throughout the country as live fences. Also occurs naturally throughout the country in village shrubberies, usually growing by the side of ditches and in other moist places.

Physiographic, edaphic and biotic requirements: It grows in clay or sandy soils but prefers a loose, well-drained moist but not wet, alkaline soil for better growth performance. It is widely planted as a hedge plant along road



Vitex negundo



Young leaf of *Vitex negundo*



Flowering of *Vitex negundo*



Stem of *Vitex negundo*

sides and between fields. Found throughout the greater part of India, often occurring gregariously. It can grow at the altitudes of 0-2000 m and mean annual rainfall ranges from 600-2,000 mm.

Silvicultural characteristics: It often suffers from shoot dieback in organic rich or other soil types, which is too wet. Its tolerance to hot weather is good and to aerosol salt is moderate. It grows well in full sun and light shade. It grows along roadsides, coastal dunes, scrub forests, village thickets and edge of forests.

Phenological characters: It is an evergreen to sub-deciduous species. It can be found flowering and fruiting throughout the year. The seeds ripen in mid October.

Regeneration: Propagation is generally by stem cuttings that are planted in nursery beds or polythene containers and transplanted after two months. Cuttings can also be planted directly. The seeds can germinate at room temperature after one month of cold treatment.

Regularly pruning to the ground level in early spring can support the luxuriant growth in the manner of a herbaceous perennial. It grows moderately to fairly fast and can be managed by coppicing with a rotation of 2 years. Seeds are recalcitrant and lose viability in about 3 weeks.

Chemical constituents: Leaves contain a pale greenish yellow essential oil, an alkaloid, nishindine, α-glucoside, p-hydroxybenzoic acid, ascorbic acid, carotene, hentricontane, sterols, β-sitosterol, β-sitosterol acetate and stigmasterol, and amino acids. Stem bark contains flavonoid glycosides of wogonin, aurosin, vitexin, myrecetin, also leucodelphinidin, luecocyandin rhamnoside, β-sitosterol, luteolin, vanillic acid and p-hydroxybenzoic acid.

Medicinal use: Leaves are antiparasitic and used as alterative, vermiguge and anodyne. They very effectively reduce inflammatory swellings of joints in rheumatic attacks, relieve catarrh and headache. Juice of fresh leaves removes foetid discharges and worms from ulcers. Flowers are astringent and cooling, oil form flowers are applied to sinuses and scrofulous sores. Fruits are nervine stimulant, emmenagogue and vermifuge. Root is tonic, febrifuge, expectorant and diuretic.

Other uses: Its roots are strong and deep and produce suckers profusely. It can be used as a contour hedge in sandy arid areas for soil retention and moisture conservation that are useful for reducing soil erosion. It has been

found suitable for shelterbelts and windbreaks and also used as a live fence. The shrub can be used for afforestation, especially for reclamation of forestlands which are affected by floods, and in arid areas. Some forms are ornamental. In Bangladesh, the dried leaves are put in bags of lentil and other food grains during storage and said to be a good insect repellent. Twigs are used for making baskets. Wood is used as a fuel wood and light construction. The ash of wood is used to make color.

Traditional use by the herbal healer of Bolipara: Local herbal healers use this species to cure from ear infection, hair loss, intestinal worm, menstrual problems and rheumatic pain. Different ethnic groups, such as, Bawm, Chak, Chakma, Khumi, Marma and Mru use this species for their treatment. Several Bengali people living in the area also use for their treatment.

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