

# Monograph on *Duabanga grandiflora* (Roxb. ex DC.) Walp.

Prepared by:

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LAMPATE

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**University of North Bengal**

Raja Rammohunpur – 734013  
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4<sup>th</sup> March, 2022

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**INTRODUCTION:**

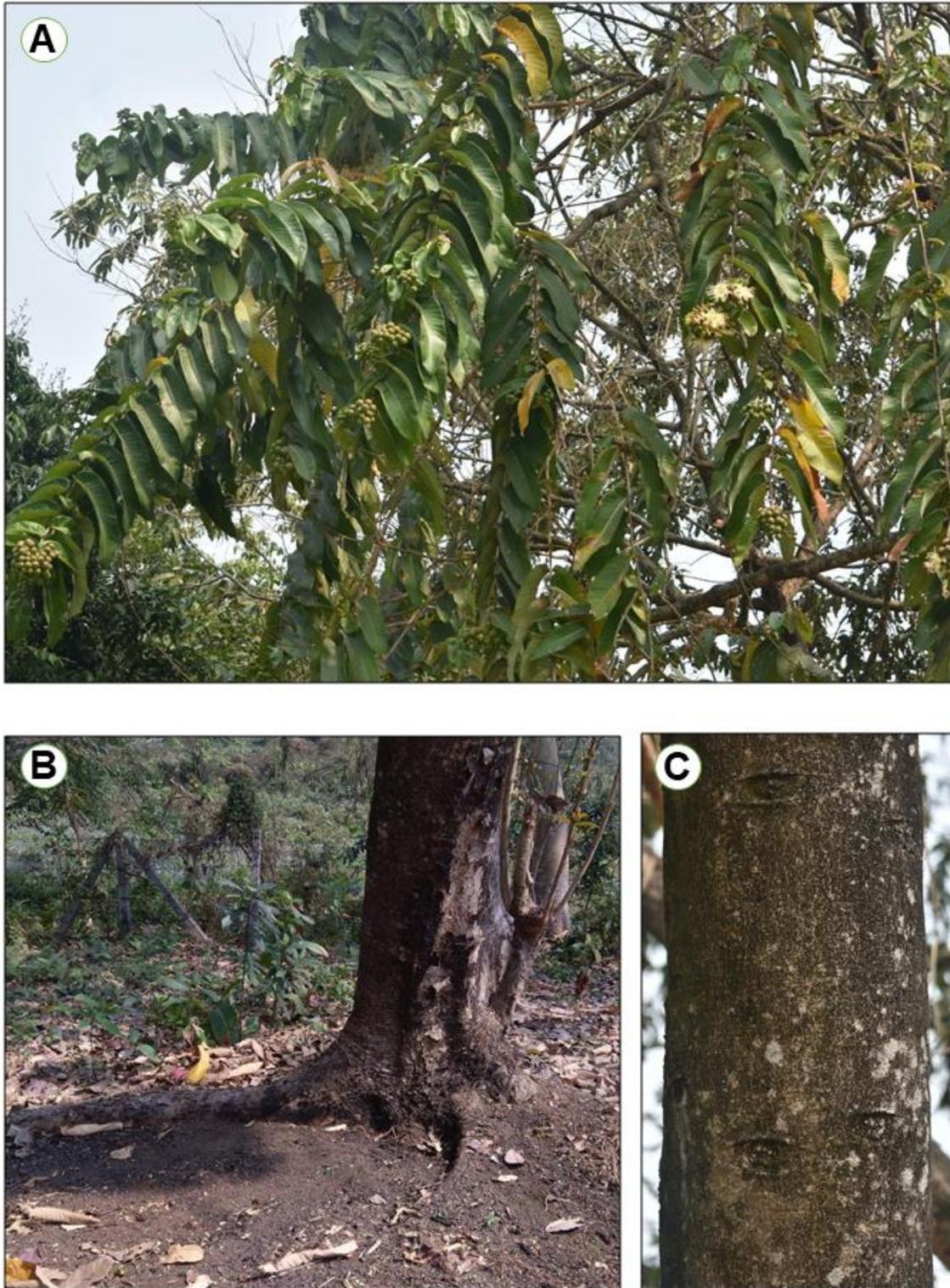
*Duabanga grandiflora* (Roxb. ex DC.) Walp. is a huge, fast growing gigantic evergreen forested tree with drooping branches belong to the family Lythraceae J.St.-Hil. and its native range of origin is extended from Tropical forests of Himalayas to Assam, Manipur, China, Bangladesh, Burma and Peninsula Malaysia. This species was earlier placed under the family Sonneratiaceae. It occurs mainly in subtropical forests along the bank of streams and on the sides of moist ravines, springing up on landslips and other places where the soil has been exposed, always on well-drained ground, at an altitude upto 1200 m (Fig. 1). It is essentially a tree of moist warm climates. The Genus *Duabanga* Buch.-Ham. Having two accepted species and one Notho or hybrid taxa i.e., *Duabanga grandiflora* (Roxb. ex DC.) Walp. *Duabanga moluccana* Blume and *Duabanga* × *taylorii* Jayaw. respectively (POWO, 2021). *Duabanga grandiflora* (Roxb. ex DC.) Walp. is only species that are found in various tropical subtropical to sub-temperate forest along the Himalaya. *Duabanga moluccana* Blume and *Duabanga* × *taylorii* Jayaw. are found in tropical forests of SE Asian countries and E. Jawa extending to New Guinea, Caroline Islands (Palau). Initially William Roxburgh publish this species as *Lagerstroemia grandiflora* Roxb. in the book of Hortus Bengalensis, or a Catalogue of the Plants Growing in the East India Company's Botanical Garden at Calcutta. Serampore Hort. Bengal (38; Fl. Ind. ii. 503.1814). Francis Hamilton and Francis Buchanan the famous plant taxonomist also publish the species *Duabanga sonneratioides* Buch.-Ham. In the journal of Transactions of the Linnean Society of London in 17 volume part 2 of page number 177 in the year of 1835. Latter on Wilhelm Gerhard Walpers merge both species as *Duabanga grandiflora* (Roxb. ex DC.) Walp. Published in Repertorium Botanices Systematicae (Walpers) in volume 2 of page number 114 in the year of 1843. Presently *Duabanga grandiflora* (Roxb. ex DC.) Walp. is an accepted name along with valid synonyms.

The tree is nicely grown in subtropical and tropical climate and can also well adopted in moist localities of terai, duars and hilly slopes of Himalaya (Fig. 2). *Duabanga grandiflora* (Roxb. ex DC.) Walp. is the handsome tree with beautiful

pendulum branches and mostly growing along the along the bank or sides of streams, rivers, hill slopes i.e., basically it is a riverine forest component. The elaborate root network help them to survive in loose sandy slops and treat as very good soil binder. Their rooting network helps to resist soil erosion and landslides in hilly areas. It is essentially a component of the moist warm climates and they can grow in temperature varies from 4 to 45 °C with average rainfall from 500 to 3000 mm. The species is nicely growing in moist sandy soil upto 1200 m of Himalaya. It is also introduced in various counties of Africa and Asia due to their wood, canopy and as very soil binder species. It is widely distributed throughout Mainland Southeast Asia for their excellent uses in the making of tea-boxes and as fast growing useful softwood this tree (Troup, 1921).



**Fig. 1:** *Duabanga grandiflora*, tree canopy at Tista river valley, Mahananda WLS.



**Fig. 2:** *Duabanga grandiflora*. A. flowering branches; B. Tree trunk with elaborate root butress; C. Stem bark.

## SCIENTIFIC CLASSIFICATION (APG IV, 2016)

Kingdom: Plantae

Clade: Tracheophytes

Clade: Angiosperms

Clade: Mesangiospermae

Clade: Eudicots

Clade: Rosids

Orders: Myrtales

Family: Lythraceae

Genus: *Duabanga*

Species: *D. grandiflora*

(Roxb. ex DC.) Walp.

## TAXONOMY

*Synonyms*: (02 Accepted; POWO, 2022)

*Duabanga sonneratioides* Buch.-Ham.

*Lagerstroemia grandiflora* Roxb. ex DC.

**COMMON NAMES:** Lampate (*Nepali*), Bondorphulla (*Bengali*); Thora, Khukan (*Assamese*); Zuang. (*Mizo*); Tal. (*Manipuri*); Duyabangga. (*Tripuri*); Magas, Tagahas (*Malaysian*); Phay (*Vietnamese & Laos*); Phay, Linkwai (*Thailand*); Myaukngo (*Myanmar*); Kalam (*Indonesia*); Dlom chloeu ter (*Cambodia*); Loktob (*Philippines*); Duabanga (*Papua New Guinea*).

**DISTRIBUTION:**

The native range of distribution of *Duabanga grandiflora* (Roxb. ex DC.) Walp. is reported as native species from the Tropical to the sub-temperate forests of Himalaya of Eastern India and distributed to China, Myanmar, Nepal, Bhutan, Cambodia, Vietnam, Bangladesh, Laos, Malaysia, Thailand of South and South East Asia upto 1200m altitude of Himalaya (Fig. 3). In China it grown in S Yunnan province at an altitude of 900-1500 m. (e-flora, 2022).

In Flora of Bhutan, D. G. Long and S. J. Rae reported this species from districts like Samchi, Phuntsholing, Sarbhang, Gaylegphug, Deothang, Tongsa, Mongar Thashigang of Bhutan Himalaya and Tista and Rangit valley of Darjeeling and Sikkim Himalaya. The species is well adopted, growing nicely in sub-tropical and tropical forest of terai and hilly slopes of Himalaya, and available between the 50-1200 meter of altitudes. This species is also introduced in various tropical and subtropical forests in different Asian and Australian countries for its good quality woods and fast growing trees. It was introduced as popular fast growing trees in various islands of south East Asian countries.

Indian territories especially eastern and North Eastern parts (Sub-Himalaya West Bengal, Sikkim, Manipur, Tripura, Assam,) are the native range of *Duabanga grandiflora* (Roxb. ex DC.) Walp. Apart from this, it is commonly planted and naturally grown in tropical and sub-tropical climates of Bihar and Uttar Pradesh of Eastern and Northern India. It is also planted in similar forest in Gujrat of western India and Maharashtra of Southern India and Andaman Island.

**BIOPHYSICAL LIMITS:** *Duabanga grandiflora* (Roxb. ex DC.) Walp. is easily grown in sub-tropical, tropical and sub-temperate climate with mean temperature 15-45°C with mean Mean annual rainfall 500-3000 mm. It is grown in undulating sandy soils of Terai, duars and hilly slops at an altitude upto 1200 m in Himalayas. For the better growth this species prefers well-drained, deep, fertile soils with humus, bhabar soil with small sand, humus and bolder of terai and duars for their luxurious growth.



**Fig. 3:** Distribution map of *Duabanga grandiflora* (Roxb. ex DC.) Walp. (Green=Native Range) [www.powo.org]

### **HABITATS:**

In the Himalayan and sub-Himalayan tract of India (North Bengal, Manipur,) *Duabanga grandiflora* (Roxb. ex DC.) Walp. is found mostly in moist tropical forest areas and also planted in similar forest of forests of Gujarat and Uttar Pradesh, The species is also quite commonly planted and growing in the Andaman islands. *Duabanga grandiflora* (Roxb. ex DC.) Walp. is native to Himalaya of Eastern India and distributed to China, Myanmar, Nepal, Bhutan, Cambodia, Vietnam, Bangladesh, Laos, Malaysia, Thailand.

In India, the climate of the natural habitat comprises rainfall from 500–3000 mm per year and temperatures range from about 4–45°C and can tolerate some frosts.

The population of *Duabanga grandiflora* (Roxb. ex DC.) Walp. is found significant component along the slopes of River Tista and their rivulets in the districts of Darjeeling of West Bengal and Sikkim in Subtropical, Tropical and sub-temperate

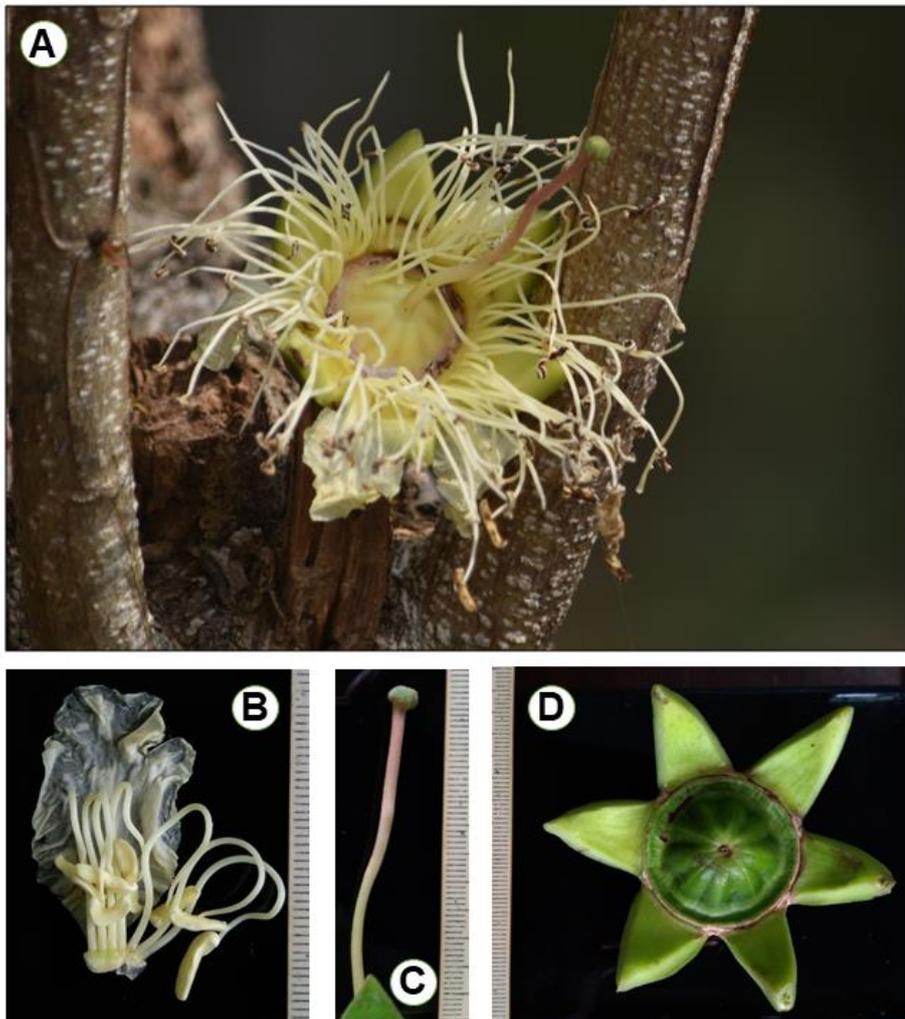
climates. The rivers or streams side or banks of district Kalimpong and Jalpaiguri are also having good population of *Duabanga grandiflora* (Roxb. ex DC.) Walp. The in frequent population of the species are observe in various moist forests of terai and duars of North Bengal. *Duabanga grandiflora* (Roxb. ex DC.) Walp. is common in valley forests, open places, especially on river banks at an elevations of 900 - 1,500 meters of Himalaya. Often found in disturbed moist areas, at elevations up to 1,200 metres, more frequent in hilly areas on the moist valley slopes (Hoang Van Sam et al, 2004)

## TAXONOMIC DESCRIPTION:

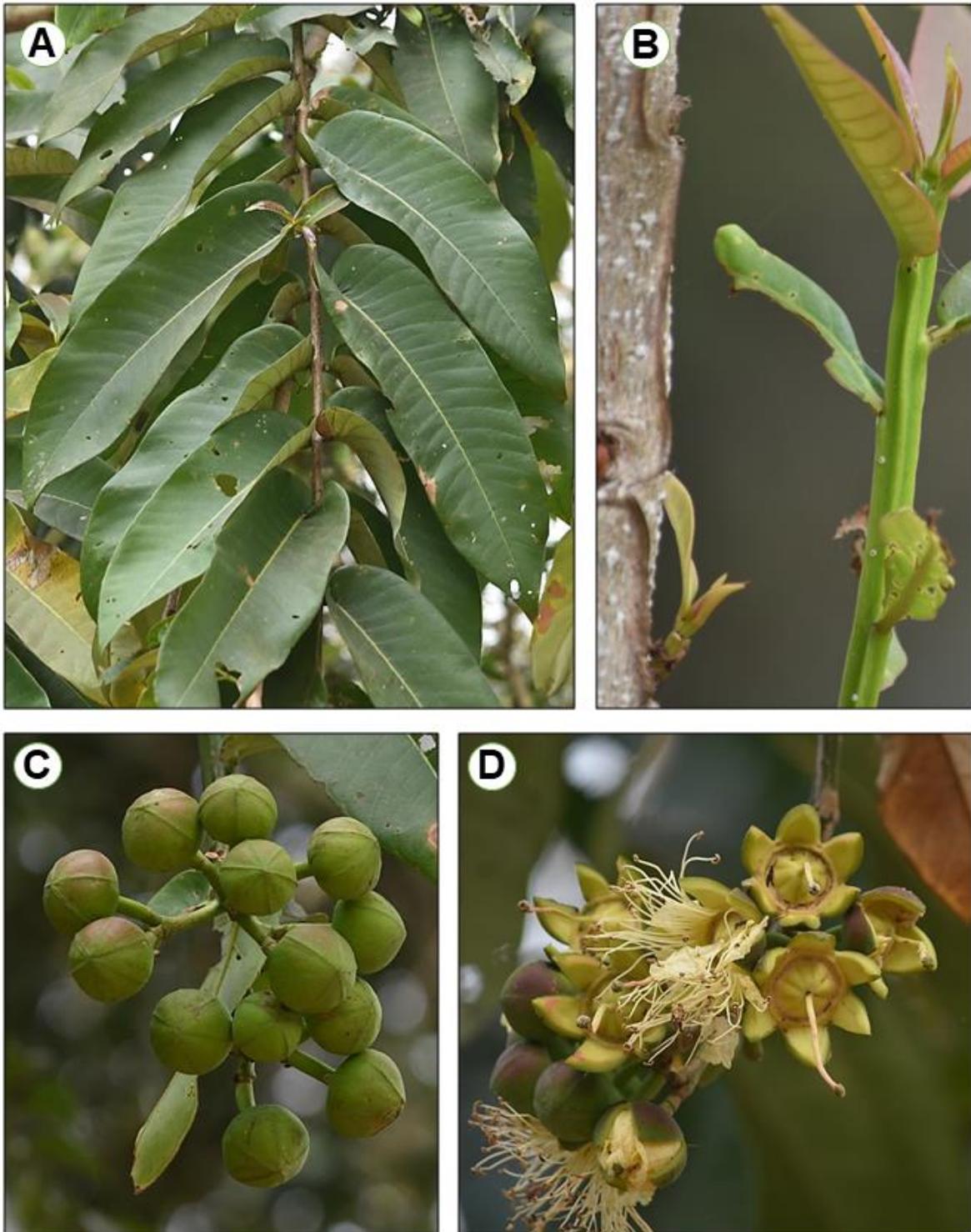
### Macroscopic Characters: (Fig. 4, 5)

**Habit:** Evergreen, large sized, grows upto 45 m high, Young trees with long horizontal side branches, in older trees becoming steeply ascending with drooping tips. **Stem:** Main trunk 30-40 m tall, mostly straight, girth ranges 1.9 -2.3 md.b.h. for mature trees; bark 3-5 mm thick, whitish grey, creepy yellowish beneath, smooth, exfoliating in large flakes at base, fibrous; canopy mostly round, spreading, large, loose; sap-wood white -yellow. Twigs glabrescent, inconspicuously lenticellate with small lenticels. **Root** buttresses of present, root network quite elaborate, nice soil binder; **Bark:** Pale Grey, not cracked, irregularly flaking in older trees. **Stem:** Erect, quadrangular, the corner winged by the decurrent leaf bases, glabrous, green with a pink tinge in first season; internodes in first season 0.1-0.5 in. long; **Leaves:** Leaves borne in one plane, decussate, simple, entire, pinnately veined, exstipulate, alternate on main stem, opposite on side branches, sub-sessile or with petioles up to 2.5 cm. long, exstipulate, first two or three leaves often small and abortive. Normal leaves 26-28 x 8-10 cm, oblong lanceolate, acute or acuminate, base elongated or decurrent down petiole and stem, entire, glabrous, dark green with petiole and decurrent wings often pink. Stalks about, 0.2 – 0.7 cm. **Inflorescence:** inflorescence raceme or cymose. Flowers large, in terminal corymbose cymes, or 2-3 fascicles on top of branchlets, opening at night, **Flowers:** Flower 5 – 7.5 cm, white, in heavy branched clusters at the end of twigs margins shortly ciliate; pedicle prominent, 2-2.5 cm long. Calyx with funnel-shaped tubular base adnate to base of ovary, lobes thick, star shaped at open,

sepals 5, 2.3-2.5 cm. Petals 4-8 free, inserted at the mouth of the corolla, showy, crumpled, usually with crisped margins, 3.4-3.6 cm. Stamens numerous, free, inserted on the 10 calyx tube, inflexed in bud; anthers versatile, 8-11 mm long. Carpels 2-6, ovary superior, 4-8 celled, style simple, elongate, curved, stigma capitate, ovules numerous, axile. Fruit: a leathery capsule, valve 6-8, or indehiscent berry, fruit 2.7 – 4.5 cm, broadly ovate with large star-shaped calyx at base, splitting into 5 sections. Seeds: seeds many, minute, endosperm absent. Embryo large, usually straight with flat cotyledons.



**Fig. 4:** *Duabanga grandiflora*. A, whole; B, petal with associated stamens; C, a stigma; D, fruit with persistent calyx.



**Fig. 5:** *Duabanga grandiflora*. A. leaves; B. winged juvenile branch; C. flowering buds; D. flowers and persistent calyces.

**Floral Formula:**  $O_{\text{♀}} K_{4-8} C_{4-8} \underline{A_{8-16}} \underline{G}_{(2-6)}$

**Microscopic Characters (Fig. 6):**

**Leaf:** Young and matured both types of leaflets are used for this study. Leaflets look like glabrous with the naked eyes. Both glandular and non-glandular trichomes are present on the abaxial surface of this plant. Two types of non-glandular trichomes are found; branched, multicellular type and unbranched, curved trichomes (80 – 115  $\mu\text{m}$  length). Non-glandular trichomes are very rare in occurrence. Glandular trichomes are capitate type and observed on the abaxial surface.

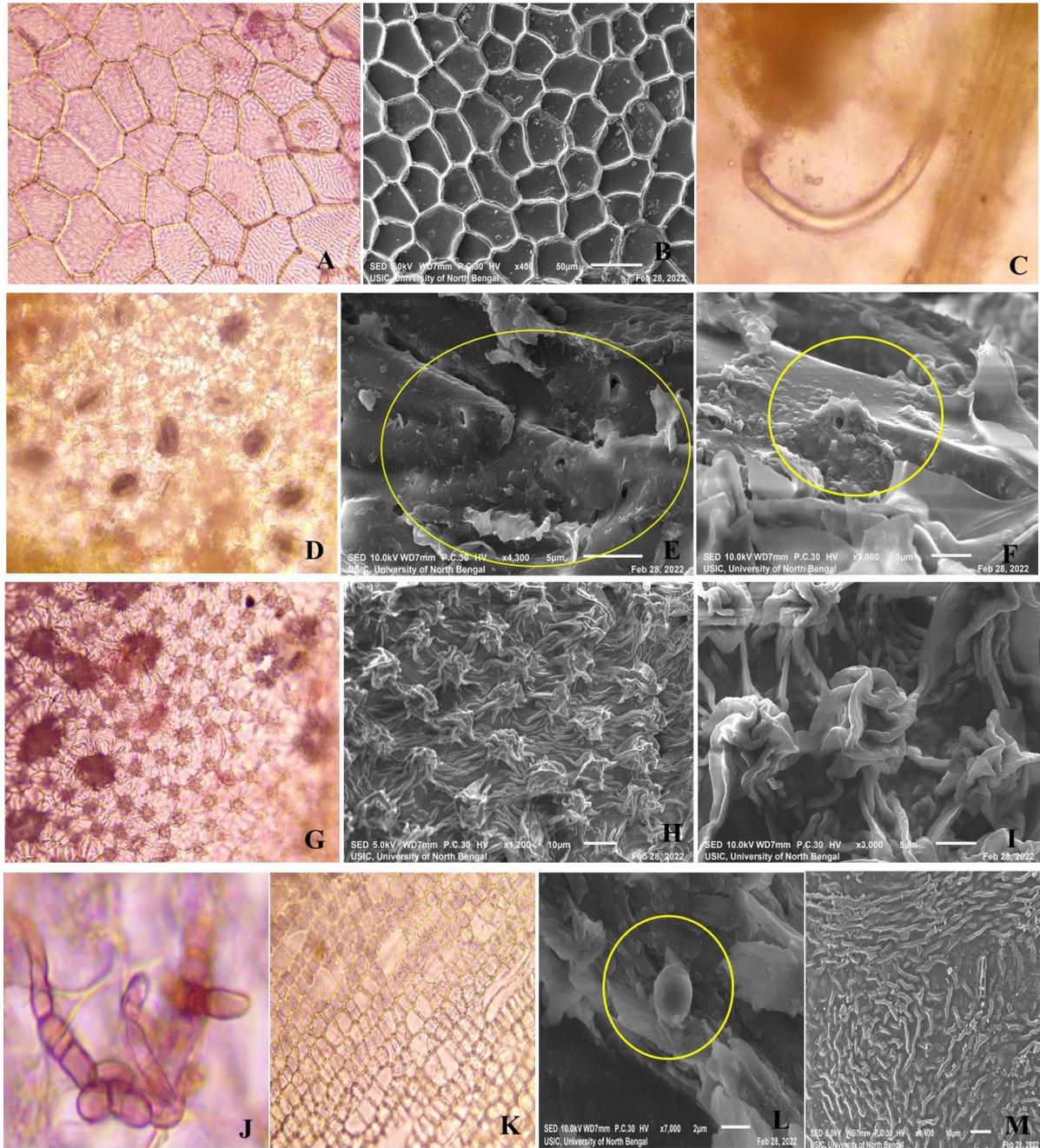
Leaflets are hypostomatic. Stomata are anomocytic type. Stomatal pore size is  $1.16 \pm 0.55 \mu\text{m}^2$ , Guard cell kidney shaped, length  $4.38 \pm 0.48 \mu\text{m}$ , Breadth  $3.38 \pm 0.46 \mu\text{m}$ .

Epidermal cells are polygonal, straight pattern in both surfaces. During LM and SEM study, a large number of papillate structure was found in both surfaces.

Cuticle deposition was uneven, striated type throughout the adaxial surface.

**Petiole:** Petiole is glabrous. Cells are rectangular shaped, anticlinal wall rounded.

**Branchlets:** Terete, glabrous.



**Fig. 6:** LM & SEM images of *Duabanga grandiflora* (Roxb. ex DC.) Walp. leaf, petiole. A. & B. Epidermal cell pattern, C. Non-glandular, unbranched, curved trichome of abaxial surface, D. & E. Anomocytic stomata, F. Enlarge view of Stomata embedded in cuticle layer, G. & H. Papillae in adaxial surface, I. Enlarge view of papillae, J. Non-glandular, branched trichome, K. Cells of petiole, L. Glandular, capitate trichome of abaxial surface, K. Striated cuticle in adaxial surface.

**Anatomical Features:**

Fresh plant parts like winged stem, mature roots and leaf petioles of *Duabanga grandiflora* were dissected, double stained and mounted on slides. The prepared slides were studied under trinocular microscope and necessary photograph taken. The anatomical features were described in detailed below (Fig. 7).

**Root Anatomy:**

**Epidermis:** It is the outermost single layer with several unicellular root hairs. It consists of thin walled, compactly arranged living parenchymatous cells. **Cortex:** It is thin walled, multi layered region made from parenchymatous cells. they usually have intercellular spaces. The cortex is porous. **Endodermis:** It is the innermost layer of cortex and covers the stele. It composed of barrel shaped parenchymatous cells. **Vascular bundles:** Several vascular bundle arranged in ring. Xylem and phloem bundles are separated from each other by parenchymatous cells. Xylem is exarch i.e. protoxylem towards the periphery and metaxylem towards the centre. **Pith:** In the middle portion of root pith is located. It consists of thin walled, polygonal parenchyma cells with intercellular spaces.

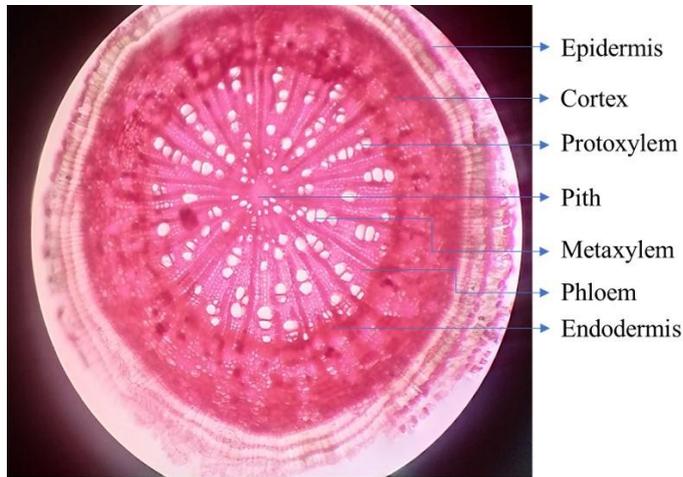
**Stem Anatomy:**

**Epidermis:** Epidermis is the outermost and two to three layer. Epidermis is without intercellular space, cuticle is present in the outer surface of epidermis. **Cortex:** This zone lies just beneath the hypodermis. The cells of this zone are parenchymatous and multi-layered and porous. **Endodermis:** This zone lies beneath the cortex and is made up of a single layer of barrel-shaped cells. It is the innermost layer of the cortex. **Leaf trace:** There is one leaf trace present bellow the endodermis. **Pericycle:** It lies Just below the endodermis. **Medullary rays:** It lies in between the vascular bundles and is made up of parenchymatous cells that constitute medullary rays. **Vascular bundles:** The vascular bundles are present. It is made up of xylem, phloem, and cambium. **Pith:** The pith holds the large central part of the stem.

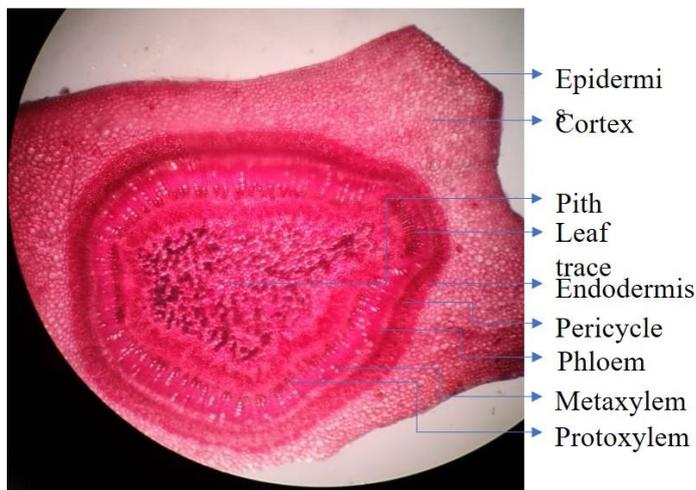
**Leaf petiole Anatomy:**

**Epidermis:** It is single layered cuticularised. Stomata may be present in it. **Hypodermis:** It is usually 3-4 layered, made up of collenchymatous cells. **Vascular Bundles:** The bundles are arranged in a semi-circular manner and are of different

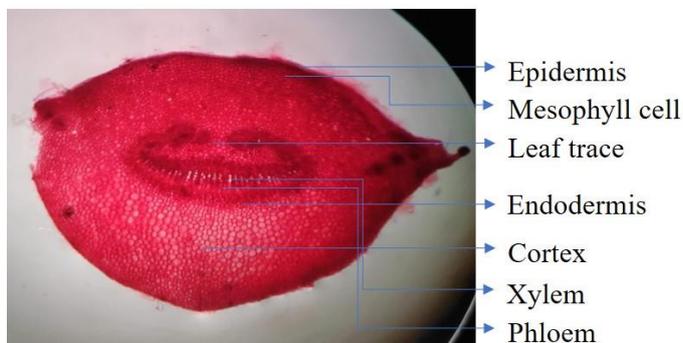
sizes in the same petiole. Each bundle is made up of xylem, phloem. There is a great variation in the distribution of the vascular tissues within the petiole.



T.S of *Duabanga grandiflora* root



T.S of *Duabanga grandiflora* stem



T.S of *Duabanga grandiflora* petiol

Fig. 7: Anatomical Study

**FLOWERING AND FRUITING:**

*Duabanga grandiflora* is a evergreen tree with drooping branches. The species remain sterile with dense healthy leaves throughout the year. Fertile stage observed with the flowering that starts blooming from first week of January in pendulous dense terminal or axillary cymose. The trees are in full bloom with huge green dense canopy till the month of February to May. From April to May each branches bears dry clusters of fruits and fruits dehiscing through slits and filiform small seed are dispersed.

**SPECIMENS EXAMINED:** North Bengal Terai and Duars are good habitat for the growth of *Duabanga grandiflora* and habitat extended to the hilly slops of Himalaya of Darjeeling and Kalimpong upto 1200 m along the river valley. For details study about the species out of several trees of *Duabanga grandiflora* five mature individual were studied, among them four from lower hill slops of Darjeeling and Kalimpong Himalaya (Sevok Range of Mahananda Wildlife Sanctuary) and one individuals from University of North Bengal campus in Medicinal plant garden were considered. Details of sample coordinates, altitude, and locations for the studied specimens were as follows:

**SITE 1 (Hill Slopes):** Coordinates N 26°51'05.25" N & E 88°57'52.59" E; Altitude 303 M; Khumani-6 Beat, Jaldhaka Range, Kalimpong division, Kalimpong, WB.

**SITE 2 (Hill Slopes):** Coordinates N 26°56'07.36"& E 88°42'30.00"; Altitude 283 M; Mal-7 HQ Beat, Neora Valley Range, Kalimpong division, Kalimpong, WB.

**SITE 3 (Terai):** Coordinates N 26°42'36.32"& E 88°21'21.35"; Altitude 31 M; Medicinal and aromatic plant garden, University of North Bengal, Raja Rammohunpur, Darjeeling, 734 011, WB.

**SITE 4 (Hill Slopes):** Coordinates-N 26°57'08.42" & E 88°26'16.98"; Altitude 231 M; Tista Valley, Sevok Range, Mahananda Wildlife Sactuary, Darjeeling, WB.

**SITE 5 (Hill Slopes):** Coordinates-N 26°57'28.10" & E 88°26'29.30"; Altitude 227 M; Tista Valley, Sevok Range, Mahananda Wildlife Sactuary, Darjeeling, WB.

**ECOLOGICAL IMPORTANCE:** In natural forest *Duabanga grandiflora* (Roxb. ex DC.) Walp. is a significant components in primary as well as secondary Low-Montane Evergreen Broadleaf Rain Forest and The hill and mountain region of Himalaya. Very fast growing pioneer species preferring moist areas in all types of forest. Common feature after shifting cultivation, at roadsides and streams. Often growing together with *Anthocephalus chinensis*, *Mallotus* spp. can be planted as a framework species for restoring forest ecosystems. The species grown faster in plains and moist riverine and riverine forests along the rivers and streams bank and occurs upto 3000 ft altitude in different part of the world and prefers average range of 500–3000 mm annual rainfall. The seeds are well germinated in shade but also well capable of regeneration in full sunlight. For the growth of the species, fertile soils with humus are preferable. The root network system of the species is quite elaborate, strong that can hold the trees in loose, and sand wet soils even in hill erect slops. It is a very good to control soil erosion. This species is not showing any allelopathic effects on other associated plant species. The species is growing nicely along the several other tree species and allows epiphytes and climbers on it along with dense floor cover.

**Association:** In Lower hills of Darjeeling Himalaya and Terai-Duars *Duabanga grandiflora* (Roxb. ex DC.) Walp. grows with many other associated species and that includes *Anthocephalus chinensis*, *Melia dubia*, *Gmelina arborea*, *Chukrassia tabularis* var. *velutina*, *Cassia siamea*, *Pterospermum lanceaefolium*, *Mecaranga denticulata*, *Mecaranga peltata*, *Calamus* spp., *Clerodenreum japonicum*, *C. infortunatum*, *Cinnamomum* sp., *Albizia procera*, *Dipterocarpus turbinatus*, *D. costatus*, *Artocarpus chama*, *Swintenia floribunda*, *Protium serratum*, *Toona ciliata*, *Canarium resiniferum*, *Calophyllum polyanthum*, *Michelia champaca*, *Pterygota alata*, *Tetrameles nudiflora*, *Amoora chittagonga*, *Aphanamixis polystachya*, *Chukrasia tabularis*, *Podocarpus neriifolius*, *Syzygium* spp., *Albizia procera*, *Bombax ceiba*, *B. insignis*, *Garuga pinnata*, *Adina cordifolia*, *C. tamala*, *Oplishmenus compositus*, *Dalbergia stipulacea*, *Maesa indica*, *Leea indica*, *Leea asiatica*, *Piper peepuloides*, *Dioscorea prazeri*, *Carex* sp, *Tebernemontana divericata*, *Coffea benghalensis*, *Bauhunia valli*, *Musanda roxburghi*, *Mellotus philipensis*, *Tunbergia grandiflora*, *Smilex zeylanika*, *Strobilanthus* sp., *Callicarpa arborea*, *Lepidagathis*

*imbrecata*, *Panicum repens*, *Amoora wallichii*, *Artocarpus chaplasha*, *Pterygota alata*, *Atrocarpus lakocha*, *Tectona grandis*, *Uncaria sp.*, *Pandanus nepalensis*, *Zanthoxylum armatum*, *Z. budrunga.*, etc.

**Provide shelters epiphytes:** The bark of *Duabanga grandiflora* (Roxb. ex DC.) Walp. is thin and can absorb and hold sufficient amount of moisture. Although bark is thin and quite smooth this species allows to grow several epiphytes on varies high on its trunk. The soft cork tissue of bark allows a good population of various epiphytes that includes unidentified mosses, crustose and fruticose lichens, pteridophytes like *Dryneria quercifolia*, *Pyrrosia lanceolata*, *Microsorium punctatum* and angiosperms like species of *Raphidophora sp*, *Dendrodium sp*, *Papiliolanthe sp*, *Pholidota sp*, *Bulbophyllum sp* and *Ceologyne sp*.

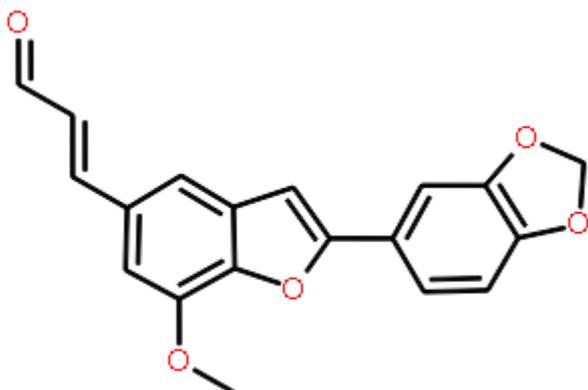
**TRADE NAMES:** *Lampatia*, Nepal; *Khokan*, Assam ; *Myaukngo*, *Mau-lettanshe*, Burma. *Binuang*, *Benuang*, *B. laki*, *gayawas hutan*, *kalanggo (RI)*; *Magasawih*, *Berembang bukit*, *Magas (MAL)*; *Loktob (RP)*; *Myaukngo (BUR)*; *Dlom chloeu ter (K)*; *Phay (LAO)*; *Lamphu-pa*, *Tum-ten*, *Lamphaen (T)*.

**ECONOMIC IMPORTANCE:** This family is economically important from the standpoint of ornamental value. The fruits of *Duabanga grandiflora* (Roxb. ex DC.) Walp. is edible and sometimes gathered from the wild for local use. The tree is exploited in the wild for its timber. Various ethnic community as a fish poison uses the crushed fresh bark (Manandhar, 2002). The fruits and leaves are boiled to make a black dye.

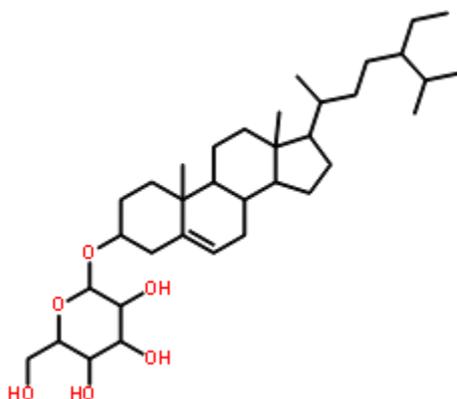
#### **Active Components:**

*Duabanga grandiflora* contains eugeniin, comprising of gallic acid, ellagic acid, and sugar [2]. phytochemicals including tannins, phenolic compounds, flavonoids and steroids. On the other hand, the ethyl acetate *D. grandiflora* extract contain high level of tannins and moderate levels of alkaloids and phenols. Stem and stem berk contains active compounds like (E)-5-(2-Formylvinyl)-7-methoxy-2(3,4-methylenedioxyphenyl)benzofuran, 3,4-O-methylenedioxy-3',4',5'-tri-O-methylellagic

acid, Acacetin, Daucosterol etc. Leaf and berk contains Ethanolic; Water; Ethyl Acetate; Hexane (Auamcharoen, 2009; Kaweetripob, 2012)



**(E)-5-(2-Formylvinyl)-7-methoxy-2(3,4-methylenedioxyphenyl)benzofuran**



Daucosterol

**TIMBER USES:** The heartwood is light yellow to light brown with light yellowish streaks and is not demarcated from the sapwood. The texture is coarse, the grain straight or interlocked. The wood is light in weight, soft; it is not durable, being susceptible to fungi, dry wood borers and termites. It seasons rapidly, with only a slight risk of checking or distortion; once dry it is moderately stable in service. The wood is easily worked with ordinary tools, though these must be kept very sharp to avoid fuzzy surfaces; filling is necessary in order to obtain a good finish; nailing and screwing are poor; gluing is correct. A lower quality timber, it is used for purposes

such as boxes and crates, tea boxes, furniture components, house and boat building, blockboard, fibre boards and pulp. Traditional wood having high natural durability and other desirable properties are becoming scarce and as such the use of alternative non-traditional woods has become very common. Bandarhola is one such non-traditional timber species, which is available in large quantity and is being used, in an increasing rate in various types of light constructions. The wood is used as Moulding, Interior panelling, Veneer for interior of plywood, Veneer for back or face of plywood, Boxes and crates, Current furniture or furniture components, Sliced veneer, Fiber or particle boards. Block board, Pulp Matches etc.

**ETHNIC USES:** The plant is a tonic, acting on the spleen. The roots are boiled to cure indigestion. Preventative and tonic, barnyard grass is a folk remedy for treating carbuncles, haemorrhages, sores, spleen trouble, cancer and wounds. The plant extract is used in diseases of the spleen. The grain of some varieties is eaten by humans in times of scarcity and sometimes used for adulterating fennel. The shoots and/or the roots are applied as a styptic to wounds. Various ethnic communities of NE India use the plant parts as medicine. Pounded leaves are applied as a poultice for stomachache and other abdominal diseases. The soft Timber is used for making crates and furniture.

**OTHER USES:** The wood of this species considered as valuable firewood among the forested villagers of Himalaya and terai-duars of North Bengal and Assam. The people of North East Indian states also use the wood as house building materials as pillar and/or wood.

**PESTS AND DISEASES:** The pest *Spondias* spp. attacks the leaves of *Duabanga grandiflora* (Roxb. ex DC.) Walp. and causing leaf defoliating disease. The beetles first appear in the month of June and strip on leaves. Eggs are laid in clusters of 20-60. Larvae infect the leaves and complete their life within 50-55 days. The young larvae of the moth feeds on green epidermal layers of leaves, but on maturity it bites out the tissue between the veins. Leaf browning is a common sight in areas of severe defoliation. Parasites found were the nematode *Mermis* and the fungus *Cephalosporium*. The larva can be controlled by foliar application of cypermethrin at 12 ml/10 litres of water, 0.25% malathion in June/July gave effective control.

Seedlings of *D. grandiflora* were found to be affected by soft root rot disease in the Lailad reserve forest of Meghalaya, India and most noticeable symptoms were mainly on the hypocotyl zone and the infected part of the seedling above ground showed wilting symptoms. Fungus causes soft rot are *Fusarium moniliforme* [*Gibberella fujikuroi*].

### **PROPAGATION AND CULTIVATION:**

*Duabanga grandiflora* (Roxb. ex DC.) Walp. reproduce through wind dispersed seeds and seed dispersal starts with detachments of fruits from the mother tree (Fig. 8). The capsules maturation period varies in different climatic zone and it was reported that the fruits maturation period in India is April –May. Mature fruits with viable seeds for the seedling production are collected during April and May. Quantity of filiform seeds required for raising seedlings, one Kg that include 28000000 seeds (approx.). During propagation, atleast 4gm seeds that are required for around 2000 samplings.

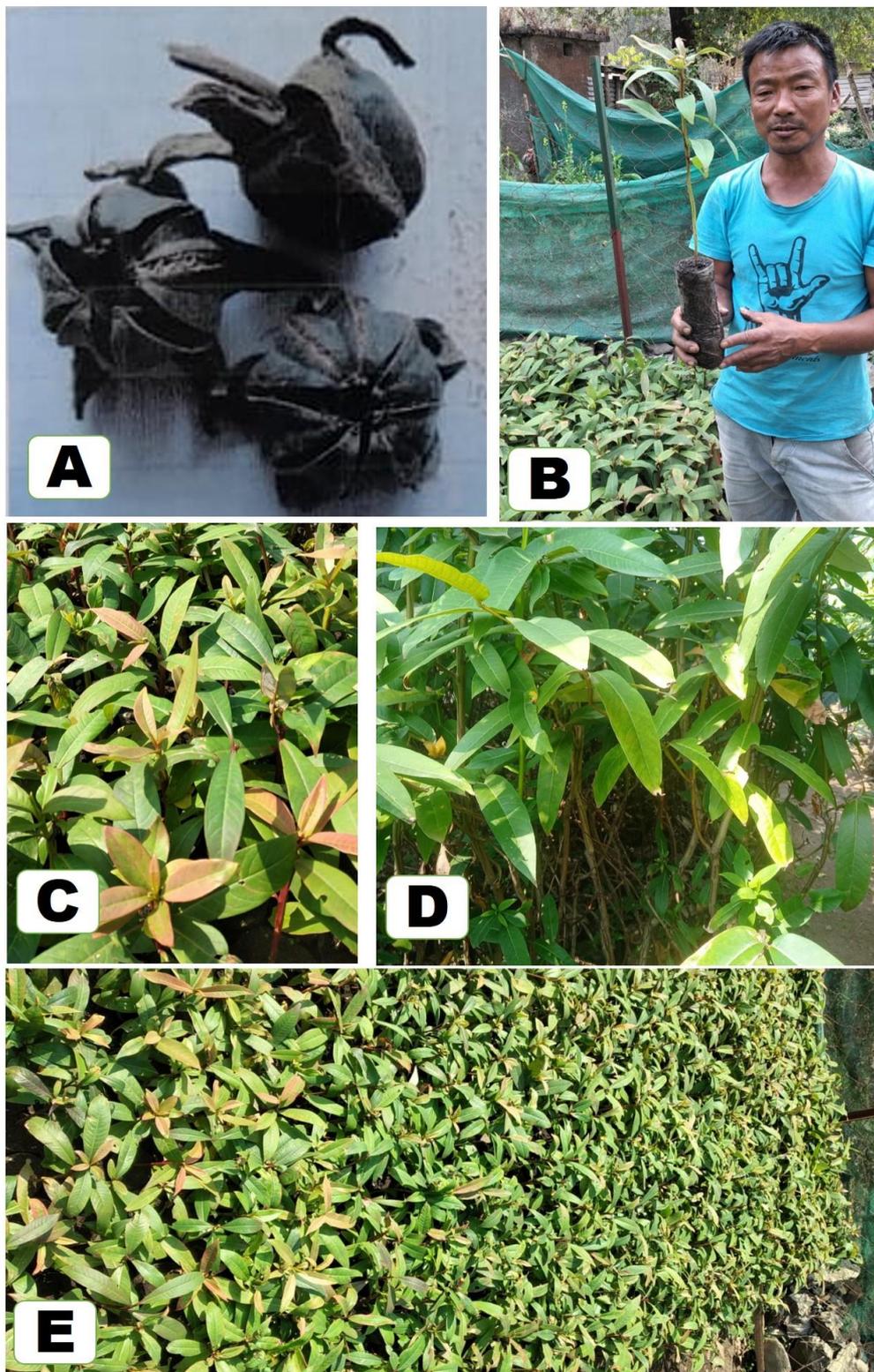
Fruits of *Duabanga grandiflora* (Roxb. ex DC.) Walp. are broadly ovate with large star-shaped calyx at base, splitting into 5 sections, reproduce through wind dispersed minute seeds (Fig. 8). The fruits mature at the end of April or during May. Seeds are tiny and tapering at each end to a point (approx. 1.3 mm) and are light in weight. Seeds retain their vitality fairly well for a year. Quality seedlings are grown naturally.

Natural seedlings spring up only on the newly exposed grounds, like landslips and riverbanks, and it's appearing to require for their development as abundance of light and absence of drip from overhanging trees. Complete drainage and loose but moist soil also appear to be necessary. Natural reproduction comes up readily on banks of silt in the beds of rivers.

***Method of collection of seed:*** Mature ripen fruits are usually collected during the months of April and May. After the collection, the seeds are separated from the fruits.

***Method of treating seed:*** Mature fruits are put under sun for drying then with gentle thrashing fine filiform seeds as freshly collected are sown mixing with ashes to prevent them being blown away in shaded bed or sub soil only no other admixture should be used because seeds germinates well on sub soil. No further special treatment

is required for the seeds. Mature fruits and the seeds are sun dried for few days after immediate collections from trees.



**Fig. 8:** *Duabanga grandiflora*. A. Mature Fruits with seeds; B. Seedling in tube; C. Seedling at nursery bed; D. Mature Seedling; E. Seedling in Nursery bed at Kalijhora.



**Fig. 9:** *Duabanga grandiflora*. A & B. Mature Seedling, ready for transfer from Silviculture Nurseries in North Bengal.

**Sowing:** The seed is sown about the end of May or beginning of June in well raised seed beds of porous soil which have been very little manured, and the beds are sheltered by sloping.

**Treatment in nursery:** No special treatment is required except the standard method of weeding and slight watering.

**Method of propagation:** The species mainly propagates by means of seed. During month of April–May the mature fruits are collected. The collected seeds are sowing in sterile soil and around 30% seed were germinated.

**Seedling:** After germination, the young seedlings are extremely minute, almost resembling green powder on the surface of the ground. The growth during the first season is slow, a height of only 1 to 2 inch being attained by the end of the year. During the second year the growth is more rapid, a height of 2 ft. or more being attained; there after the growth is reported very rapid.

**Treatment after transplanting:** Just after transplanting weeding & cleaning in one month or two month, interval is necessary followed by two soil mulches at a suitable interval in order to ensure better growth of the seedlings (Fig. 9). Regular weeding, cleaning, climber cutting operations are to be carried out up to 5th year after planting, because in North Bengal Plain weed growth is a major problem in the course of establishing a successful plantation.

### **INVADER TENDENCY:**

Wide spreading superficial root system of *Duabanga grandiflora* absorbed soil moisture and is a very good soil binder. The species is naturally growing from the seeds and quite dominating the riversides. One mature tree can produce large amount of seeds and the seeds are not so spreading due small filiform sizes. The 30 % successful germination process huge individuals but that much huge successful individual is not noticed in wild. So, its aggressive invasive tendency is not observed in the forested areas of sub-Himalayan region though, it has great capability to spread

over short and medium distances through wind-dispersal (anemochory). Allopathic effect of the species is also not observed severely on other native species that are grows nicely around them and the tree trunk allows the growth of several epiphytes on it.

## CONSERVATION STATUS

The timber of *Duabanga grandiflora* is quite good and it has great medicinal and ecological importance. The population size of *Duabanga grandiflora* in different forested areas are quite high and IUCN (2022) keep this species in Lower Risk and/or least concern status in their Red List of Threatened Plants. The Forest department of different Eastern and North eastern states keep this species in their preferred list for afforestation plan specially for hilly slops as they are very good soil binder and landslides may be controlled. Due to low level of extinction risk no such specific conservation measure yet not been initiated anywhere. A good number of individuals of varies age group are frequently observed in different conservatories like Mahananda WLS, Gorumara NP, Buxa NP along the rivers and streams. Apart from the conservatories, the species are also frequently planted in various public and Govt. occupied areas of various districts of Northern West Bengal.

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