

## Notes on some Zingibers from West Bengal and Meghalaya, India

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### Abstract

West Bengal and Meghalaya encompasses a bulk of Eastern Himalaya and the present study reports the diversity of Zingiberaceae in these two states. A total of 36 species belonging to 12 genera were recorded and morphologically described in the present investigation including their chromosome counts.

**Key words:** Zingiberaceae, West Bengal, Meghalaya, Morphology, Chromosome numbers

### INTRODUCTION

Zingiberaceae, one of the largest monocot families, possess the maximum number of species among all the 8 families of Zingiberales. The highest concentration of zingibers is found in the tropical and sub-tropical regions of the world. These plants generally grow in tropical rain and monsoon forests, in damp and humid conditions (Chen *et al.* 1989; Jatoi *et al.* 2007).

The centre of diversity of Zingiberaceae is considered to be primarily in South and South-East Asia (Larsen *et al.* 1998), including the Indo-Malayan region (Chakravorti 1948; Joseph 1998; Larsen *et al.* 1998; Kress *et al.* 2002; Islam 2004; Sabu 2006) with a few genera being distributed in the neotropics (South and Central America) and Africa (Smith 1998; Harris *et al.* 2000). In India, these plants are confined to the Himalayas, specially the North-Eastern parts, and also in the Western Ghats (Joseph 1998; Sabu 2006).

According to recent reports, a total of 1377 species of this family are distributed worldwide that belong to 53 genera (Kress *et al.* 2002; Kong *et al.* 2010). About 200 species covering 21 genera of Zingiberaceae are known to grow in India (Sabu 2006). According to Jain and Prakash (1994), among these, approximately 70 species are endemic in different parts of the country (North-East, East, South and Andaman and Nicobar Islands).

Zingiberaceous plants are characterized by generally rhizomatous herbs with distichous, sheathing, usually ligulate leaves. Flowers are mostly in terminal spikes or racemes, bracteates, zygomorphic, bisexual and epigynous, trimerous; perianth biseriate; only median posterior stamen is fertile with ditheous anther, petaloid staminodes forming showy labellum; style terminal passing through the folded filament of fertile stamen with extruded stigma; ovary trilobular with many anatropous, bitegmic ovules in axile placentation; nectaries 2, epigynous; capsules with many arillate or non-arillate seeds (Larsen *et al.* 1998; Simpson 2006; Sabu 2006).

The present investigation focuses on the occurrence of Zingiberaceous flora in the states of West Bengal and Meghalaya of E & NE India.

## METHODOLOGY

Live plants were collected from field trips during 2010 to 2014 either from the wild, or, authenticated plants were kindly provided by National Bureau of Plant Genomic Resources, New Delhi (NBPGR Regional Research Station, Shillong), Botanical Survey of India (Eastern Regional Centre, Shillong), Ramakrishna Mission Medicinal Plants' Garden (Narendrapur, Kolkata, West Bengal) and from the NBU Garden of Medicinal Plants (North Bengal University, West Bengal).

For collection of wild plants, field trips were generally scheduled, to different parts of West Bengal and Meghalaya, coinciding with the known flowering seasons of these plants in the Eastern Himalaya, so that floral parts and/or fruits could be collected for identification. These plants were later authenticated using relevant references.

Voucher specimens (mounted Herbarium sheets) were submitted in the NBU-Herbarium, North Bengal University, West Bengal.

Valid names of the plants studied were confirmed from the [www.theplantlist.org](http://www.theplantlist.org) (version 1.1), accessed on 15<sup>th</sup> June 2016. Standard taxonomic characters for different taxa were collected from literatures (Baker 1890–1892; Wu & Raven 2000; Sabu 2006) to describe the plants morphologically.

## RESULTS

A total of 36 species belonging to 12 genera of Zingiberaceae were collected for the present study from the states of West Bengal and Meghalaya. Morphological characterization of each of the studied species was done separately and has been presented below alphabetically [PLATE – I; Figures A – W].

*Alpinia calcarata* (A.H. Haworth) Roscoe in Trans. Linn. Soc. London 8: 347. 1807.

Common synonyms: *Alpinia calcarata* var. *breviligulata* Gagnep., *Alpinia calcarata* var. *compacta* Gagnepien [Plate – I; Figure A]

Chromosome number:  $2n = 48$  (Chakravorti 1948; Ramachandran 1969; Joseph 1998)

Leaves sessile. Inflorescence dense panicle. Bracts minute, deciduous, lower cincinni 4-flowered, upper 2-flowered. Bracteoles deciduous, membranous. Corolla greenish–white. Labellum variegated with red and yellow. Lateral staminodes small, subulate. Anther thecae ecrested. Ovary inferior. Stigma slightly projected above the anther. Fruit red.

*Alpinia galanga* (Linnaeus) Willdenow in Sp. Pl. 1: 12. 1797.

Common synonyms: *Alpinia galanga* (Linnaeus) Willdenow var. *galanga*, *Alpinia galanga* var. *pyramidata* (Blume) K.Schumann [Plate – I; Figure B]

Chromosome number:  $2n = 48$  (Raghavan & Venkatasubban 1943; Ramachandran 1969; Joseph 1998)

Voucher No.: NBU 09697

Rootstock aromatic. Leaves shortly petiolate. Inflorescence dense panicle, covering sheaths 2, large. Bracts small, deciduous, each subtending a cincinnus of 4–5 flowers. Bracteoles small. Calyx greenish white. Corolla tube greenish white, lobes unequal, spreading. Labellum unguiculate in lower half, margin wavy, white with a few oblique lilac lines. Lateral staminodes small. Anther thecae ecrested. Ovary ellipsoid.

*Alpinia malaccensis* (Burman f.) Roscoe in Trans. Linn. Soc. London 8: 345 1807.

Common synonyms: *Alpinia malaccensis* (Burman f.) Roscoe var. *malaccensis*

Chromosome number:  $2n = 48$  (Chakravorti 1948; Joseph 1998)

Rootstock strongly aromatic. Leaves long petiolate, margin wavy. Inflorescence rachis very stout, erect or slightly curved raceme, ebracteate, cincinni of 1–2 flowers present. Bracteoles white, deciduous. Calyx white. Corolla tube white. Labellum ovate, centre beautifully variegated red and yellow, narrowed to an emarginate apex, with 2 papillose, fleshy swellings at the base. Lateral staminodes subulate. Anther thecae ecrestate.

*Alpinia zerumbet* (Persoon) B. L. Burtt & R.M. Smith in Notes Roy. Bot. Gard. Edinburgh 31: 204 1972.

Common synonyms: *Alpinia cristata* Griffith; *Alpinia fimbriata* Gagnepain, *Alpinia speciosa* (J.C.Wendland) K.Schumann, *Amomum nutans* (Andrews) Schultes, *Renealmia nutans* Andrews, *Zerumbet speciosum* J.C.Wendland [**Plate – I; Figure C**]

Chromosome number:  $2n = 40$  (Joseph 1998),  $2n = 48$  (Chen *et al.* 1987; Joseph 1998),  $2n = 52$  (Bhadra & Bandyopadhyay 2016)

Voucher No.: *NBU 09710*

Leaves petiolate. Inflorescence drooping panicle, rachis purple–red, covering sheaths 2, lower cincinni with 2–3 flowers present. Bracteoles tubular, deciduous, white with a pink tip. Calyx white with a pink tip. Corolla tube white with pink apex, central lobe larger than lateral ones. Labellum narrowing to the apex, yellow, heavily lined with red. Lateral staminodes subulate.

*Amomum dealbatum* Roxburgh in Fl. Ind. 1: 42 1820.

Common synonyms: *Amomum dealbatum* var. *sericeum* (Roxburgh) Baker

Chromosome number: Not found

Leaves petiolate, acuminate, lamina large. Inflorescence globose. Bract outer ovate, reddish. Bracteoles tubular. Corolla tube white, oblong, white. Labellum large, emarginate, white with a yellow and red line. Lateral staminodes subulate. Filament short. Anther–crest small, Stigma small.

*Amomum subulatum* Roxburgh in Fl. Ind. 1: 43 1820.

Common synonyms: *Cardamomum subulatum* (Roxburgh) Kuntze [**Plate – I; Figure G**]

Chromosome number:  $2n = 48$  (Sharma & Bhattacharyya 1959),  $2n = 50$  (Mandi 1990)

Leaves sessile, base rounded. Inflorescence globose. Bracts obtuse, red–brown, with a horny cusp. Bracteoles tubular. Calyx lobes subulate. Corolla tube yellow. Labellum with yellow midvein. Lateral staminodes red. Filament very short. Anther–crest small. Stigma subglobose. Fruit red–brown.

*Boesenbergia longiflora* (Wallich) Kuntze in Revis. Gen. Pl. 2: 685 1891.

Common synonyms: *Alpinia hamiltoniana* Wallich, *Boesenbergia fallax* Loes, *Curcumorpha longiflora* (Wallich) A.S.Rao & D.M.Verma, *Kaempferia fallax* Lingelsh. & Borza [**Plate – I; Figure D**]

Chromosome number:  $2n = 36$  (Chen *et al.* 1987, 1988)

Leaves cuspidate, base cordate. Bracts ovate, densely imbricate, acuminate, each subtending a single flower. Calyx lobes 3, lanceolate. Corolla tube shorter than bract. Labellum margin crisped. Anther connective broad. Stigma thickened, cylindrical. Fruit oblong. Seeds many.

*Cautleya gracilis* (J.E. Smith) Dandy in J. Bot. 70: 328 1932.

Common synonyms: *Cautleya gracilis* (J.E. Smith) Dandy var. *gracilis* [Plate – I; Figure F]

Chromosome number:  $2n = 24, 26$  (Mehra & Sachdeva 1979)

Voucher No.: *NBU 09717*

Stem slender. Leaves sessile, narrow lanceolate. Inflorescence rachis red, slightly flexuous, lax, flowers 2–10. Bracts green, lanceolate, shorter than calyx. Calyx apex minutely toothed, purple–red. Corolla bright yellow. Labellum apically 2–fid. Lateral staminodes narrowly obovate. Filament curved. Fruit red.

*Cautleya gracilis* var. *robusta* (K. Schumann) Sanjappa in Fl. Ind. Enum. Monocot.: 291 1989.

Common synonyms: *Cautleya cathcartii* Baker, *Cautleya lutea* var. *robusta* K. Schumann

Chromosome number:  $2n = 24, 26$  (Mehra & Sachdeva 1979)

Voucher No.: *NBU 09715*

Stem slender, base with bladeless leaves. Leaves sessile, narrow lanceolate. Inflorescence rachis red, slightly flexuous, dense, flowers more than 10. Bracts green, lanceolate, shorter than calyx. Calyx apex minutely toothed, purple–red. Labellum apically 2–fid. Filament curved.

*Cautleya spicata* (J.E. Smith) Baker in Fl. Brit. India 6: 209 1890.

Common synonyms: *Cautleya petiolata* Baker, *Cautleya robusta* Baker, *Roscoea spicata* J.E. Smith [Plate – I; Figure E]

Chromosome number:  $2n = 26$  (Ngamriabsakul 2004),  $2n = 34$  (Sharma & Bhattacharyya 1959)

Leaves shortly petioled, oblong. Inflorescence dense. Bracts red, oblong, longer than calyx. Calyx minutely obtusely 2–toothed, red. Corolla bright yellow. Labellum apex 2–cleft. Lateral staminodes narrowly obovate. Filament erect. Stigma turbinate. Fruit red.

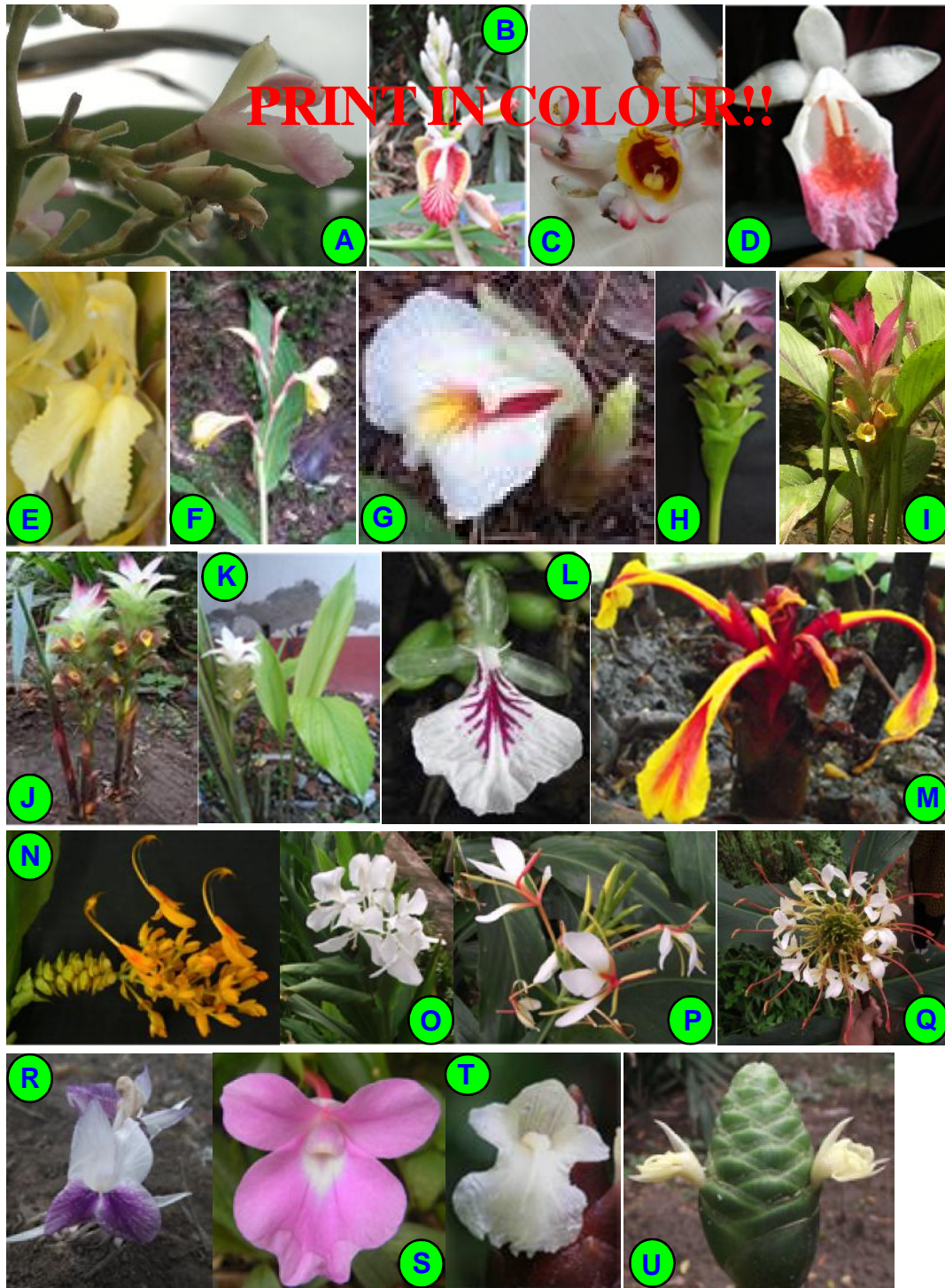
*Curcuma aeruginosa* Roxburgh in Asiat. Res. 11: 335 1810.

Chromosome number:  $2n = 63$  (Apavatjirut *et al.* 1996; Joseph *et al.* 1999; Škorničková *et al.* 2007),  $2n = 84$  (Islam 2004)

Rootstock blue inside, strongly aromatic. Leaves oblong–lanceolate, acute, lamina large, with purple or reddish–brown patch along the sides of mid rib on the upper side. Inflorescence lateral, vernal, pink to violet. Fertile bracts green with a pink tip, ovate, obtuse, each subtends a cincinnus of 8–10 flowers. Bracteoles large, white with a median light green patch. Corolla tube pink, rounded. Labellum yellow. Lateral staminodes yellow. Anther ecrested, spurred. Stigma bilipped, slightly exerted. Fruiting not common.

*Curcuma amada* Roxburgh in Asiat. Res. 11: 341 1810.

Common synonyms: *Curcuma amada* var. *glabra* Velay., Unnikrishnan, Asha & Maya [Plate – I; Figure H]



**PLATE – I. Figures:** A. *Alpinia calcarata*; B. *Alpinia galangal*; C. *Alpinia zerumbet*; D. *Boesenbergia longiflora*; E. *Cautleya spicata*; F. *Cautleya gracilis* var. *gracilis*; G. *Amomum subulatum*; H. *Curcuma amada*; I. *Curcuma caesia*; J. *Curcuma rubescens*; K. *Curcuma longa*; L. *Elettaria cardamomum*; M. *Etilingera loroglossa*; N. *Globba marantina*; O. *Hedychium coronarium*; P. *Hedychium spicatum*; Q. *Hedychium ellipticum*; R. *Kaempferia galangal*; S. *Kaempferia rotunda*; T. *Zingiber rubens*; U. *Zingiber zerumbet*

Chromosome number:  $2n = 42$  (Raghavan & Venkatasubban 1943; Sharma & Bhattacharyya 1959; Škorníèková *et al.* 2007; Bhadra & Bandyopadhyay 2015)

Voucher No.: *NBU 09701*

Rootstock with the smell of green mango. Leaves oblong–lanceolate, tapering gradually at the base and apex, lamina large. Inflorescence lateral, autumnal, concealed within leaf sheaths. Fertile bracts pale green, each bract subtends a cincinnus of 4–5 flowers. Bracteoles small. Corolla lip pale yellow, dorsal lobe larger. Labellum 3–lobed, pale yellow with a median dark yellow band. Lateral staminodes slightly incurved, pale yellow. Anther basal spur slightly convergent. Stigma cup shaped, closely appressed within the anther lobes. Fruiting not common.

***Curcuma caesia*** Roxburgh in *Asiat. Res. 11: 334 1810.*

Common synonyms: *Curcuma kuchoor* Royle [**Plate – I; Figure I**]

Chromosome number:  $2n = 63$  (Joseph 1998; Škorníèková *et al.* 2007)

Voucher No.: *NBU 09709*

Rootstock pale grey inside. Leaves oblong–lanceolate, lamina with a broad purple–brown streak down the middle, glabrous beneath. Inflorescence arise from a separate stalk from the rhizome before leaf opens, dense, coma bracts rather longer, many, bright red. Fertile bract ends free, more or less spreading, green, ovate, very obtuse, longer than flowers, each subtends a cincinnus of bracteolate flowers. Corolla lobes 3, rounded, red, lateral lobes linear–elliptic. Labellum broad, obscurely 3–lobed. Lateral staminodes linear. Stigma cup shaped. Seeds many.

***Curcuma longa*** Linnaeus, *Sp. Pl. 2. 1753.*

Common synonyms: *Curcuma longa* var. *vanaharidra* Velay., Pandrav., J.K.George & Varapr. [**Plate – I; Figure K**]

Chromosome number:  $2n = 63$  (Ramachandran 1961; Joseph 1998; Škorníèková *et al.* 2007; Lamo & Rao 2014; Bhadra & Bandyopadhyay 2015)

Voucher No.: *NBU 09703*

Rootstock bright yellow inside, strongly aromatic. Leaves oblong with wavy margins, acuminate. Inflorescence central, autumnal, concealed within leaf sheaths, coma white tinged with pink. Fertile bracts pale green, lower bracts subtend cincinnati of 2 flowers, upper bracts 1–flowered. Bracteoles large, ovate–oblong. Calyx white. Corolla lobes white, dorsal lobe larger. Labellum 3–lobed, light yellow with a broad, median dark yellow band. Lateral staminodes linear. Anther thecae spurred. Stigma bilipped. Fruiting not common.

***Curcuma rubescens*** Roxburgh, *Asiat. Res. 11: 336. 1810.*

Common synonyms: *Curcuma erubescens* Wallich, *Curcuma longiflora* Salisbury, *Curcuma rubricaulis* Link [**Plate – I; Figure J**]

Chromosome number:  $2n = 42$  (Islam 2004; Škorníèková *et al.* 2007)

Voucher No.: *NBU 09699*

Rootstock white inside. Leaves oblong–lanceolate, tapering towards base and apex, petiole with long deep red–brown midrib and veins. Inflorescence radical or central, vernal, coma bracts few, pale red. Fertile bracts pale green, each subtends a cincinnus of bracteolate flowers. Corolla lobes reddish, lateral lobes linear–elliptic. Labellum obscurely 3–lobed. Lateral staminodes linear. Stigma bilipped.



***Elettaria cardamomum*** (Linnaeus) Maton in Trans. Linn. Soc. London 10: 254 1811.

Common synonyms: *Alpinia cardamomum* (Linnaeus) Roxburgh, *Amomum ensal* Raeuschel, *Amomum racemosum* Lamarck, *Elettaria repens* Baillon [**Plate – I; Figure L**]

Chromosome number:  $2n = 48$  (Sharma & Bhattacharyya 1959; Joseph 1998)

Voucher No.: *NBU 09712*

Leaves linear. Inflorescence radical, prostrate. Bracts linear, each subtends a cincinnus of 3–7 flowers, upper bracts 2–3 flowered. Bracteoles tubular. Calyx lobes mucronate. Corolla lobes 3, equal, dorsal lobe wider than the lateral lobes, rounded, lateral lobe linear–oblong. Labellum apex slightly 3-lobed, white with violet strips in the centre. Anther thecae parallel, crested. Stigma bilipped.

***Etilingera linguiformis*** (Roxburgh) R.M. Smith in Notes Roy. Bot. Gard. Edinburgh 43: 246 1986.

Common synonyms: *Achasma linguiforme* (Roxburgh) Loesener, *Elettaria linguiformis* (Roxburgh) Schultes, *Hornstedtia linguiformis* (Roxburgh) K.Schumann [**Plate – I; Figure M**]

Chromosome number: Not found

Rootstock perennial. Leafy stem tall. Leaves petiolate, oblong–lanceolate, acuminate, lamina glabrous. Inflorescence radical, somewhat submerged in soil, few–flowered. Bracts densely imbricate, each subtending a single flower. Bracteoles tubular. Calyx spatulate, 2–dentate. Corolla lobes 3. Labellum yellow, bifid, deflexed, ligulate, folded below middle. Ovary oblong. Seeds many.

***Globba marantina*** Linnaeus in Mant. Pl. 2: 170 1771.

Common synonyms: *Ceratanthera amomoides* Hornemann, *Globba bulbifera* Roxburgh, *Globba heterobracteata* K.Schumann [**Plate – I; Figure N**]

Chromosome number:  $2n = 44$  (Raghavan & Venkatasubban 1943; Sharma & Bhattacharyya 1959)

Voucher No.: *NBU 09706*

Rootstock yellow inside. Leafy stem two or more produced in a group, vegetative bracts reddish green, tubular towards base. Leaves short-petiolate. Inflorescence lax spike, lower bracts subtend bulbils. Bracts ovate, green, each subtends a cincinnus of 8–10 flowers. Bracteoles triangular. Calyx green. Corolla lobes cup-shaped. Labellum oblong, deeply bifid, yellow. Lateral staminodes longer than the corolla lobes, spreading, yellow. Anther with two triangular spreading appendages. Ovary inferior, unilocular, placentation parietal. Stigma exerted.

***Hedychium coccineum*** Buchanan–Hamilton ex J.E. Smith in Cycl. 17: 5. 1811.

Common synonyms: *Gandasulium angustifolium* (Roxburgh) Kuntze, *Hedychium angustifolium* Roxburgh, *Hedychium carneum* Roscoe, *Hedychium longifolium* Roscoe, *Hedychium squarrosum* Buchanan–Hamilton ex Wallich

Chromosome number:  $2n = 34$  (Sharma & Bhattacharyya 1959),  $2n = 68$  (Mukherjee 1970; Chen & Chen 1984)

Rootstock pale brown inside. Leafy stem covering sheath purple. Leaves sessile, oblong–lanceolate. Inflorescence moderately dense. Bracts lax, each subtends a cincinnus of 5–6

flowers. Bracteoles glabrous, light green to light purple. Flowers fragrant. Calyx green. Corolla lobes linear–lanceolate. Labellum dull orange–red to brick–red, lobes orbicular. Lateral staminodes dull orange–red. Stamen more than twice as long as the labellum. Stigma cup–shaped.

***Hedychium coronarium*** J. Koenig in Observ. Bot. 3: 73 1783.

Common synonyms: *Amomum filiforme* Hunter ex Ridley, *Gandasulium lingulatum* (Hasskarl) Kuntze, *Hedychium chrysoleucum* Hooker, *Hedychium maximum* Roscoe [**Plate – I; Figure O**]

Chromosome number:  $2n = 34$  (Sharma & Bhattacharyya 1959; Chen & Chen 1984),  $2n = 54$  (Raghavan & Venkatasubban 1943)

Rootstock yellow inside. Leaves sessile, oblong–lanceolate. Inflorescence erect, dense. Bracts smaller towards the top, oblong, green, each subtends a cincinnus of 4–5 flowers. Bracteoles triangular. Flowers fragrant. Calyx green. Corolla white. Labellum narrowed at the base into a short claw, white with a central greenish–yellow tinge. Lateral staminodes white. Stamen slightly shorter than labellum. Stigma slightly exerted from anther–lobes.

***Hedychium ellipticum*** Buchanan–Hamilton ex J.E. Smith in Cycl. 16: 2 1811.

Common synonyms: *Gandasulium ellipticum* (Buchanan–Hamilton ex J.E. Smith) Kuntze [**Plate – I; Figure Q**]

Chromosome number:  $2n = 34$  (Mukherjee 1970)

Rootstock tuberous. Leaves sessile or shortly petiolate, oblong–elliptic. Inflorescence dense. Bracts green, each subtends a cincinnus of 1 flower. Bracteole acute. Corolla lobes yellowish. Labellum oblong, distinctly clawed. Stamen twice as long as labellum. Stigma green.

***Hedychium flavum*** Roxburgh, Fl. Ind. 1: 81 1820.

Common synonyms: *Gandasulium flavum* (Roxburgh) Kuntze, *Hedychium coccineum* var. *flavum* (Roxburgh) Baker, *Hedychium urophyllum* Loddiges

Chromosome number:  $2n = 34$  (Sharma & Bhattacharyya 1959),  $2n = 52$  (Raghavan & Venkatasubban 1943)

Leaves sessile, oblong–lanceolate, acuminate. Bracts subtending a cincinnus of 3 or 4 flowers each. Bracteole tubular. Corolla lobes reflexing. Labellum yellow, claw short. Lateral staminodes oblanceolate. Stamen shorter than labellum. Stigma funnel–shaped.

***Hedychium spicatum*** J.E. Smith, Cycl. 17: 8. 1811.

Common synonyms: *Gandasulium spicatum* (J.E. Smith) Kuntze, *Hedychium album* Buchanan–Hamilton ex Wallich, *Hedychium trilobum* Wallich ex Roscoe [**Plate – I; Figure P**]

Chromosome number:  $2n = 34$  (Mukherjee 1970; Joseph 1998),  $2n = 68$  (Bhadra & Bandyopadhyay 2015)

Voucher No.: *NBU 09696*

Leaves petiolate, lamina oblong–lanceolate. Inflorescence lax or dense. Bracts green, smaller than flowers, each bract subtends a single flower. Corolla lobes equal. Labellum cuneate, lanceolate, white. Lateral staminodes linear, tip shortly bifid or entire. Stamen shorter than labellum. Filament red. Anther thecae free at the base.



***Hedychium stenopetalum*** Loddiges in Bot. Cab. 20: t. 1902 1833.

Common synonyms: *Hedychium elatum* Horaninow

Chromosome number: Not found

Voucher No.: *NBU 09718*

Leaves sessile, linear–lanceolate to oblong–lanceolate. Inflorescence rachis very stout, lax or moderately dense. Bracts large, each subtends a cincinnus of 2 flowers. Corolla lobes linear. Labellum shorter than corolla–segments, oblanceolate, white, Stamen twice as long as labellum. Anther thecae yellow.

***Kaempferia angustifolia*** Roscoe in Trans. Linn. Soc. London 8: 351 1807.

Common synonyms: *Kaempferia roxburghiana* Schultes, *Kaempferia undulata* Link

Chromosome number: 2n = 22 (Mahanty 1970), 2n = 36 (Sharma & Bhattacharyya 1959; Omanakumari & Mathew 1984)

Leafy shoot stemless. Leaves sessile, acute., Inflorescence central, sessile, covered with two innermost leaf–sheaths. Bracts small, few. Bracteoles small. Corolla lobes long, reflexing, white. Labellum spreading, lilac with purple blotch at the center, lobes suborbicular. Anther crest quadrate, shallowly bifid. Stigma turbinate.

***Kaempferia elegans*** (Wallich) Baker in J.D. Hooker, Fl. Brit. India 6: 222 1890.

Common synonyms: *Kaempferia atrovirens* N.E.Brown, *Kaempferia crawfordia* Wallich ex Horaninow, *Monolophus elegans* Wallich

Chromosome number: 2n = 22 (Chen *et al.* 1987; Eksomtramage *et al.* 2002)

Voucher No.: *NBU 09711*

Leafy shoot stemless. Leaves petiolate, orbicular, lower surface light green turning dark, upper surface variegated with dark brown and green alternate distinct radiating bands, ligulate. Inflorescence dense, terminal. Bract ovate–oblong, acuminate. Bracteole lanceolate, lobe colourless. Calyx hyaline. Corolla dull white in colour. Labellum lobes circular, lilac, dull white circular patch at the base. Lateral staminodes 2, lilac. Anther introrse, connective white towards the base and lilac towards tip. Stigma funnel–shaped. Fruiting not common.

***Kaempferia galanga*** Linnaeus, Sp. Pl. 3. 1753.

Common synonyms: *Alpinia sessilis* J.Koenig, *Kaempferia humilis* Salisbury, *Kaempferia marginata* Carey ex Roscoe [**Plate – I; Figure R**]

Chromosome number: 2n = 22 (Sharma & Bhattacharyya 1959), 2n = 54 (Raghavan & Venkatasubban 1943; Omanakumari & Mathew 1984)

Rootstock tuberous. Leafy shoot stemless. Leaves sub–sessile, spreading flat on the ground, broadly ovate to orbicular, lamina upper surface dark green, lower surface pale green, ligule absent. Inflorescence sessile, terminal, enclosed within imbricating leaf sheaths. Bracts ovate, white with light green tip. Bracteoles membranous. Flowers fugitive, sweet–scented. Corolla tube white, lanceolate. Labellum lip white with a lilac throat. Lateral staminodes white. Anther white, sessile, connective prolonged into a crest. Stigma globular. Fruiting not common.

***Kaempferia rotunda*** Linnaeus, Sp. Pl. 3. 1753.

Common synonyms: *Kaempferia longa* Jacquin, *Kaempferia versicolor* Salisbury [**Plate – I; Figure S**]

Chromosome number:  $2n = 33$  (Bhattacharyya 1968),  $2n = 44$  (Raghavan & Venkatasubban 1943; Ramachandran 1969)

Voucher No.: *NBU 09700*

Leaves petiolate, oblong–lanceolate, lamina purple beneath, mottled green above. Inflorescence radical, appearing before the leaves in March and April, enclosed within greenish purple sheath. Bracts oblong, purple–brown. Bracteoles bidentate. Calyx light violet. Corolla spreading, white. Labellum broadly ovate, reflexed, lilac with deep violet in the centre, with many radiating violet lines. Lateral staminodes white with a violet tinge towards the margin. Anther crest deeply bifid. Stigma slightly flattened. Fruiting not common.

***Roscoea purpurea*** J.E. Smith in Exot. Bot. 2: 97. 1806.

Common synonyms: *Roscoea procera* Wallich, *Roscoea purpurea* var. *gigantea* Wallich, *Roscoea purpurea* var. *procera* (Wallich) Baker

Chromosome number:  $2n = 24$  (Ngamriabsakul 2004)

Leaves sessile, acuminate. Inflorescence sessile, enclosed in upper leaf sheaths, only upper part of bracts and flowers visible. Bracts acute. Calyx 2–toothed, pale green. Corolla purple, lobes 3, upper segment obovate–cuneate. Labellum half as long as the upper segment. Stamen as long as labellum. Anther cream yellow. Style white. Stigma white. Seeds many.

***Zingiber officinale*** Roscoe in Trans. Linn. Soc. London 8: 348 1807.

Common synonyms: *Amomum zingiber* Linnaeus, *Zingiber majus* Rumphius, *Zingiber sichuanense* Z.Y.Zhu, S.L.Zhang & S.X.Chen

Chromosome number:  $2n = 22$  (Raghavan & Venkatasubban 1943; Sharma & Bhattacharyya 1959)

Voucher No.: *NBU 09702*

Rootstock grayish yellow inside. Leaves sessile, narrow. Inflorescence radical, on a long leafless peduncle. Bracts greenish, lower ones turning red at maturity. Bracteoles ovate–oblong, white. Corolla tube greenish, lip small purplish–black. Labellum dark purple with blotched creamy yellow tube. Lateral staminodes smaller. Anther crest dark purple. Stigma white. Seeds not common.

***Zingiber rubens*** Roxburgh in Asiat. Res. 11: 348 1810. [Plate – I; Figure T]

Chromosome number:  $2n = 22$  (Chakravorti 1948)

Leafy stem stout. Leaves shortly petiolate. Inflorescence terminal, very dense, on a leafy shoot. Bracts bright red, large, fleshy. Flower short lived. Corolla lobes, subequal, bright red, present below the labellum. Labellum yellowish white, copiously spotted and streaked with minute dots and lines of red–purple. Lateral staminodes adnate to labellum. Anther thecae long, narrow, connective prolonged Stigma subglobose. Seeds many.

***Zingiber zerumbet*** (Linnaeus) Roscoe ex J.E. Smith in Exot. Bot. 2: 105 1806.

Common synonyms: *Amomum silvestre* Poirer, *Amomum zerumbet* Linnaeus, *Dieterichia major* Raeuschel, *Zingiber aromaticum* Valetton [Plate – I; Figure U]

Chromosome number:  $2n = 22$  (Raghavan & Venkatasubban 1943; Eksomtramage *et al.* 2001)

Voucher No.: *NBU 09716*

Rootstock pale yellow inside. Basal portion of stem enclosed by vegetative bracts. Leaves shortly petiolate. Inflorescence radical, on a leafless peduncle. Bracts ovate, green. Bracteoles ovate, shorter than the bracts. Calyx white. Corolla lobes whitish, lip sulphur yellow. Labellum margin highly crumpled, yellow, dark yellow towards the centre. Lateral staminodes adnate to labellum. Anther long, connective prolonged. Seeds many.

## DISCUSSION

The family Zingiberaceae includes plants with immense medicinal importance, those have been used since ancient times in India, as documented in the traditional Indian Ayurvedic and Siddha systems of medicine (Kala *et al.* 2006). Beside this, ethnic groups across India use local flora (including Zingiberaceous plants) for curing a large number of ailments. Many Zingiberaceous plants, though not in conventional use, are rapidly gaining importance in the herbal medicine and cosmetic industries (Sasaki *et al.* 2002; Suksathan *et al.* 2014; Gao *et al.* 2008; Bua-in & Paisooksantivatana 2010; Techaprasan *et al.* 2010). The major spices produced in this country and exported on a large scale include *Amomum subulatum*, *Curcuma longa*, *Elettaria cardamomum* and *Zingiber officinale*, all of which are belonging to Zingiberaceae. According to the report of Spice Board India (2016), India accounts for about 8,93,920 tons of global spice export worth Rs.14,899.68 crore [<http://www.indianspices.com/export/major-itemwise-export>]. The family also includes other economically important plants that are used in perfumery (*Curcuma zedoaria*, *Hedychium larsenii*), as condiments (*Alpinia galanga*, *Curcuma amada*), as colouring agents (*Curcuma longa*) and in horticulture (*Alpinia* species, *Curcuma* species, *Rhynchanthus longiflorus* etc.).

Through the present survey it is realized that Zingiberaceous plants are not rare in our vegetation but, at the same time, those are being harvested from their natural habitat mercilessly except for a few species those are under cultivation. Most of these plants are also used as ornamentals and are collected from the wild for marketing.

Apart from an exhaustive collection in the Botanic Garden of Calicut University, Kerala, there is no other such ex situ conservatory for zingibers in India. In India the major centre of their distribution is Eastern Himalaya and NE India. Present study area is falling within this. So, it is very important to establish one such ex situ Protected Area, preferably in the sub-tropical climate for the conservation of most of these plants.

It was also noticed during the present study much of the phytochemical works have been conducted on these plants of this region but there is almost no attempt to use such knowledge at the industrial level.

However, climatic changes and human activities including rapid urbanization, agriculture, shifting cultivation, has led to depletion of the fragile ecosystem of the thereby continuously threatening the habitat of these plants, especially the wild ones. Domestication and subsequent mass cultivation, on the other hand, has resulted in the targeted selection of only a few plants like *Elettaria cardamomum*, *Curcuma longa*, *Zingiber officinale* etc., but the primarily vegetative mode of propagation and low seed setting has decreased their genetic variability, thereby making them vulnerable to biological and other stresses. It is thus necessary to identify wild relatives of the economically exploited plants, not only for increasing their variability but also for planning their conservation strategies. So conducting surveys and unequivocal identification is very important for judicious exploitation of these plants.

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